# 第3章 基因的本质

# 基因的本质

第1节 DNA是主要的遗传物质

第2节 DNA分子的结构

第3节 DNA的复制

第4节 基因是有遗传效应的DNA片段

# 第2节 DNA分子的结构

**本节聚焦**

1、沃森和克里克是怎样发现DNA分子的双螺旋结构的？

2、DNA分子的双螺旋结构有哪些主要特点？

# 一、问题探讨


DNA雕塑

坐落于北京中关村高科技园区的DNA雕塑，以它简洁而独特的双螺旋造型吸引着过往行人。你知道为什么将它作为高科技的标志吗？

2003年是DNA分子双螺旋结构发现50周年。上网查一查有关DNA的信息，收集你感兴趣的资料与同学交流共享。

# 二、DNA双螺旋结构模型的构建

DNA分子是以4中脱氧核苷酸为单位连接而成的长链，这4中脱氧核苷酸分别含有ATGC四种碱基。

1951年春

DNA分子呈螺旋结构

尝试多种结构失败后，构建磷酸—核糖骨架在螺旋外部，碱基在螺旋内部的结构；

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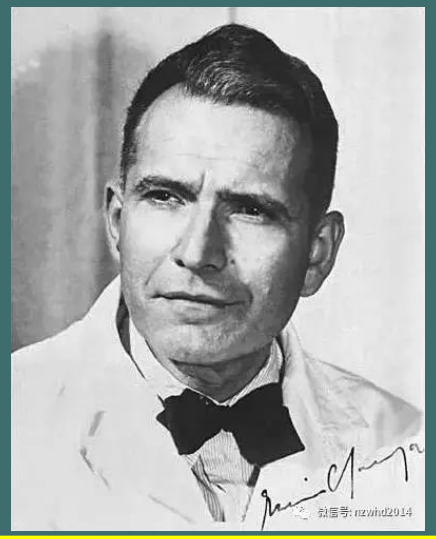

A=T，G=C；

**A与T配对，G与C配对，构建新的DNA模型；**

**A-T碱基对，与G-C碱基对具有形同的形状和直径——DNA具有稳定的直径，能够解释碱基数量关系，也能解释DNA的复制；**

相同碱基进行配对；

违反化学规律

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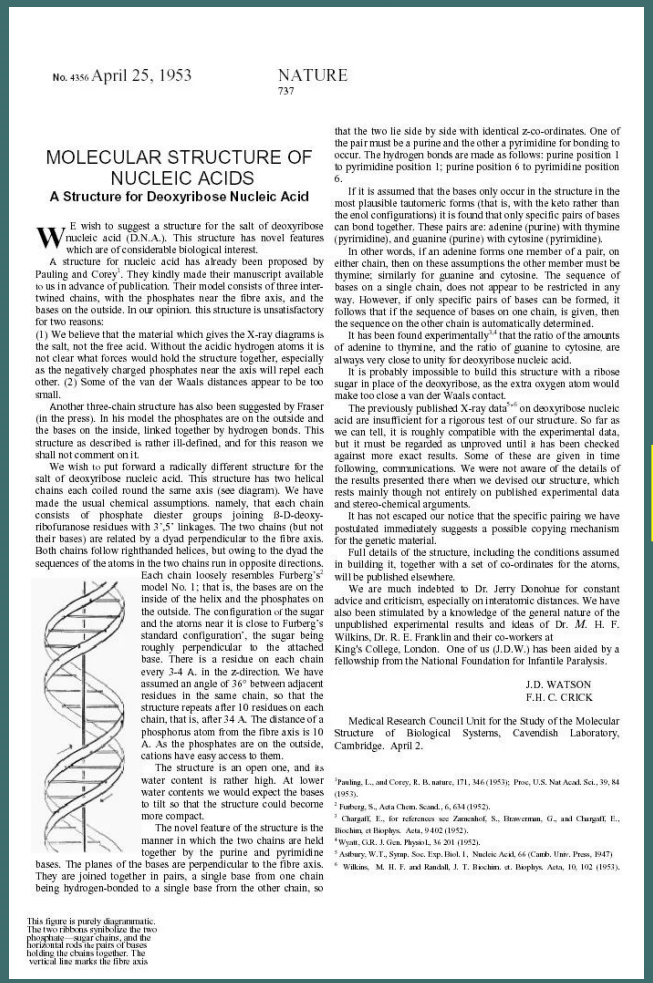
1953年



No. 4356 April 25, 1953 NATURE 737

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We are much indebted to Dr. Jerry Donohue for constant advice and criticism, especially on interatomic distances. We have also been stimulated by a knowledge of the general nature of the unpublished experimental results and ideas of Dr. M. H. F. Wilkins, Dr. R. E. Franklin and their co-workers at King's College, London. One of us (J.D.W.) has been aided by a fellowship from the National Foundation for Infantile Paralysis.

J.D. WATSON
F.H. C. CRICK

Medical Research Council Unit for the Study of the Molecular Structure of Biological Systems, Cavendish Laboratory, Cambridge. April 2.

[1] Pauling, L., and Corey, R. B., nature, 171, 346 (1953); Proc. U.S. Nat Acad. Sci., 39, 84 (1953).
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[3] Chargaff, E., for references see Zamenhof, S., Brawerman, G., and Chargaff, E., Biochim. et Biophys. Acta, 9 402 (1952).
[4] Wyatt, G.R., J. Gen. Physiol., 36 201 (1952).
[5] Astbury, W.T., Symp. Soc. Exp. Biol. 1, Nucleic Acid, 66 (Camb. Univ. Press, 1947)
[6] Wilkins, M. H. F. and Randall, J. T. Biochim. et. Biophys. Acta, 10, 102 (1953).

This figure is purely diagrammatic. The two ribbons symbolize the two phosphate—sugar chains, and the horizontal rods the pairs of bases holding the chains together. The vertical line marks the fibre axis

1962年

Francis Harry Compton Crick (1916-2004)

诺贝尔生理学或医学奖

James Dewey Watson (1928 - )

Maurice Hugh Frederick Wilkins (1916-2004)

# 二、DNA双螺旋结构模型的构建

思考与讨论

1、请根据资料回答有关DNA结构方面的问题：

1）DNA是由几条链构成的？它具有怎样的立体结构？

1）DNA由2条链构成，盘旋成双螺旋结构；

2）DNA的基本骨架是由哪些物质组成的？它们分别位于DNA的什么部位？

2）DNA的基本骨架由磷酸和脱氧核糖组成，位于DNA的螺旋外部；

# 二、DNA双螺旋结构模型的构建

思考与讨论

3）DNA中的碱基是如何配对的？它们位于DNA的什么部位？

1）A与T配对，G与C配对，分布在螺旋的内部；

# 二、DNA双螺旋结构模型的构建

思考与讨论

2、上述资料中涉及到哪些学科的知识和方法？这对你理解生物科学的发展有什么启示？

2）主要涉及物理学（主要是晶体学）、生物化学、数学和分子生物学等学科的知识。涉及的方法主要有：X射线衍射结构分析方法，其中包括数学计算法；建构模型的方法等。现代科学技术中许多成果的取得，都是多学科交叉运用的结果；反过来，多学科交叉的运用，又会促进学科的发展，诞生新的边缘学科，如生物化学、生物物理学等。

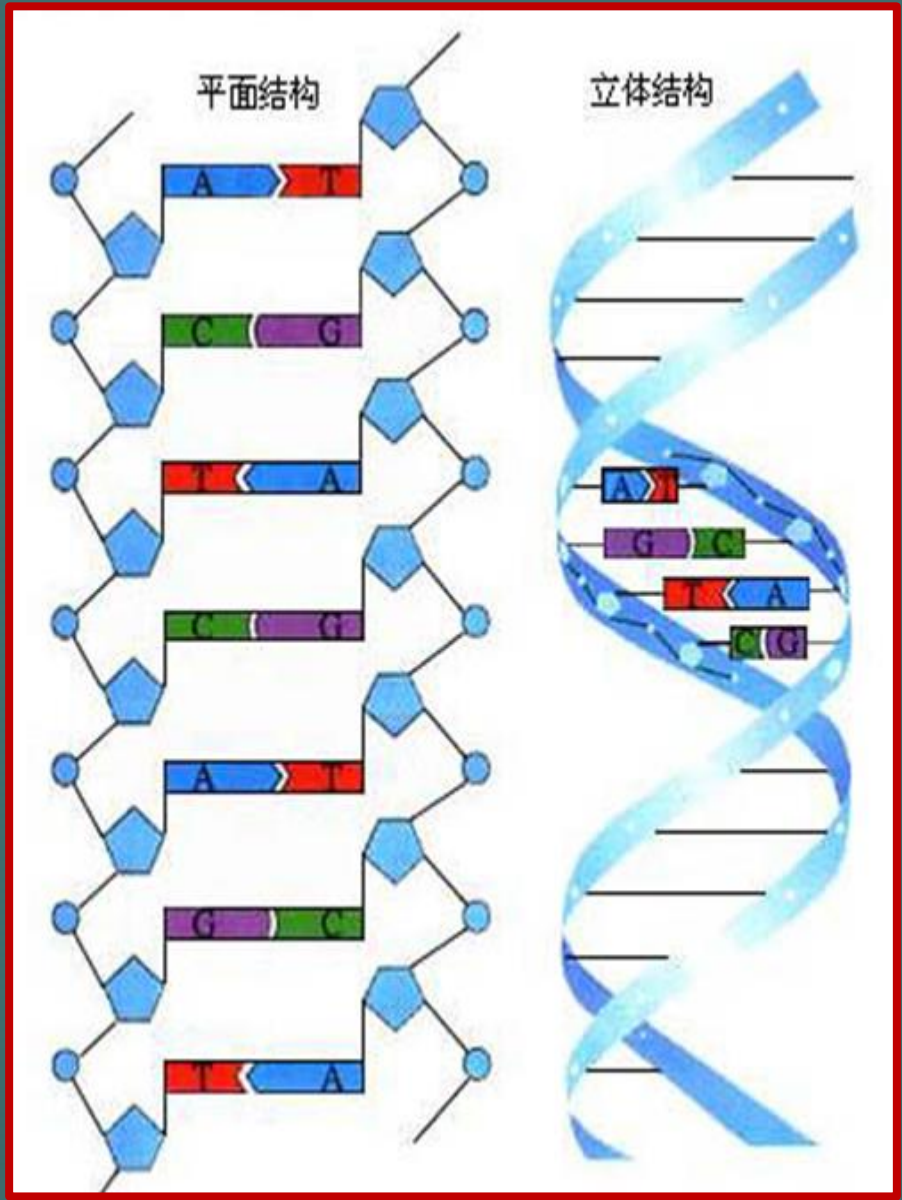
# 二、DNA双螺旋结构模型的构建

思考与讨论

3、沃森和克里克默契配合，发现DNA双螺旋结构的过程，作为科学家合作的典范，在科学界传为佳话。他们的这种工作方式给予你哪些启示？

3）要善于利用他人的研究成果和经验；要善于与他人交流和沟通，闪光的思想是在交流与撞击中获得的；研究小组成员在知识背景上最好是互补的，对所从事的研究要有兴趣和激情等。

# 三、DNA分子的结构




1）DNA分子由反向平行的双链组成，盘旋成双螺旋结构；

2）DNA分子的基本骨架由磷酸和脱氧核糖交替连接而成，排在外侧；碱基成对排在内侧；

3）DNA两条链上的碱基通过氢键进行互补配对：A—T，G—C；

——碱基互补配对原则；

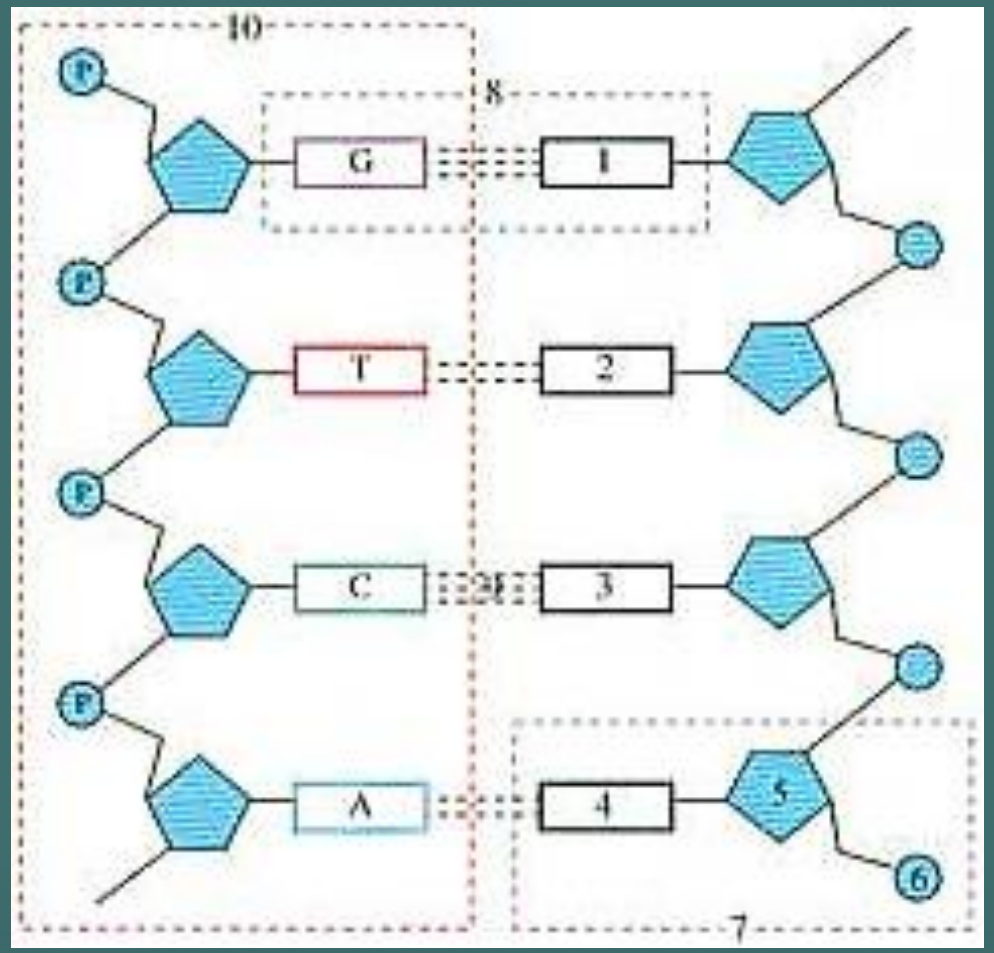
# 三、DNA分子的结构

模型构建

制作DNA双螺旋结构模型

# 四、DNA分子的结构——课后练习

1、下面是DNA分子的结构模式图，请用文字写出图中1—10的名称；




1、_____ 2、_____

3、_____ 4、_____

5、_____ 6、_____

7、_____ 8、_____

9、_____ 10、_____

# 四、DNA分子的结构——课后练习

2、已知1个DNA分子中有4000个碱基对，其中胞嘧啶有2200个，这个DNA分子中应含有脱氧核苷酸的数目和腺嘌呤的数目分别是：

A、4000个和900个

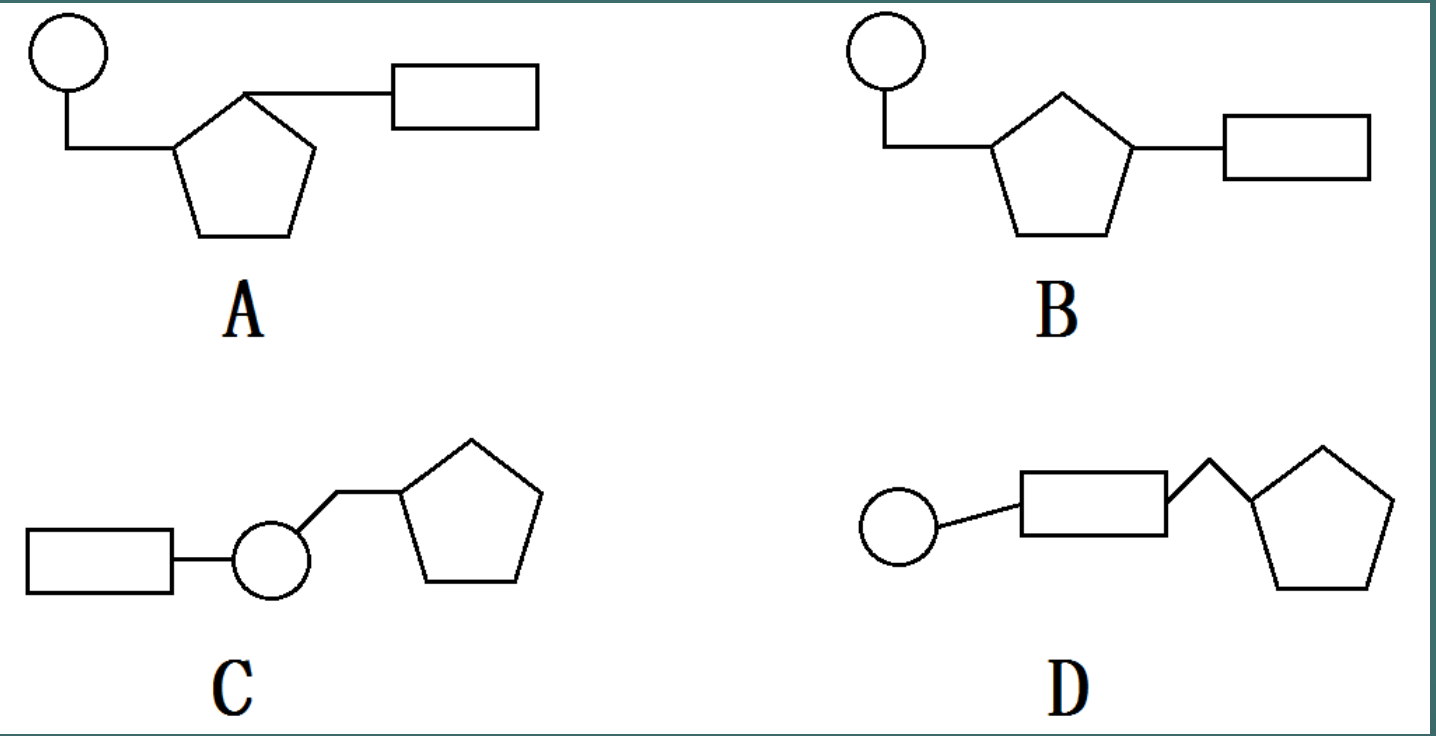
B、4000个和1800个

C、8000个和1800个

D、8000个和3600个

# 四、DNA分子的结构——课后练习

3、下列各图中，图形 ○ ⬠ ▭ 分别代表磷酸、脱氧核糖和碱基，在制作脱氧核苷酸模型时，各部件之间需要连接，下列连接中正确的是：



# 四、DNA分子的结构——课后练习

**拓展题：**你能根据碱基互补配对原则，推导出相关的数学公式吗？推导后，尝试进一步总结这些公式，从中概括出一些规律。

∵A=T，G=C

∴A+G=T+C

∴（A+G）/（　　）=(T+C）/（　　）=50%

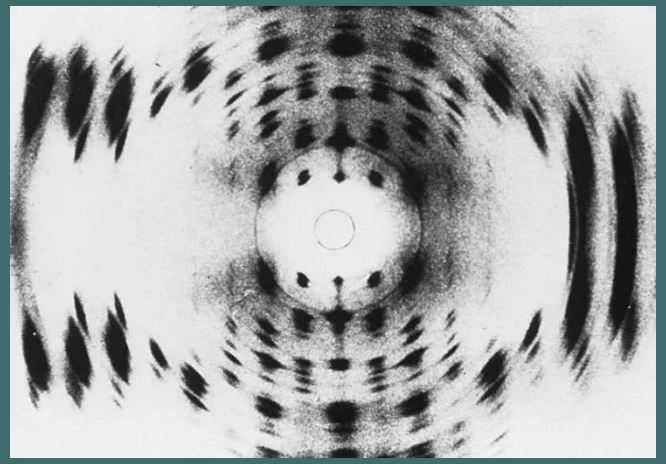
也可以写成以下形式：

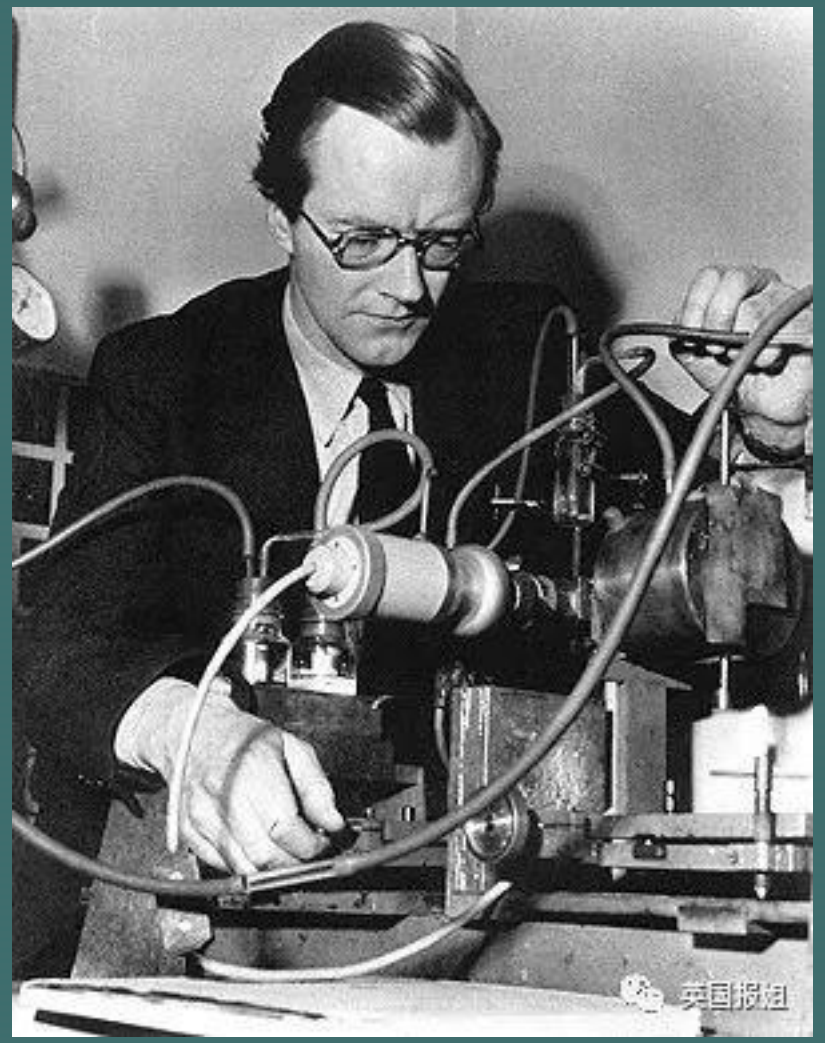
$$\frac{A+G}{T+C}=\frac{(\quad\quad)}{(\quad\quad)}=\frac{(\quad\quad)}{(\quad\quad)}\cdots\cdots=1$$

**规律概括：**在DNA双链中，任意两个不互补碱基之和_____，并为碱基总数的_____；

# 二、DNA双螺旋结构模型的构建

1951年春，在意大利举行的生物大分子结构会议上，展示了一张DNA的X射线的衍射幻灯片。





威尔金斯（M.Willkins）

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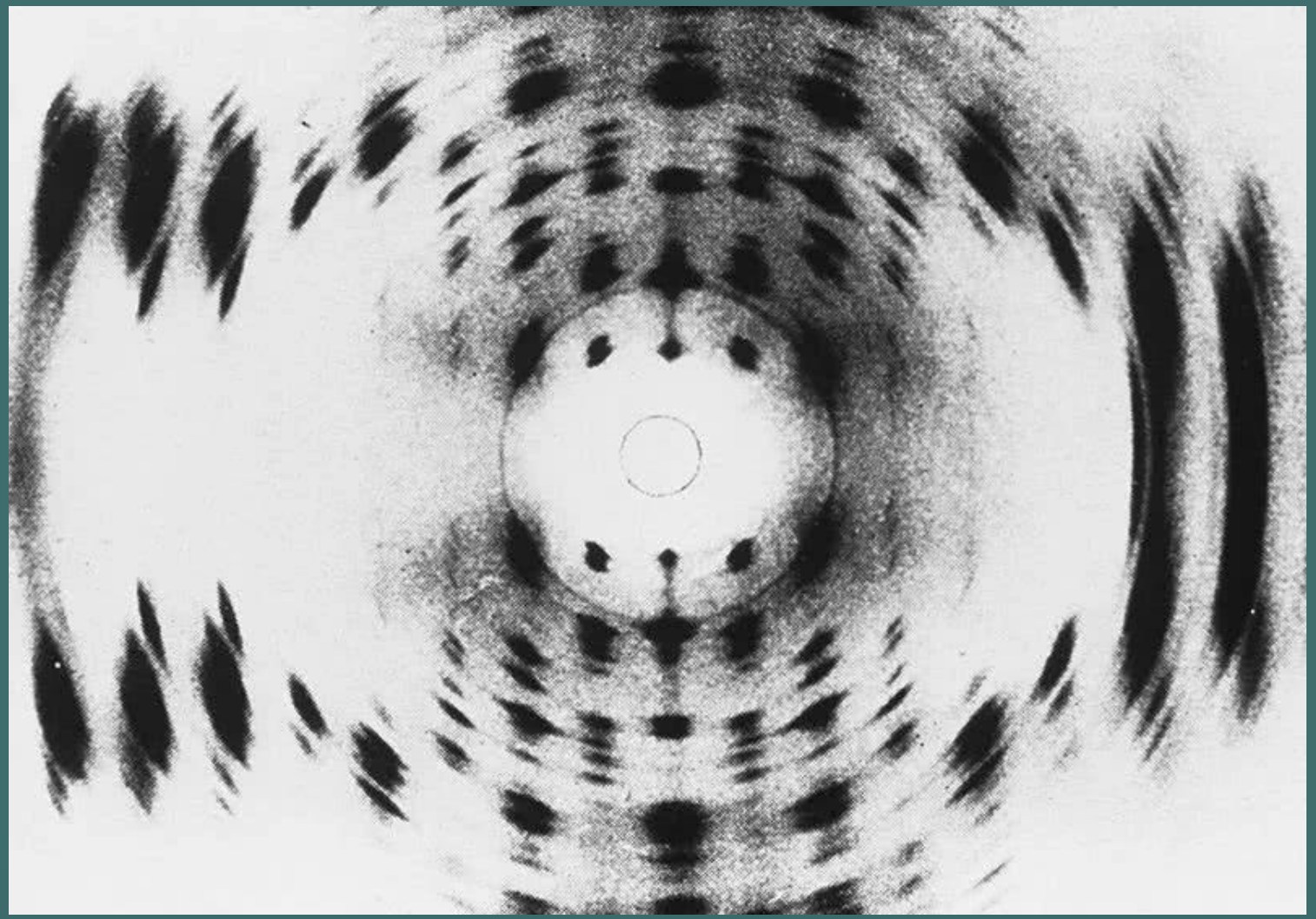

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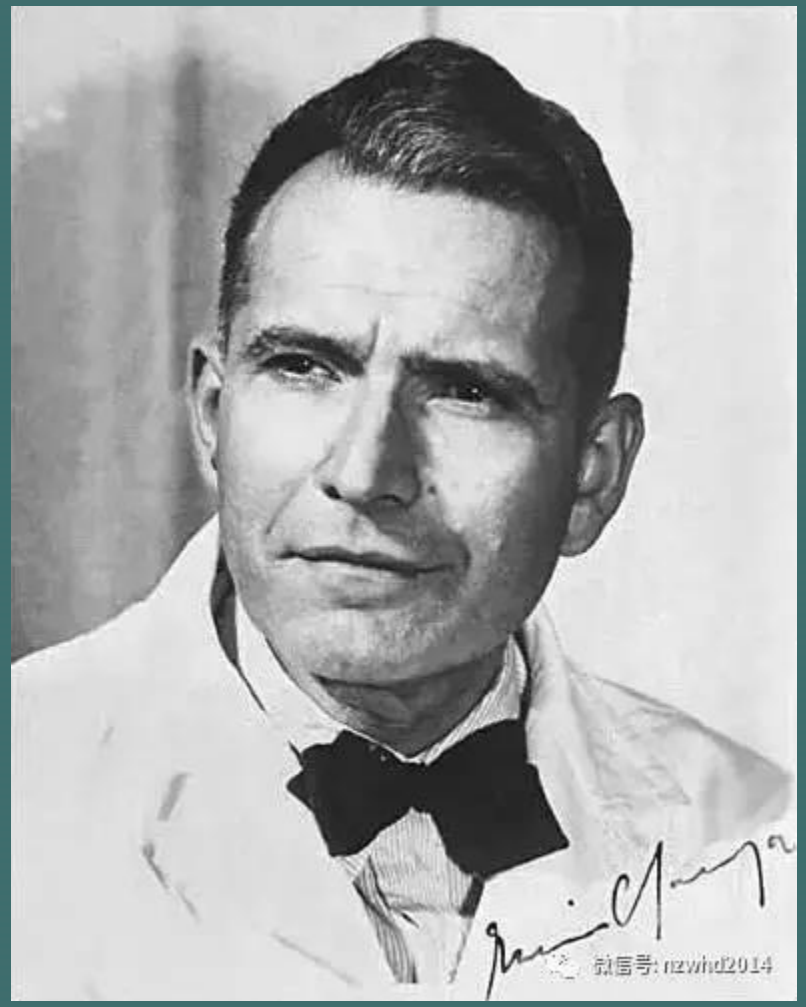


埃尔文·查哥夫

DNA中的腺嘌呤与胸腺嘧啶数量几乎完全一样，鸟嘌呤与胞嘧啶的数量也是一样；即A=T，G=C；

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No. 4356 April 25, 1953 NATURE
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