第四课 纯科学和应用科学

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Unit 4

PURE AND APPLIED SCIENCE

As students of science you are probably sometimes puzzled by the terms 'pure' and 'applied' science. Are these two totally different activities, having little or no interconnection, as is often implied? Let us begin by examining what is done by each.

Pure science is primarily concerned with the development of theories (or, as they are frequently called, models) establishing relationships between the phenomena of the universe. When they are sufficiently validated, these theories (hypotheses, models) become the working laws or principles of science. In carrying out this work, the pure scientist usually disregards its application to practical affairs, confining his attention to explanations of how and why events occur. Hence, in physics, the equations describing the behaviour of fundamental particles, or in biology, the establishment of the life cycle of a particular species of insect living in a Polar environment, are said to be examples of pure science (basic research), having no apparent connection (for the moment) with technology, i.e. applied science.

Applied science, on the other hand, is directly concerned with the application of the working laws of pure science to the practical affairs of life, and to increasing man's control over his environment, thus leading to the development of new techniques, processes and machines. Such activities as investigating the strength and uses of materials, extending the findings of pure mathematics to improve the sampling procedures used in agriculture or the social sciences, and developing the potentialities of atomic energy, are all examples of the work of the applied scientist or technologist.

It is evident that many branches of applied science are practical extensions of purely theoretical or experimental work. Thus the study of radioactivity began as a piece of pure research, but its results are now applied in a great number of different ways—in cancer treatment in medicine, the development of fertilizers in agriculture, the study of metal-fatigue in engineering, in methods of estimating the ages of objects in anthropology and geology, etc. Conversely, work in applied science and technology frequently acts as a direct stimulus to the development of pure science. Such an interaction occurs, for example, when the technologist, in applying a particular concept of pure science to a practical problem, reveals a gap or limitation in the theoretical model, thus pointing the way for further basic research. Often a further interaction occurs, since the pure scientist is unable to undertake this further research until another technologist provides him with more highly-developed instruments.

It seems, then, that these two branches of science are mutually dependent and interacting, and that the so-called division between the pure scientist and the applied scientist is more apparent than real.

作为理科学生，你可能有时被术语“纯”科学和“应用”科学困惑。这两个科学活动是如通常所意味的，完全不同，很少或没有相互联系吗？让我们首先检查每个做了什么。

纯科学主要关注的是发展用于建立宇宙现象之间关系的理论（或通常称为模型）。当得到充分验证时，这些理论（假设、模型）便成为科学的工作规律或原理。在进行这项工作中，纯科学家通常会忽视它对实际事物的应用 ，将注意力集中在解释事情如何和为什么发生。因此，在物理学中描述基本粒子的行为，在生物学中确定特种昆虫类生活在极地环境中的生命周期，都是纯科学（基础研究）的范例，此时与技术即应用科学没有明显的联系。

另一方面，应用科学直接关注将纯科学的工作规律应用于实际生活事务，并增加人对自己环境的控制，从而导致新技术、流程和机器的发展。这些活动如研究材料强度与使用、扩展纯数学的成果以改进农业或社会学里使用的抽样程序、以及开发原子能潜力，都是应用科学家或技术人员工作的范例。

很明显，应用科学的许多分支都是纯理论或实验工作的实际拓展。于是，放射性研究开始是一项纯粹的研究， 但其结果现在已应用于大量不同方面 --- 医学上癌症治疗、农业中肥料发展、工程中金属疲劳研究， 人类学和地质学中估计物体年龄的方法，等等。反过来，应用科学与技术的工作经常直接刺激纯科学的发展。例如有这样的互动发生，当技术人员在将纯科学的特定概念用于一个实际问题时，显现出该理论模型某个差距或局限性，从而为进一步的基础研究指明了方向。进一步的互动经常发生，因为纯科学家无法推进一项研究，直到另一位技术专家为他提供了更高度发达的仪器。

这样看来，这两个科学分支相互地依赖和作用，所谓的纯科学家和应用科学家之间的区分则有名无实。