参考译文：

化石保存

When one considers the many ways by which organisms are completely destroyed after death, it is remarkable that fossils are as common as they are. Attack by scavengers and bacteria, chemical decay, and destruction by erosion and other geologic agencies make the odds against preservation very high. However, the chances of escaping complete destruction are vastly improved if the organism happens to have a mineralized skeleton and dies in a place where it can be quickly buried by sediment. Both of these conditions are often found on the ocean floors, where shelled invertebrates (organisms without spines) flourish and are covered by the continuous rain of sedimentary particles. Although most fossils are found in marine sedimentary rocks, they also are found in terrestrial deposits left by streams and lakes. On occasion, animals and plants have been preserved after becoming immersed in tar or quicksand, trapped in ice or lave flows, or engulfed by rapid falls of volcanic ash.

在生物体死后有很多种途径会将其彻底的破坏，化石却可以令人惊讶的长久保存。食腐动物和细菌的破坏、化学性腐烂、腐蚀以及其它地质因素都会非常不利于保存。不过，在少数情况下如果生物体具有矿化的骨骼并且死于可以迅速被沉积物掩埋的地方，就有可能避免被完全破坏。海底通常就具有上述的两方面条件，这里生活着很多带壳的无脊椎动物（没有脊椎的动物），连绵的沉积颗粒雨会把它们掩埋起来。虽然多数的化石是在海相沉积岩中发现的，但是在溪流和湖泊留下的陆相沉积物中也发现过。有些陷入焦油和流沙、冻结在冰中、被岩浆包裹或被火山尘雨吞没的动植物得以保存下来。

The term “fossil” often implies petrifaction, literally a transformation into stone. After the death of an organism, the soft tissue is ordinarily consumed by scavengers and bacteria. They empty shell of a snail or clam may be left behind, and if it is sufficiently durable and resistant to dissolution, it may remain basically unchanged for a long period of time. Indeed, unaltered shells of marine invertebrates are known from deposits over 100 million years old. In many marine creatures, however, the skeleton is composed of mineral variety of calcium carbonate called aragonite. Although aragonite has the same composition as the more familiar mineral known as calcite, it has a different crystal form, is relatively unstable, and in time changes to the more stable calcite.

术语“化石”常常意味着石化，按字面意思来解释就是变成了石头。生物体死后，软组织一般会被食腐动物和细菌吃掉。可能会留下蜗牛或蛤蜊空壳，如果空壳足够坚固并且能抵御分解，就有可能在很长一段时间内基本上保持原样。事实上，我们现在所知的在沉积物中发现的海洋无脊椎动物保存良好的壳已超过了 1 亿年之久。不过，很多海洋生物的骨骼是由称为霰石的各式碳酸钙矿物质组成的。虽然霰石与我们更为熟悉的矿物方解石具有同样的组成，但是它的晶型不同，相对不稳定，最终会变成更稳定的方解石。

Many other processes may after the shell of the clam or snail and enhance its chances for preservation. Water containing dissolved silica, calcium carbonate, or iron many circulate through the enclosing sediment and be deposited in cavities such as narrow cavities and canals in bone once occupied by blood vessels and nerves. In such cases, the original composition of the bone or shell remains, but the fossil is made harder and more durable. This addition of a chemically precipitated substance into precipitated is termed “permineralization.”

留下的蜗牛或蛤喇的壳会还会经历其它诸多过程，增加了它们被保存下来的几率。含有溶解的二氧化硅、碳酸钙或铁的水可能会流经包裹着空壳的沉积物，并沉积到诸如骨髓腔和骨头内曾经是血管和神经的管中。这种情况下，骨和壳的原始组成没有改变，但是形成的化石更坚硬并且更持久。这种在孔隙中填充化学沉积物的过程就叫做“矿质充填作用”。

Petrifaction may also involve a simultaneous exchange of the original substance of a dead plant or animal with mineral matter of a different composition. This process is termed “replacement” because solutions have dissolved the original material and replaced it with an equal volume of the new substance. Replacement can be a marvelously precise process, so that details of shell ornamentation, tree rings in wood, and delicate structures in bone are accurately preserved.

石化还可能同时涉及死亡的动植物的原有物质与不同组成的矿物质的交换作用。

该过程叫做“置换作用”，因为溶液溶解了原始物质并将其置换成为等体积的新物质。置换是一个让人难以置信的精确过程，空壳上的纹路细节、树木的年龄以及骨骼的精细结构都被精准地保存了下来。

■Another type of fossilization, known as carbonization, occurs when soft tissues are preserved as thin film of carbon.■ Leaves and tissue of soft-bodied organisms such as jellyfish or worms may accumulate, become buried and compressed, and lose their volatile constituents.■ The carbon often remains behind as a blackened silhouette.■

另一个种类型的石化，称为“碳化”，当软组织被保存在碳薄膜中时会发生碳化。树叶和软体动物例如水母或蠕虫的组织可能会堆积起来，被掩埋并被压实，然后其中的挥发性组分会消失。碳通常会被保留下来，形成黑色的外表。

Although it is certainly true that the possession of hard parts enhances the prospect of preservation, organisms having soft tissues and organs are also occasionally preserved. Insects and even small invertebrates have been found preserved in the hardened resins of conifers and certain other trees. X-ray examination of thin slabs of roc sometimes reveals the ghostly outlines of tentacles, digestive tracts, and visual organs of a variety of marine creatures. Soft parts, including skin, hair, and viscera of ice age mammoths, have been preserved in frozen soil or in the oozing tar of oil seeps.

虽然拥有坚硬的部分的确会增加保存的可能性，但是具有软组织和器官的生物也偶尔会被保存下来。在针叶树以及某些其它的树种的凝固树脂中就发现了被保存下来的昆虫，甚至是很小的无脊椎动物。对岩石薄片的 X 射线检查有时会发现各种各样的海洋生物的触手、消化道和视觉器官若隐若现的轮廓。冻土或石油渗漏时渗出的焦油中保存了包括冰河时代猛犸象皮肤、毛发、内脏在内的软组织。

The probability that actual remains of soft tissue will be preserved is improved if the organism dies in an environment of rapid deposition and oxygen deprivation. Under such conditions, the destructive effects of bacteria are diminished. The middle Eocene Messel shale (from about 48 million years ago) of German accumulated in such an environment. The shale was deposited in an oxygen-deficient lake where lethal gases sometimes bubbled up and killed animals. Their remains accumulated on the floor of the lake and were then covered by clay and silt. Among the superbly preserved Messel fossils are insects with iridescent exoskeletons (hard outer coverings), frogs with skin and blood vessels intact, and even entire small mammals with preserved fur and soft tissue.

如果生物体死于一个具有快速沉积和缺氧的环境，会有助于软组织残骸的保存。在这种条件下，细菌的破坏作用被减少了。德国始新世中期的麦塞尔页岩（来自4800 万年前）就是在这种环境下积累起来的。该页岩沉积于一个缺氧的湖泊，那里时有致命的气体冒出并杀死动物。动物的残骸在湖底越积越多，然后被粘土和淤泥所覆盖。在保存极佳的麦塞尔化石中有带闪亮外骨骼（硬质外部覆盖物）的昆虫，皮肤和血管完好无损的青蛙，甚至是保存有毛皮和软组织的完整的小型哺乳动物。