

nature

The Living Record of Science

《自然》百年科学经典

英汉对照版 (平装本)

第一卷 (下)

总顾问: 李政道 (Tsung-Dao Lee)

英方主编: Sir John Maddox
Philip Campbell

中方主编: 路甬祥



外语教学与研究出版社 · 麦克米伦教育 · 自然科研

FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS · MACMILLAN EDUCATION · NATURE RESEARCH

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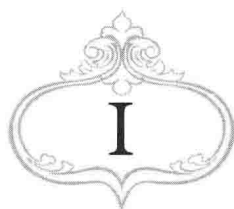
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Volume I
(1869-1930)

Molecules*

J. C. Maxwell

Editor's Note

James Clerk Maxwell was sometimes accused of being a poor lecturer, but this talk delivered to the British Association offers a lucid, engaging picture of the current understanding of the molecular nature of matter. Maxwell made a decisive contribution himself with his kinetic theory of gases, which explained how the macroscopic properties of gases, such as the laws relating pressure, volume and temperature, could be explained from the microscopic motions of the constituent particles. Maxwell's estimate of the size of a hydrogen molecule is only slightly bigger than the modern view. And his discussion of molecular diffusion anticipates the work of Albert Einstein and Jean Perrin on Brownian motion that provided the first real evidence for molecules as physical entities.

AN atom is a body which cannot be cut in two. A molecule is the smallest possible portion of a particular substance. No one has ever seen or handled a single molecule. Molecular science, therefore, is one of those branches of study which deal with things invisible and imperceptible by our senses, and which cannot be subjected to direct experiment.

The mind of man has perplexed itself with many hard questions. Is space infinite, and if so in what sense? Is the material world infinite in extent, and are all places within that extent equally full of matter? Do atoms exist, or is matter infinitely divisible?

The discussion of questions of this kind has been going on ever since men began to reason, and to each of us, as soon as we obtain the use of our faculties, the same old questions arise as fresh as ever. They form as essential a part of the science of the nineteenth century of our era, as of that of the fifth century before it.

We do not know much about the science organisation of Thrace twenty-two centuries ago, or of the machinery then employed for diffusing an interest in physical research. There were men, however, in those days, who devoted their lives to the pursuit of knowledge with an ardour worthy of the most distinguished members of the British Association; and the lectures in which Democritus explained the atomic theory to his fellow-citizens of Abdera realised, not in golden opinions only, but in golden talents, a sum hardly equalled even in America.

* Lecture delivered before the British Association at Bradford, by Prof. Clerk Maxwell, F. R. S.

分子^{*}

麦克斯韦

编者按

有人认为詹姆斯·克拉克·麦克斯韦缺乏演讲天赋，但这篇在英国科学促进会所作的报告中，麦克斯韦对物质分子的那些得到普遍接受的性质描述得非常透彻，给人留下了深刻的印象。麦克斯韦在分子学方面作出了有决定意义的贡献，他提出的气体动力学理论能够说明如何用组成粒子的微观运动来解释气体的宏观性质，如与压力、体积和温度相关的定律。麦克斯韦对氢分子大小的估计只比现在的公认值略大一些。他对分子扩散现象的讨论促使阿尔伯特·爱因斯坦和让·佩兰开始了关于布朗运动的研究，这使人们第一次认识到分子是一种物理实体。

原子是不能被一分为二的实体。分子是组成物质的最小单位。没有人看见或者摆弄过单个分子。因此，分子科学是研究不可见也不可感觉的事物的一门学问，我们无法对它进行直接实验。

人类经常思索很多难以回答的问题。空间是无限的吗？如果是，是从什么意义上讲的？物质世界的范围是无限的吗？在这个范围内是不是每个地方都同等地充满了物质？原子存在吗？或物质是否无限可分？

自从人类开始理性思考以来，关于这类问题的讨论就一直没有停止过。对于我们每个人来说，一旦开始用心智思考，那些古老的问题就会像从前一样令人觉得新奇。不论是在我们所处的19世纪，还是在公元前5世纪，这些问题都构成了科学的基本部分。

我们对2,200年前位于色雷斯的科学组织所知甚少，也不知道他们用何种方式来传播对自然研究的兴趣。不过那时候确实有人毕生追求知识，热情不亚于英国科学促进会中最杰出的成员。当德谟克利特向他的阿布德拉市民开设讲座讲解自己的原子理论时，他获得的高度评价和丰厚报酬即使在今天的美国也很少有人能比得上。

* 皇家学会会员克拉克·麦克斯韦教授在布拉德福德对英国科学促进会作的报告。

To another very eminent philosopher, Anaxagoras, best known in the world as the teacher of Socrates, we are indebted for the most important service to the atomic theory, which, after its statement by Democritus, remained to be done. Anaxagoras, in fact, stated a theory which so exactly contradicts the atomic theory of Democritus that the truth or falsehood of the one theory implies the falsehood or truth of the other. The question of the existence or non-existence of atoms cannot be presented to us this evening with greater clearness than in the alternative theories of these two philosophers.

Take any portion of matter, say a drop of water, and observe its properties. Like every other portion of matter we have ever seen, it is divisible. Divide it in two, each portion appears to retain all the properties of the original drop, and among others that of being divisible. The parts are similar to the whole in every aspect except in absolute size.

Now go on repeating the process of division till the separate portions of water are so small that we can no longer perceive or handle them. Still we have no doubt that the sub-division might be carried further, if our senses were more acute and our instruments more delicate. Thus far all are agreed, but now question arises, Can this sub-division be repeated for ever?

According to Democritus and the atomic school, we must answer in the negative. After a certain number of sub-divisions, the drop would be divided into a number of parts each of which is incapable of further sub-division. We should thus, in imagination, arrive at the atom, which, as its name literally signifies, cannot be cut in two. This is the atomic doctrine of Democritus, Epicurus, and Lucretius, and, I may add, of your lecturer.

According to Anaxagoras, on the other hand, the parts into which the drop is divided, are in all respects similar to the whole drop, the mere size of a body counting for nothing as regards the nature of its substance. Hence if the whole drop is divisible, so are its parts down to the minutest sub-divisions, and that without end.

The essence of the doctrine of Anaxagoras is that the parts of a body are in all respects similar to the whole. It was therefore called the doctrine of *Homoiomereia*. Anaxagoras did not of course assert this of the parts of organised bodies such as men and animals, but he maintained that those inorganic substances which appear to us homogeneous are really so, and that the universal experience of mankind testifies that every material body, without exception, is divisible.

The doctrine of atoms and that of homogeneity are thus in direct contradiction.

But we must now go on to molecules. Molecule is a modern word. It does not occur in *Johnson's Dictionary*. The ideas it embodies are those belonging to modern chemistry.