Science and Technology

The 2021 Nobel science prizes and the winners are......

This year's Nobel prizes brought both delight and disbelief

Important work was honoured, but there was a surprising omission

SCIENTISTS SOMETIMES refer elliptically to winning a Nobel prize as "the trip to Stockholm". Not this year, it isn't.

The white-tie award ceremony in the Concert Hall, the splendid banquet in the City Hall and—for those who can last the pace, the equally splendid unofficial after-party in the students' union of one of Stockholm's universities (they rotate the honour) are all cancelled, just as they were last year.

That will probably not, however, diminish the joy of this year's laureates. They will be on cloud nine already, having snagged the most famous awards in science.

The physics prize went to three researchers who have studied complex, chaotic and apparently random systems and developed ways to predict their long-term behaviour, with implications ranging from how to study the climate to the exploitation of exotic materials.

Half of the award of SKr10m (about $1.1m) was shared by Syukuro Manabe of Princeton University and Klaus Hasselmann of the Max Planck Institute for Meteorology, in Hamburg.

The other half went to Giorgio Parisi of Sapienza, the principal university in Rome.

Drs Manabe and Hasselmann laid the foundations of the modelling of Earth's climate that led to "quantifying variability and reliably predicting global warming", according to the Nobel Committee for Physics of Sweden's Royal Academy of Science.

Dr Parisi was awarded his share for discoveries around the "interplay of disorder and fluctuations in physical systems from atomic to planetary scales".

In the 1960s Dr Manabe, an atmospheric scientist, wove together emerging strands of understanding of the dynamics and thermodynamics of Earth's atmosphere to make the first reliable prediction that doubling the level of carbon dioxide present would also increase the planet's surface temperature.

His work led to the development of physical models of Earth's climate and laid the foundation for the climate models used today.

Around the same time, scientists such as Edward Lorenz of the Massachusetts Institute of Technology were beginning to describe weather as a chaotic system—in other words, something that had so many interacting individual components, such as temperature, pressure, humidity and wind speed, that even small variations in initial conditions could result in enormous differences at a later stage.

In this description, weather evolved rapidly and became essentially unpredictable even just a few days into the future.

In the 1970s Dr Hasselmann developed models to show how weather, despite being chaotic and unpredictable in the short-term, could yield reliable models to foreshadow Earth's climate over much longer periods.

In describing his work he made an analogy to Brownian motion, the jostling movement of pollen grains in water that was first observed down a microscope by Robert Brown, a botanist, in 1827.

Almost 80 years later, Albert Einstein posited that the slow zigzagging of such grains could be explained by their continual bombardment by much tinier, fast-moving water molecules.

The large-scale climate can similarly be seen as a consequence of numerous smaller events.

Around 1980 Dr Parisi found some of the rules that govern apparently random phenomena.

He studied a type of material called "spin glass", in which, for example, iron atoms are mixed at random into a matrix of copper atoms.

The iron atoms each behave as tiny magnets but, whereas in a normal lump of magnetised metal their north-south poles all point in the same direction, in a spin glass they do not.

Dr Parisi devised a way to understand how they find their optimal orientations.

His mathematical ideas not only help explain some of the complex systems of Earth's climate, as described by his two fellow laureates, but also illuminate other apparently random phenomena in fields as diverse as animal behaviour, neuroscience and machine learning.

This year's physics prize is the first scientific Nobel awarded for understanding of the climate.

Asked if this was a not-so-subtle message to world leaders ahead of the upcoming COP26 climate summit in Glasgow, members of the award committee said the prize was meant to celebrate the discoveries themselves.

But, they added, it also showed that the modelling of the climate and the notion of global warming rest on solid physical science.

Human beings can no longer say they did not know how or why Earth is heating up.

科技版块

2021 年诺贝尔科学奖的获得者是……

今年的诺贝尔奖让人既高兴又难以置信

重大科学成就得到了尊重和认可，但也有一个令人惊讶的遗漏

科学家有时会将获得诺贝尔奖的过程简略地称为"斯德哥尔摩之旅"。今年可不是这样。

音乐厅最隆重的颁奖典礼、市政厅的盛大宴会，以及斯德哥尔摩一所大学学生会同样精彩纷呈的非官方庆祝会（它们将会轮流颁发荣誉）都被取消了，就像去年一样。

然而，这可能不会减少今年获奖者的喜悦。他们已经获得了科学界最著名的奖项，已经欣喜若狂了。

诺贝尔物理学奖颁给了三名研究人员，他们研究了复杂、混乱和完全随机的物理系统，并开发了预测它们长期行为的方法，涉及的范围从如何研究气候到开发创新材料。

1000 万瑞典克朗（约合 110 万美元）奖金的一半由普林斯顿大学的真锅淑郎（Syukuro Manabe）和克劳斯·哈塞尔曼（Klaus Hasselmann）共享。

另一半给予了就职于罗马的重点大学——罗马大学的乔治·帕里西（Giorgio Parisi）。

瑞典皇家科学院诺贝尔物理学委员会表示，真锅淑郎和哈塞尔曼为建立地球气候的物理建模奠定了基础，该模型可量化可变性并可靠地预测全球变暖。

帕里西博士发现了从原子到行星尺度的物理系统中无序和涨落的相互作用而获奖。

20 世纪 60 年代，气象学家真锅淑郎博士对地球大气动力学和热力学的新认识结合，做出了第一个可靠的预测，即目前存在的二氧化碳水平翻一番也会提高地球表面的温度。

他的成果促进了地球气候物理模型的发展，并为今天使用的气候模型奠定了基础。

大约在同一时间，麻省理工学院的爱德华·洛伦兹等科学家开始将天气描述为一个混沌的系统，换句话说，它包含非常多相互作用且独立的成分，如温度、压力、湿度和风速，以致于即使初始条件的微小变化也可能导致后期巨大的差异。

在这个描述中，天气演变迅速，甚至在未来短短几天内也变得基本上不可预测。

在 20 世纪 70 年代，哈塞尔曼博士开发了一些模型向大家展示，短期内在混乱和不可预测的情况下，天气如何产生可靠的模型来预测更长时间内的地球气候。

在描述他的工作时，他将其比作布朗运动，1827 年植物学家罗伯特·布朗（Robert Brown）首次在显微镜下观察到水中花粉颗粒的不规则碰撞运动。

将近 80 年后，阿尔伯特·爱因斯坦（Albert Einstein）提出，这些颗粒的缓慢之字形运动是因为它们不断受到更细小、快速运动的水分子的轰击产生的。

同样，大范围的气候变化也可以看作是众多小事件的结果。

大约在 1980 年，帕里西博士发现了一些支配明显随机现象的规则。

他研究了一种名为"自旋玻璃"的材料，例如，在这种材料中，铁原子被随机混合到铜原子内部。

每个铁原子的行为都像微小的磁铁，但在正常的磁化金属块中，它们的南北极都指向相同的方向，而在自旋玻璃中却不是这样。

帕里西博士设计了一种方法来了解它们是如何找到最佳方向的。

他的数学思想不仅有助于解释地球气候的一些复杂系统，正如两位获奖者所描述的那样，还解释了动物行为、神经科学和机器学习等领域中的其他明显随机的现象。

今年的物理学奖是首个因对气候的理解而获奖的诺贝尔科学奖。

当被问到这些发现是否在格拉斯哥举行的 COP26 气候峰会之前向世界各国领导人传递了一个不那么微妙的信息时，颁奖委员会成员表示，获奖是为了庆祝这些发现本身。

他们补充说，这也表明气候模型和全球变暖的概念是建立在坚实的物理科学基础上的。

人类再也不能说他们不知道地球是怎样变暖以及为什么变暖的。