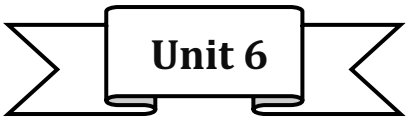

科学：颠覆性科学危机

Science: Disruptive Science Crisis

文章来源：摘自 2023 年 1 月 11 日《大西洋月刊》
适用领域：学术论文、科学创新、学术乱象
单元要点：了解近年来突破性科学减少的原因，积累科学发展、学术乱象相关表达。

精读预习

1．听录音，填空（每个空格填写一个单词，含连字符的单词算一个）。

The Consolidation-Disruption _____ Is Alarming

Science has a crummy-paper problem.

(1) We should be living in a golden age of creativity in science and technology. We know more about the universe and ourselves than we did in any other period in history, and with easy access to superior research tools, our pace of discovery should be _____. But America is running out of new ideas.

(2) In the past year, I've traced the decline of scientific breakthroughs and _____, warned that some markets can strangle novelty. This year, a new study titled "Papers and Patents Are Becoming Less Disruptive Over Time" inches us closer to an explanation for why the pace of knowledge has declined. The _____ is that any given paper today is much less likely to become influential than a paper in the same field from several decades ago.

(3) The researchers relied on a _____ called the Consolidation-Disruption Index—or CD Index—which measures the influence of new research. For example, if I write a crummy literature review and no scientist ever mentions my work because it's so basic, my CD Index will be extremely low. If I publish a _____ study and future scientists exclusively cite my work over the research I rendered irrelevant, my CD Index will be very high.

(4) This new paper found that the CD Index of just about every academic domain today is in _____ *mayday! mayday!* descent. Across broad landscapes of science and technology, the past is eating the present, progress is plunging, and truly disruptive work is hard to come by.

Why is this happening?

(5) One possibility is that disruptive science is becoming less productive as each field becomes more advanced and the amount of knowledge new scientists have to acquire increases. This is sometimes called the "burden of knowledge" theory. Just as picking apples from a tree becomes harder after you harvest the _____ fruit, science becomes harder after researchers solve the easiest mysteries. This must be true, in some cases: Calculating gravity in the 1600s basically required a telescope, pen, and paper. Discovering the Higgs boson in the 21st century required constructing a $10 billion particle _____ and spending billions more firing subatomic particles at one another at near–light speed.

(6) However, the disruption paper's co-authors seemed interested in explanations beyond the burden-of-knowledge theory. "If the low-hanging-fruit theory were sufficient, we'd expect to see the oldest fields _____ most dramatically. " said Russell Funk, a co-author. "But the fact that the decline in disruption is happening across so many fields of science and technology points to something broader about scientific practice and the decline of scientific exploration."

(7) In other words, if science is getting less productive, it's not just because we know too much about the world. It's because we know too little about how to conduct research in a way that gets the best, most _____ results.

(8) According to the rules of modern _____, a young academic should build status by publishing as many papers in _____ journals as she can, harvest the citations for clout, and solicit funding institutions for more money to keep it all going. These rules may have been created with the best intentions—to fund the most promising projects and ensure the productivity of scientists. But they have created a market logic that has some concerning consequences.

(9) First, these rules might _____ truly free exploration. As the number of Ph.D. students has grown, National Institutes of Health funding has struggled to keep up. Thus, the success rate for new project grants has mostly declined in the past 30 years. As grants have become more competitive, _____ lab directors have strategically aimed for research that seems plausible but not too radical. This approach may create a surplus of papers that are designed to advance knowledge only a little. A 2020 paper suggested that the modern emphasis on citations to measure scientific productivity has shifted rewards and behavior toward _____ science and "away from exploratory projects that are more likely to fail, but which are the fuel for future breakthroughs."

(10) Second, at the far extreme, these incentives might create a surplus of papers that just aren't any good—that is, they exist purely to advance careers, not science.

(11) Rather than blame individual scientists, Funk said the fault lies in a system that encourages _____ over quality: "There are journals, which I'd consider predatory journals, that make researchers pay money to publish their papers there, with only _____ peer review, and then the journals play games by making the authors cite articles from the same journal."

(12) It reminded me of the dark side of Moneyball: When any industry focuses too much on one metric, it can render the metric meaningless and _____ the broader purpose of the industry. Just as we are living in a platinum age of television—more _____ but perhaps not more quality—we seem to be in a platinum age of science, in which the best you can say about the industry is that there certainly seems to be more of everything, including crap.

(13) It's a useful reminder that _____ is not a sufficient end point; rather, it's an input. Science may have a deficit of disruption precisely because the industry doesn't know how to navigate its crisis of plenty—too much knowledge to _____, and too many papers bolstering their authors' reputation without expanding the frontier of science.

2. 阅读文章后，请用英语回答下列问题。

(1) According to the article, is the “burden of knowledge” theory a reasonable explanation for the plunge in disruptive scientific discoveries?

(2) According to the article, how do existing rules in the academia harm scientific development?

(3) According to paragraph 11 to 13, what is the root of the lack of disruption in science?

精读（1）

The Consolidation-Disruption Index Is Alarming

Science has a crummy-paper problem.

(1) We should be living in a golden age of creativity in science and technology. We know more about the universe and ourselves than we did in any other period in history, and with easy access to superior research tools, our pace of discovery should be accelerating. But America is running out of new ideas.

(2) In the past year, I've traced the decline of scientific breakthroughs and entrepreneurship, warned that some markets can strangle novelty. This year, a new study titled "Papers and Patents Are Becoming Less Disruptive Over Time" inches us closer to an explanation for why the pace of knowledge has declined. The upshot is that any given paper today is much less likely to become influential than a paper in the same field from several decades ago.

(3) The researchers relied on a metric called the Consolidation-Disruption Index—or CD Index—which measures the influence of new research. For example, if I write a crummy literature review and no scientist ever mentions my work because it's so basic, my CD Index will be extremely low. If I publish a paradigm-shifting study and future scientists exclusively cite my work over the research I rendered irrelevant, my CD Index will be very high.

(4) This new paper found that the CD Index of just about every academic domain today is in full-on *mayday! mayday!* descent. Across broad landscapes of science and technology, the past is eating the present, progress is plunging, and truly disruptive work is hard to come by.

Why is this happening?

(5) One possibility is that disruptive science is becoming less productive as each field becomes more advanced and the amount of knowledge new scientists have to acquire increases. This is sometimes called the "burden of knowledge" theory. Just as picking apples from a tree becomes harder after you harvest the low-hanging fruit, science becomes harder after researchers solve the easiest mysteries. This must be true, in some cases: Calculating gravity in the 1600s basically required a telescope, pen, and paper. Discovering the Higgs boson in the 21st century required constructing a $10 billion particle collider and spending billions more firing subatomic particles at one another at near–light speed.

(6) However, the disruption paper's co-authors seemed interested in explanations beyond the burden-of-knowledge theory. "If the low-hanging-fruit theory were sufficient, we'd expect to see the oldest fields stagnate most dramatically. " said Russell Funk, a co-author. "But the fact that the decline in disruption is happening across so many fields of science and technology points to something broader about scientific practice and the decline of scientific exploration."

(7) In other words, if science is getting less productive, it's not just because we know too much about the world. It's because we know too little about how to conduct research in a way that gets the best, most groundbreaking results.

精读（1）练习

1. 请翻译下列表达。

(1) ……的黄金年代 _____　(2) 让 A 缓慢靠近 B _____

(3) 颠覆范式的 adj. _____　(4) 使某物变得…… _____

(5) 容易实现的目标 _____　(6) 停滞不前 v. _____

(7) 扼杀创新 _____　(8) 想法枯竭 _____

2. 请翻译下列原文句子。

(1) We know more about the universe and ourselves than we did in any other period in history, and with easy access to superior research tools, our pace of discovery should be accelerating.

_____

_____

_____

(2) One possibility is that disruptive science is becoming less productive as each field becomes more advanced and the amount of knowledge new scientists have to acquire increases.

_____

_____

_____

3. 请运用括号中的表达写出下列句子。

(1) 如果你扼杀了学生的好奇心，他们就会丧失创新和创业精神，更别提追求突破性发现的动力。（strangle, upshot, entrepreneurship, groundbreaking）

(2) 随着传统制造业的黄金时代即将过去，我们可能会看到一些企业走向衰落，尤其是那些只完成最简单的目标、没有努力对抗发展停滞的企业。（the golden age of, the decline of, low-hanging fruits, stagnation）

精读（2）

(1) According to the rules of modern academia, a young academic should build status by publishing as many papers in prestigious journals as she can, harvest the citations for clout, and solicit funding institutions for more money to keep it all going. These rules may have been created with the best intentions—to fund the most promising projects and ensure the productivity of scientists. But they have created a market logic that has some concerning consequences.

(2) First, these rules might discourage truly free exploration. As the number of Ph.D. students has grown, National Institutes of Health funding has struggled to keep up. Thus, the success rate for new project grants has mostly declined in the past 30 years. As grants have become more competitive, savvy lab directors have strategically aimed for research that seems plausible but not too radical. This approach may create a surplus of papers that are designed to advance knowledge only a little. A 2020 paper suggested that the modern emphasis on citations to measure scientific productivity has shifted rewards and behavior toward incremental science and "away from exploratory projects that are more likely to fail, but which are the fuel for future breakthroughs."

(3) Second, at the far extreme, these incentives might create a surplus of papers that just aren't any good—that is, they exist purely to advance careers, not science.

(4) Rather than blame individual scientists, Funk said the fault lies in a system that encourages volume over quality: “There are journals, which I’d consider predatory journals, that make researchers pay money to publish their papers there, with only symbolic peer review, and then the journals play games by making the authors cite articles from the same journal.”

(5) It reminded me of the dark side of Moneyball: When any industry focuses too much on one metric, it can render the metric meaningless and warp the broader purpose of the industry. Just as we are living in a platinum age of television—more quantity but perhaps not more quality—we seem to be in a platinum age of science, in which the best you can say about the industry is that there certainly seems to be more of everything, including crap.

(6) It’s a useful reminder that abundance is not a sufficient end point; rather, it’s an input. Science may have a deficit of disruption precisely because the industry doesn’t know how to navigate its crisis of plenty—too much knowledge to synthesize, and too many papers bolstering their authors’ reputation without expanding the frontier of science.

精读（2）练习

1. 请翻译下列表达。

(1) 学术界 n. _____　　(2) 过剩的某物 _____

(3)（问题、过错）在于 _____　　(4) 阻挠自由探索 _____

(5) 在极端情况下 _____　　(6) 鼓励 A 而非 B _____

(7) 终点，目标 _____　　(8) 充足的某物 _____

2. 请翻译下列原文句子。

(1) According to the rules of modern academia, a young academic should build status by publishing as many papers in prestigious journals as she can, harvest the citations for clout, and solicit funding institutions for more money to keep it all going.

(2) Science may have a deficit of disruption precisely because the industry doesn't know how to navigate its crisis of plenty—too much knowledge to synthesize, and too many papers bolstering their authors' reputation without expanding the frontier of science.

3. 请运用括号中的表达写出下列句子。

(1) 论文的过剩和颠覆性科学的不足形成了让人担忧的对比，其根源在于现在的制度更鼓励数量而不是质量。（surplus, deficit, concerning, lie in, encourage）

(2) 目前，科学家的地位和他们对行业的贡献之间存在不平衡，这警示我们，学术界的规则可能让很多科学家变得沾沾自喜，科学探索因而停滞不前。（status, reminder, render sb. adj., stagnate）

写作练习

请按照课程视频要求完成相应写作练习。

泛读文章

Papers and patents are becoming less disruptive

Why that is, is a mystery

(1) “Ideas are like rabbits,” John Steinbeck said. “You get a couple and learn how to handle them, and pretty soon you have a dozen.” Scientific and technological progress is often viewed in this way. Current ideas build on previous ones. And ideas, along with papers and patents, have indeed proliferated in the recent past.

(2) Yet despite—or perhaps because of—this productivity (papers published and patents issued each year now number in the millions), it has been documented that innovation within specific fields has been in decline. For example, a paper titled “Science in the age of selfies”, published in 2016, warned of a shifting incentive-and-information landscape in biology, particularly neuroscience, that has diluted the number of high-impact discoveries.

(3) Michael Park and Russell Funk of the University of Minnesota, and Erin Leahey of the University of Arizona, have set out to determine whether this decline holds for science and technology in general. In a study published this week in Nature they analyse 45m papers and 3.9m patents published and filed between 1945 and 2010.

(4) The measurement they use for this work, known as the CD index, quantifies how "consolidating" or "disruptive" each paper or patent is. A paper is consolidating (a low CD score) if later work citing it also cites the papers that it, itself, cited. Discoveries and inventions of this sort—like a patent awarded in 2005 for genetically modified soyabeans—serve to propel science forward along its existing trajectory. By contrast, a paper is disruptive (a high CD score) if it is cited by later work in the absence of citations of its predecessors. A classic example of that was the study published in 1953 by James Watson and Francis Crick on the double-helical structure of DNA. High-CD papers disrupt the status quo, fundamentally altering a field's trajectory or creating a new field altogether.

(5) Both consolidating and disruptive work are needed for scientific progress, of course, but science now seems to favour the former over the latter in a potentially unhealthy way. Mr Park and Drs Leahey and Funk found that the average CD score for papers has fallen by between 92% and 100% since 1945, and for patents between 79% and 92%. These declines are not mere artefacts of changing publication, citation or authorship practices; the researchers controlled for that. Why, then, has science become less disruptive?

(6) One hypothesis is the low-hanging-fruit theory—that all the easy findings have been plucked from the branches of the tree of knowledge. If true, this would predict different fields would have different rates of decline in disruption, given that they are at different stages of maturity. But that is not the case. The decline the researchers found was comparable in all big fields of science and technology.

(7) Another idea is that the decline in disruptiveness stems from one in the quality of published work. To test this, the researchers looked at two specific categories: papers in premier publications and Nobel-prizewinning discoveries. “If there were a pocket of science where the quality might have declined less, or hasn’t declined,” said Mr Park, “it would be in those places.” But the downward trend persisted there, too.

(8) A more likely reason for the change, the researchers argue, is that scientists and inventors are producing work based on narrower foundations. They found that citing older work, citing one’s own work, and citing less diverse work all correlate with less disruption. As the amount of published science grows, the effort required to master a pool of knowledge that is both deepening and narrowing as the years roll by may inhibit the ability to form creative connections between disparate fields. Here is an argument for the rebirth of the renaissance human.

(9) Mr Park maintains there is room for optimism. Though the average disruptiveness of discoveries has declined, the number of “highly disruptive” ones has remained constant. Humanity does not appear to be reaching the end of science. Albert Michelson, winner of the 1907 Nobel prize in physics for his work on the immutability of the speed of light, which underlay Albert Einstein’s special theory of relativity, is as wrong now as he was in 1894, when he said that it was “probable that most of the grand underlying principles have been firmly established”.

* 摘自《经济学人》2023 年 1 月 4 日文章

泛读阅读理解

(1) According to the article, what is the aim of the research conducted by Michael Park, Russell Funk and Erin Leahey?

(2) According to the article, what are the findings of the research mentioned in Question 1?

(3) According to the article, what are the three possible explanations for the decline of scientific innovation?