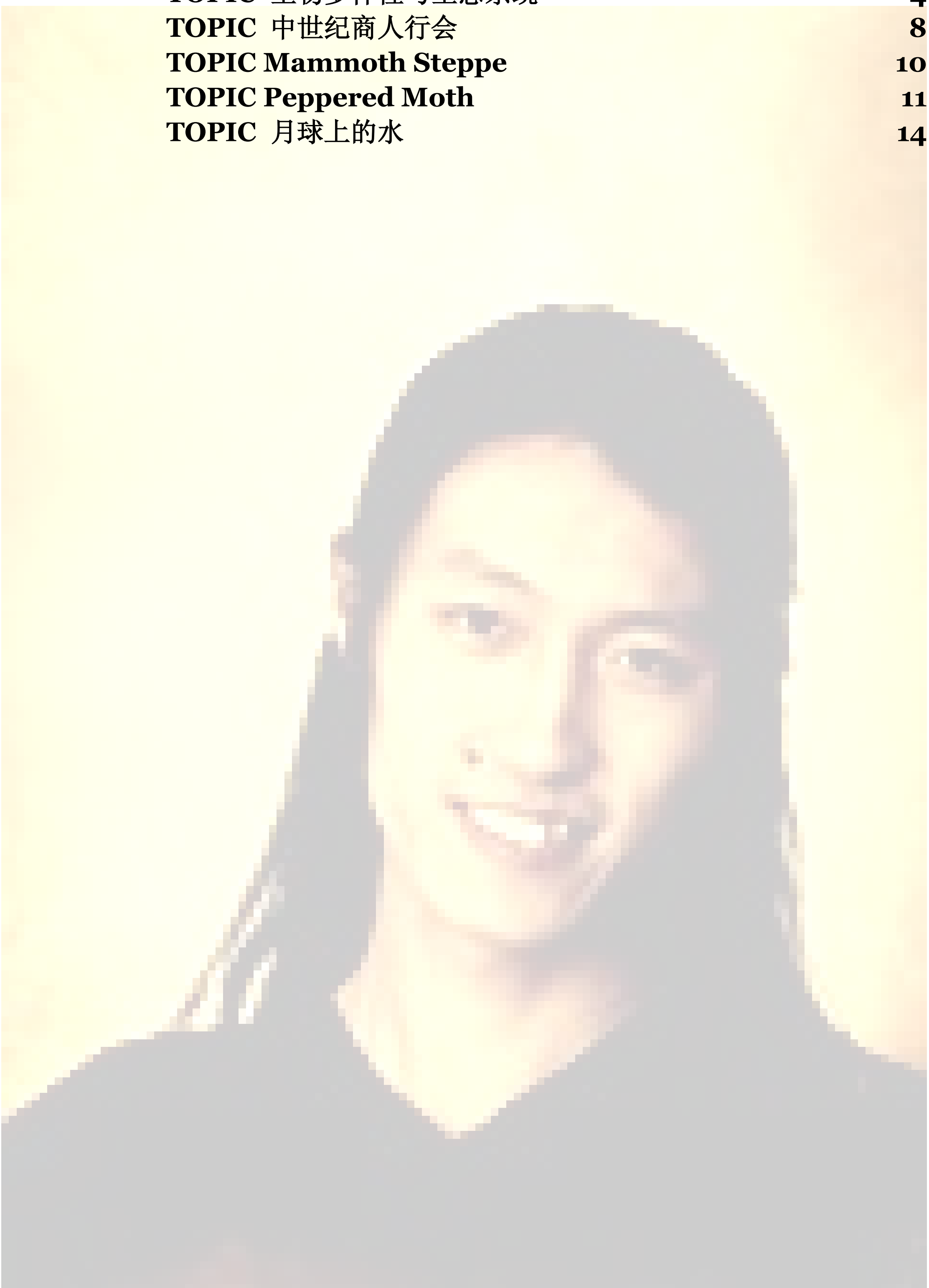
CONTENT



【2012.3.23NA】

TOPIC 深海生物

➢ 考生回忆

深海生物研究说有个欧洲人上了一艘爱琴海 aegean sea research ship 船，经常穿梭于两个海域之间，他做了一个极长无比的网子从海上捞鱼，根据他多年的经验，根据捞起来的鱼的种类判断，海里的动物分为 8 层渔网来捕捞海底的生物。他做了 1300 英尺深的探索，发现下面的水中动物分了 8 层并且断定在 1800 尺下面没有生物了，这个说法太可笑了，而且很多人当时竟然都相信；接下来说还有一个更可笑的说法，有俩人一个人说海底全是冰，冰下面就不会有动物。他们愚昧得忽视了冰的密度比水小，会浮在水面上，还有个人说海底下面是密度很大的压缩水导致动物不能生存，继续愚昧，其实水在自然状态下是不会被压缩的，然后说前面两种都白扯，其实有个人早在第一个人之前就证明了水底是有动物的，不是什么 8 层冰层的问题，他在 1818 年就已经从更深的地方捕到过海洋生物。他也做过一个实验，在另一个海搜索，其实已经比第一个人探索的更深了，最后说为什么第一个人的实验错了：第一个原因是爱琴海是比较特殊的海底生物比较少的海，第二海底水压大，鱼都长得比较扁，他做渔网网眼太大了，鱼都跑没了。

Edward Forbes[1]

In the autumn of 1838 he read before the British Association at Newcastle a paper on the distribution of terrestrial Pulmonata in Europe, and was commissioned to prepare a similar report with reference to the British Isles. In 1841 was published his History of British star-fishes, embodying extensive observations and containing 120 illustrations, inclusive of humorous tail-pieces, all designed by the author. On 17 April of the same year Forbes, accompanied by his friend William Thompson, joined at Malta H.M. surveying ship "Beacon," to which he had been appointed naturalist by her commander Captain Thomas Graves (1802–1856). From April 1841 until October 1842 he was employed in investigating the botany, zoology and geology of the Mediterranean region.[2]

The results of these researches were made known in his *Report on the Mollusca and Radiata of the Aegean Sea*,[3] presented to the British Association in 1843, and in Travels in Lycia, published in conjunction with Lieut. (afterwards Admiral) TAB Spratt in 1847. In the former treatise he discussed the influence of climate and of the nature and depth of the sea bottom upon marine life, and divided the Aegean into eight biological zones; his conclusions with respect to bathymetrical distribution, however – namely his azoic hypothesis, stating that the realms beyond 300 fathom are entirely devoid of life – have naturally been modified to a considerable extent by the

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[1] http://en.wikipedia.org/wiki/Edward_Forbes#Marine_biology

[2] Chisholm 1911, p. 637.

[3] Forbes 1844.

more recent explorations of the deep seas.[4] [5]

Deep-sea Exploration (Sir John Ross)[6]

Deep-sea exploration really started off with a series of expeditions to measure the depth of the ocean using lead sounding lines in the early 19th century. Thin ropes with a lead weight (called a "plummet") at the bottom were dropped off ships to estimate the depth of the water. Sometimes the lead weight had a recess built into it that was filled with a sticky substance called tallow – this would pick up a small sample of the sediment underneath the ship (e.g., mud or sand). Both the depth and sediment information were used for the ship to navigate safely.

In 1818 Sir John Ross, uncle of Sir James Clark Ross (a famous marine explorer), took part in an expedition to locate the northwest passage in the Arctic Ocean, and, whilst carrying out sounding surveys he pulled up a basket star (a relative of the starfish) from 1.6 km depth. Years later, on an expedition to the Southern Ocean, his nephew James found lots of animals living at 1.8 km depth on the Antarctic continental slope. Discoveries like these, including those by Norwegian father and son, Michael and G.O. Sars, of animals living at the bottom of deep Norwegian fjords, filled Victorian scientists with excitement and sent them looking for more deep-sea animals.

Comments

However, many scientists at this time believed that the deep sea was an empty, barren place. They thought that the darkness, cold, and great pressure would prevent life from flourishing, and some studies seemed to confirm this theory. Scientist Edward Forbes carried out research in the Aegean Sea between 1841-1842, dredging the seabed for deep-sea fauna, but he didn't find very much. In 1843 he published his "azoic hypothesis" – that beyond 0.6 km depth there was no life. We now know that Forbes was just a bit unlucky – this particular area of the Aegean deep sea is quite sparsely populated. Had he carried out his research somewhere else it might have been a different story.[7]

[4] Chisholm 1911, p. 637.
[5] Anderson & Rice 2006, p. 131–137.
[6] http://www.eu-hermione.net/learning/exploring-the-oceans
[7] http://www.eu-hermione.net/learning/exploring-the-oceans

TOPIC 生物多样性与生态系统

➢ 考生回忆

讲生物多样性对 ecosystem 的平衡是否有好处，给了很多例子，但是结论是 biodiversity 对 eco-system 的发展是否有好处仍然有待商榷。

Biodiversity and Ecosystem Function: The Debate Deepens[8]

We continue to lose species and genetic diversity locally, nationally, and planet-wide. In deciding priorities for conservation, there is an urgent need for criteria that help us to recognize losses with potentially serious consequences. It would be naïve to assume that species-poor ecosystems are always malfunctional; some of the world's most extensive and ancient ecosystems--boreal forests, bogs, and heathlands--contain few species. For both species-rich and species-poor ecosystems, we need to establish whether current losses in biodiversity are likely to seriously impair functioning and reduce benefits to humans. This problem is serious enough that the United States and the United Kingdom have invested recently in costly ventures specifically designed to test experimentally the consequences of reduced diversity on ecosystems.

Model communities with controlled levels of species diversity have been created in the Ecotron at Silwood Park in southern England and at the Cedar Creek Reserve in Minnesota to assess the effects of diversity on various ecosystem properties such as primary productivity, nitrogen mineralization, and litter decomposition. Early publications from both sites[9] [10] claimed to demonstrate benefits to ecosystem function arising from higher levels of biodiversity, and these have been highlighted by commentators[11] excited by the prospect of a scientific underpinning for conservation measures.

This view that "biodiversity begets superior ecosystem function" is not shared by all ecologists[12]. There are obvious conflicts with published evidence from work on natural rather than synthesized ecosystems. As early as 1982, Leps et al.[13] had suggested that ecosystem processes were determined primarily by the functional characteristics of component organisms rather than their number. The same conclusion was drawn by MacGillivray et al.[14] who showed that differences between five adjacent ecosystems in northern

[8] Author: J. P. Grime. The author is in the Unit of Comparative Plant Ecology, University of Sheffield

[9] D. Tilman and J. A. Downing, *Nature* 367, 363 (1994).

[10] S. Naeem, L. J. Thompson, S. P. Lawler, J. H. Lawton, R. M. Woodfin, *ibid.* 368, 734 (1994).

[11] P. Karieva, *ibid.*, p. 686.

[12] J. P. Grime, in *Colonisation, Succession and Stability*, A. J. Gray, M. J. Crawley, P. J. Edwards, Eds. (Blackwell, Oxford, 1987), pp. 413-428.

[13] J. Leps, J. Osbornová-Kosinová, M. Rejmanek, *Vegetation* 50, 53 (1982).

[14] C. W. MacGillivray, J. P. Grime, ISP Team, *Funct. Ecol.* 9, 640 (1995).

England in their responses to frost, drought, and burning were predictable from the functional traits of the dominant plants but were independent of plant diversity.

...variation in ecosystem properties is found to be related to differences in the functional characteristics, especially resource capture and utilization, of the dominant plants, and there is no convincing evidence that ecosystem processes are crucially dependent on higher levels of biodiversity. The evidence presented by Wardle et al.[15] is particularly compelling because it involves an extensive study of ecosystem properties on 50 relatively pristine forested islands of varied size and plant biodiversity. It is clearly shown that a suite of ecosystem properties--including higher microbial biomass, high litter quality, and more rapid rates of litter decomposition and nitrogen mineralization--coincide with the lower botanical diversity and the earlier successional state of the vegetation on larger islands (both consequences of the higher incidence of lightning strikes and more frequent fire history of larger islands). On small islands, succession proceeds uninterrupted to more species-rich vegetation, but here the dominant plants, Picea abies and Empetrum hermaphroditum, are extremely stress tolerant and produce litter of poor quality, thereby slowing the rates of ecosystem processes. This strongly supports the contention of MacGillivray et al.[16] that it is the biological characteristics of the dominant plants rather than their number that control ecosystem productivity and biogeochemistry. This same conclusion is prompted by the new data presented by Tilman et al.[17] and Hooper et al.[18]. Both of these groups have adopted a more experimental approach and created ecosystems in field plots where they can control both the functional composition and species richness of the vegetation. Here again, there is strong evidence that productivity and nutrient cycling are controlled to an overwhelming extent by the functional characteristics of the dominant plants, and evidence of immediate benefits of species-richness within functional groups remains weak.

Why is a different perspective emerging from these more recent studies conducted on model systems and under more natural conditions? In a penetrating critique of earlier work, Huston[19] has pointed out that several of the apparent benefits to ecosystem function reported in the model experiments can be explained as consequences of inappropriate experimental design and faulty interpretation of data. In particular, he believes that the supposed benefit to productivity associated with greater biodiversity in the Ecotron experiments is attributable to the fact that the more diverse

[15] D. A. Wardle, O. Zackrisson, G. Hörnberg, C. Gallet, *ibid*., p. 1296.
[16] C. W. MacGillivray, J. P. Grime, ISP Team, *Funct. Ecol.* 9, 640 (1995).
[17] D. Tilman *et al., Science* 277, 1300 (1997).
[18] D. Hooper and P. M. Vitousek, ibid., p. 1302.
[19] M. A. Huston, *Oecologia* 110, 449 (1997).

communities that were created contained larger and more productive plant species that were omitted from the experimental assemblages of the less diverse communities. A key publication[20] from Cedar Creek claimed that both the resistance and resilience of vegetation to drought were increased by species richness. Huston reminds us, however, that the drought-sensitive vegetation involved in these experiments was not only species poor but was also very different functionally as a consequence of heavy and sustained applications of inorganic fertilizer. A recent reanalysis of this work[21] recognizes that drought resilience (recovery) was not more rapid in the unproductive but more diverse ecosystems; this brings the Minnesota findings into closer agreement with the earlier results from Leps et al.[22] and again points to an interpretation in which the functional characteristics of component species take precedence over their number.

It could be argued that the tide is turning against the notion of high biodiversity as a controller of ecosystem function and insurance against ecological collapse. However, such a stance would be as premature as that of the commentators who rapidly embraced early evidence of its supposed benefits. It is obvious that for all ecosystems a point could be reached at which further loss of key species could impair functioning and usefulness to humans. The most immediate problem is to identify irreplaceable species and functional types and to discover whether there are situations in which ecosystem viability depends on unusually high biodiversity. We might speculate that high biodiversity may be vitally important in structurally diverse ecosystems such as layered forests or in ecosystems that experience drastic fluctuations[23] on a seasonal or longer time scale (for example, flooded forests, lake shores, and semi-arid ecosystems).

What lessons can be learned from the recent history of research on the significance of biodiversity? First, I suspect that we need a more integrated approach with greater input from those scientists with specialist knowledge of the functional biology and resource dynamics of key plants and animals. Both laboratory experiments and studies of natural ecosystems must be informed by a knowledge of resource dynamics and should be designed as tests of predictions on the basis of the functional attributes of component plants and animals.

Perhaps most important of all, we should reconnect recent endeavors on the functional significance of biodiversity with an older and extensive literature on the mechanisms controlling biodiversity itself. This would be to reassert a more Darwinian perspective in which high species-richness is viewed not as

[20] D. Tilman and J. A. Downing, Nature 367, 363 (1994).
[21] D. Tilman, *Ecology* 77, 350 (1996).
[22] J. Leps, J. Osbornová-Kosinová, M. Rejmanek, *Vegetation* 50, 53 (1982).
[23] P. A. Keddy and A. A. Reznicek, Am. J. Bot. 69, 13 (1982).

an attribute of certain ecosystems but instead as a function of population processes associated with special circumstances that hover precariously between two different forces for extinction (extreme habitat conditions and competitive dominance)[24]. So far, neither evolutionary theory nor empirical studies have presented convincing evidence that species diversity and ecosystem function are consistently and causally connected.

[24] J. P. Grime, *Nature* 242, 344 (1973).

TOPIC 中世纪商人行会

Merchant Guilds in the Middle Ages

➢ 考生回忆

【共和国版】这篇讲贸易的。貌似说中世纪欧洲吧，商人为了生存都结成团伙了。统一团伙内的产品质量，培养学徒。但是它的主要目的呢（有题），还是抵制非团伙成员非竞争，因此也必须与政府有聯系。非团伙成员也有优势的，产品价格低（有题），而且可以雇佣农工，很便宜啦！最后一段說，但是这种团伙内部的公平呢，其实只是理论上的（有题），能力啊，雄心啊，都会导致团伙成员中一部分有钱，一部分没钱，有钱的就扩张，没钱的就抗议要公平啊！（排序题）

【民国版】欧洲中世纪行会制度 Guild

先讲大师傅 master 的出道过程。然后是整个行会的排他性。接着是行会和城邦政府怎么样由前提相互支持（垄断），到后來政府看中垄断的大面包，于是插手进來分一杯羹。除了政府以外，行会的另一个强劲对手是城外不受法律约束而且拥有廉价劳动力（农民工）的个体企业。后來行会竞争。不过，成本拼不过，价格当然也拼不过，同时又遇到一些供应上的困难，所以结果。。。还有，他们自己本身也有矛盾，主要是 master 们有些很有野心，想要扩张。所以简单说就是内忧外患。

Merchant Guilds in the Middle Ages[25]

The guilds in the Middle Ages were an important part of Medieval life. A higher social status could be achieved through membership to Merchant guilds. There were two main kinds of Medieval guilds - Merchant Guilds and Craft Guilds. The word “guild” is from the Saxon “gilden” meaning "to pay" and refers to the subscription paid to the Guilds by their members.

The system of Feudalism during the Middle Ages allowed the lords and owners of the land to tax the people and their trades. As trade increased in the Middle Ages the taxes became excessive. A single person had no chance of making any objections to the rate and amount of tax that the lord demanded. The idea of Merchant Guilds was born. A Merchant Guild was an association of of traders. The Merchant Guild was able to negotiate with the lord and the trade levy became regulated. The regulations agreed between the Merchant Guild and the lord resulted in a Merchant Guild charter. The Merchant Guild charter allowed the merchants to pay an annual payment, or fixed sum, to the lord who owned the land where the town was based.

Rules of the Merchant Guilds during the Middle Ages

The members of the Merchant Guilds became powerful. The Merchant Guilds controlled the way in which trade was conducted in the town. The merchant Guilds applied rules to the way in which trade was conducted during the Middle Ages. These rules were included in the charters of the Merchant Guilds

[25] http://www.middle-ages.org.uk/merchant-guilds-in-the-middle-ages.htm

and included:

- A ban on, or fines imposed, on any illicit trading by non Merchant Guild members
- Fines were imposed on any Merchant Guild members who violated the Merchant Guilds charter
- Members of the Merchant Guilds were protected and any Merchant Guild member who fell sick was cared for by the guild. Burials of guild members were arranged and the Merchant Guilds undertook to care for any orphans
- The members of Merchant Guilds also provided protection of their horses, wagons, and goods when moving about the land as travelling during the Middle Ages was dangerous

Members of the Merchant Guilds in the Middle Ages

The leading members of the Merchant Guilds became very important members of the Medieval town community of the Middle Ages. Leading Merchant Guild members adopted the role of spokesperson for all of the members. The introduction of the Merchant guilds in a town or city lead to its own hierarchy and involvement in civic duties:

- The chief spokesman of a Merchant Guild became the mayor of the town, or city
- The leading delegates of the Merchant Guilds became the Aldermen of the town or city
- The other members of the Merchant Guilds became the burghers of the town or city

The power of the Merchant Guild members increased to such an extent that the livelihood of individual trades or crafts within a Medieval town, or city, were being jeopardised. The Merchant Guilds were imposing regulations on the individual traders or craftsmen to regulate prices and supply. The individual workers of trades or crafts followed the example of the Merchant Guilds who had objected to the lords of land and in turn raised objections to the Merchant Guilds. The individual crafts and trades established their own guilds. The Craft Guilds were then established in the Medieval town or city of the Middle Ages.

【2012.5.26NA】

TOPIC Mammoth Steppe

➢ 考生回忆

亚洲大陆和阿拉斯加中间的白令海域在过去 2.5 万年之间有七次冰河期(?)反正有七次冷暖交替．猛马象在最后一次灭绝．G 开头的学者认为一种他命名叫 MommothSteppe 的草在过去冰河期那段寒冷期间，除了最冷到最巅峰的时间以外，都长得比现在的草还要好（有重述题）．因此可以提供足够的营养给上面大型动物．现代的植物因为比较酸(acidic)还有一个不太重要的原因没有办法带给地上动物足够的营养．他认为因为这种草在之后环境变暖了后就灭绝了，所以猛马象也一起陪葬了．可是有另外的学者觉得没有化石的证据证实这种 Mammoth Steppe 真的存在过，他们觉得猛马象消失后草才跟着一起消失的．接下来一段在讲一个例子述说大象这种踩踏有利与草原而不适合灌木生长.有一题插入题（大意是可是这个现象可以以 mommonth steppe 不易留下化石证据的理由反驳）

The Mammoth Steppe[26]

During the Late Pleistocene the environment of the northern territories of Eurasia, ranging from Western Europe to Alaska, was generally open, tending toward steppic. It is known as the Mammoth Steppe, a biotope remarkable for its unusual combination of mammal species when compared to the present-day distribution. The ecosystem of the Mammoth Steppe collapsed during the period that marks the Pleistocene – Holocene transition and was replaced by the modern tundra, taiga, and steppe belts of Eurasia. The Mammoth Steppe was very productive and characterised by a very diverse flora and fauna with a large variety in species. During the Pleistocene – Holocene transition a drastic rearrangement of its floral and faunal components occurred and led to a marked change in the distribution of species. The geographical ranges of several species shrank and many became regionally extinct, whereas others disappeared completely. It was the time when species such as giant deer, woolly mammoth, and woolly rhinoceros became extinct after having survived many climatic changes during several hundreds of thousands of years. It is also the period during which humans spread into Northern Siberia and crossed Beringia on their way to America.

[26] http://mammothsteppe.com/index.php?option=com_content&view=article&id=8&Itemid=14

【2011.11.12 NA】

TOPIC Peppered Moth

- 考生回忆

- moth 因为污染而变色 本來蛾子大多数是白色的，可是后来污染严重了，黑色的就占了大多数，但是并不是因为基因改变了，而是因为蛾子栖息在树上，树皮本來是白色的，所以从前白色蛾子不容易被吃，就很多，而污染后呢，树皮变成了黑色，
- 黑色的蛾子就不容易被吃掉了。中间有个 K 做了实验，就是放了一群做了记号的蛾子，然后又重新捕获（有 except 题），发现果然白色的蛾子的比例就比以前少很多。这就证实了自然选择是这一现象的原因（有排序题）。 最后一段说，但是有些人现在呢，怀疑自然选泽并不是唯一的原因，然后作者就继续阐述（有题，最后一段为了 干嘛啊？答案：继续 convince 这个 K 的观点），由于污染的治理，白色的蛾子又多了起來，很可能在将來，黑色 的蛾子又会成为少数。
- 词汇题：inevitable，endorse，convince，give rise to，marginally，capacious。

Peppered Moth Evolution[27]

The evolution of the peppered moth over the last two hundred years has been studied in detail. Originally, the vast majority of peppered moths had light colouration, which effectively camouflaged them against the light-coloured trees and lichens which they rested upon. However, because of widespread pollution during the Industrial Revolution in England, many of the lichens died out, and the trees that peppered moths rested on became blackened by soot, causing most of the light-coloured moths, or typica, to die off from predation. At the same time, the dark-coloured, or melanic, moths, carbonaria, flourished because of their ability to hide on the darkened trees.[28]

Since then, with improved environmental standards, light-coloured peppered moths have again become common, but the dramatic change in the peppered moth's population has remained a subject of much interest and study, and has led to the coining of the term industrial melanism to refer to the genetic darkening of species in response to pollutants. As a result of the relatively simple and easy-to-understand circumstances of the adaptation, the peppered moth has become a common example used in explaining or demonstrating natural selection.[29]

The most famous experiments on the peppered moth were carried out by Bernard Kettlewell under the supervision of E. B. Ford, who helped him gain a grant from the Nuffield Foundation to perform the experiments. In one of Kettlewell's experiments, moths were released into a large (18 m by 6 m) aviary, where they were fed on by Great Tits (Parus major). In 1953, Kettlewell

[27] http://en.wikipedia.org/wiki/Peppered_moth_evolution
[28] Miller, Ken (1999). *The Peppered Moth: An Update*
[29] A modelling exercise for students using the peppered moth as its example

experimented at Cadbury Nature Reserve in Birmingham, England, marking, releasing and recapturing marked moths. He found that in this polluted woodland typica morphs were preferentially preyed. He thus showed that the melanistic phenotype was important to the survival of peppered moths in such a habitat. Kettlewell repeated the experiment in 1955 at unpolluted woodland in Dorset and again in the polluted woods in Birmingham. He was accompanied by Nico Tinbergen, and they made a film together. Further studies by others found similar results, culminating in 1996 when reporting work on both sides of the Atlantic found a correlation between changes in melanic frequencies and pollution levels.[30][31]

Kettlewell's Experiment[32]

In Great Britain during the late 1840s through the 1850s, it was noticed that there was a reduced number of light colored European peppered moths (Biston betularia) (light color was most common) and an increased number of the darker colored moths in the industrial areas. This led British ecologist Bernard Kettlewell to search for an explanation.

During the late 1950s, Kettlewell began raising populations of light and dark peppered moths in his laboratory so he could perform his experiment. He marked all the moths with a drop of paint on the wings, so they could be recognized later. Next he released the light and dark moths in two separate wooded areas of England. One of the wooded areas was Birmingham wood near the city of Birmingham, which was very polluted. The other wooded area was Dorset wood, which was in a farm area that was not polluted. At the end of this, Kettlewell set traps around the woods to catch the moths and see which populations survived in the two different areas. Peppered moths with the color of the trunks survived; in the polluted areas where the trees were black the black moths thrived, and in the woods where the trees were light the light moths thrived.

Kettlewell concluded that the pollution from the factories in Birmingham created industrial melanism, which darkened the color of the woods. This in turn caused the moths with the recessive traits to have a better chance of survival because of the camouflage. So Kettlewell concluded that natural selection from industrial melanism caused the moths to adapt to their changing environment.

[30] Michael E. N. Majerus (August 2007). "The Peppered Moth: The Proof of Darwinian Evolution". Archived from the original on 2008-02-21. Retrieved 2007-09-09.

[31] Young, M. (2003). *Moonshine: Why the Peppered Moth Remains an Icon of Evolution.*

[32] http://en.wikipedia.org/wiki/Kettlewell%27s_experiment

【2012.1.13NA】

TOPIC 月球上的水

- 考生回忆

月球有没有水，第一段说是科学家分析了月球某些成分，发现没有有机物，而且月球上也没有化石，然后牵涉到月球上有没有水的问题。后面各种发现，什么水可能在两极啊，水可能在老火山口 crater 底部啊，还有探测到氢气，这是水的成分，所以可能有水啊什么的。然后说科学家为了证明有水，想把个快要过期的卫星撞到月球上做实验，因为会有蒸发出来的水，搞不好能探测到什么的。然后说有水好呀，星际旅行带水很贵（多少多少钱，有题），要是能直接用，那就各种省钱啊什么的。

Ice on the Moon[33]

On 5 March 1998 it was announced that data returned by the Lunar Prospector spacecraft indicated that water ice might be present at both the north and south lunar poles, in agreement with interpretations of Clementine results for the south pole reported in November 1996. The ice originally appeared to be mixed in with the lunar regolith (surface rocks, soil, and dust) at low concentrations conservatively estimated at 0.3 to 1 percent. Subsequent data from Lunar Prospector taken over a longer period has indicated the possible presence of discrete, confined, near-pure water ice deposits buried beneath as much as 18 inches (40 centimeters) of dry regolith, with the water signature being stronger at the Moon's north pole than at the south (4). The ice was thought to be spread over 10,000 to 50,000 square km (3,600 to 18,000 square miles) of area near the north pole and 5,000 to 20,000 square km (1,800 to 7,200 square miles) around the south pole, but the latest results show the water may be more concentrated in localized areas (roughly 1850 square km, or 650 square miles, at each pole) rather than being spread out over these large regions. The estimated total mass of ice is 6 trillion kg (6.6 billion tons). Uncertainties in the models mean this estimate could be off considerably.

LCROSS Overview[34]

Earth’s closest neighbor is holding a secret. In 1999, hints of that secret were revealed in the form of concentrated hydrogen signatures detected in permanently shadowed craters at the lunar poles by NASA’s Lunar Prospector. These readings may be an indication of lunar water and could have far-reaching implications as humans expand exploration past low-Earth orbit. The Lunar CRater Observing and Sensing Satellite (LCROSS) mission is

[33] http://nssdc.gsfc.nasa.gov/planetary/ice/ice_moon.html
[34] http://www.nasa.gov/mission_pages/LCROSS/overview/index.html

seeking a definitive answer.

In April 2006, NASA selected the LCROSS proposal for a low-cost, fast-track companion mission to the Lunar Reconnaissance Orbiter (LRO). The main LCROSS mission objective is to confirm the presence or absence of water ice in a permanently shadowed crater near a lunar polar region.

LCROSS launched with the Lunar Reconnaissance Orbiter (LRO) aboard an Atlas V rocket from Cape Canaveral, Fla., on June 18, 2009 at 2:32 p.m. PDT. The LCROSS shepherding spacecraft and the Atlas V's Centaur upper stage rocket executed a fly-by of the moon on June 23, 2009 (LCROSS lunar swingby video stream coverage) and entered into an elongated Earth orbit to position LCROSS for impact on a lunar pole. On final approach, the shepherding spacecraft and Centaur will separate. The Centaur will act as a heavy impactor to create a debris plume that will rise above the lunar surface. Projected impact at the lunar South Pole is currently: Oct 9, 2009 at 4:30 a.m. PDT. Following four minutes behind, the shepherding spacecraft will fly through the debris plume, collecting and relaying data back to Earth before impacting the lunar surface and creating a second debris plume.

The debris plumes are expected to be visible from Earth- and space-based telescopes 10-to-12 inches and larger.

The LCROSS science payload consists of two near-infrared spectrometers, a visible light spectrometer, two mid-infrared cameras, two near-infrared cameras, a visible camera and a visible radiometer. The LCROSS instruments were selected to provide mission scientists with multiple complimentary views of the debris plume created by the Centaur impact.

As the ejecta rises above the target crater's rim and is exposed to sunlight, any water-ice, hydrocarbons or organics will vaporize and break down into their basic components. These components primarily will be monitored by the visible and infrared spectrometers. The near-infrared and mid-infrared cameras will determine the total amount and distribution of water in the debris plume. The spacecraft's visible camera will track the impact location and the behavior of the debris plume while the visible radiometer will measure the flash created by the Centaur impact.

NASA's Ames Research Center, Moffett Field, Calif., is overseeing the development of the LCROSS mission with its spacecraft and integration partner, Northrop Grumman, Redondo Beach, Calif. LCROSS is a fast-paced, low-cost, mission that will leverage some existing NASA systems, commercial-off-the-shelf components, the spacecraft expertise of Northrop Grumman and experience gained during the Lunar Prospector Mission in

1999. Ames is managing the mission, conducting mission operations, and developing the payload instruments, while Northrop Grumman designed and is building the spacecraft for this innovative mission. Ames mission scientists will spearhead the data analysis.

The Search for Lunar Water[35]

Just like on Earth, water will be a crucial resource on the moon. Transporting water and other goods from Earth to the moon's surface is expensive. Finding natural resources, such as water ice, on the moon could help expedite lunar exploration. The LCROSS mission will search for water, using information learned from the Clementine and Lunar Prospector missions.

By going to the moon for extended periods of time, a new generation of explorers will learn how to work safely in a harsh environment. A lunar outpost is a stepping stone to future exploration of other bodies in our solar system. The moon also offers many clues about when the planets were formed.

[35] http://www.nasa.gov/mission_pages/LCROSS/searchforwater/index.html