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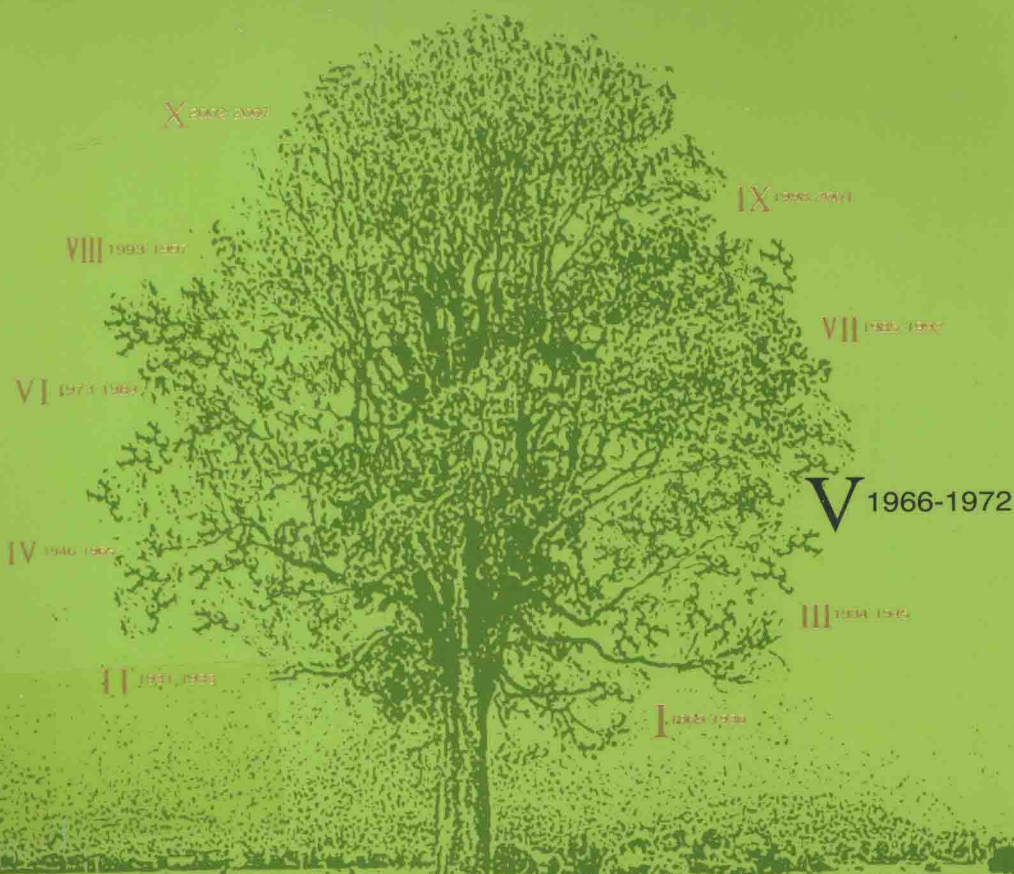
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第五卷 (上)

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



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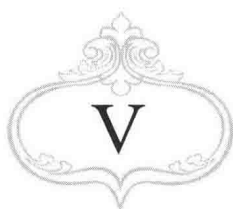
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Contents

目录

Stonehenge—An Eclipse Predictor.....	2
巨石阵——日月食的预报器.....	3
Stonehenge—A Neolithic “Observatory”	14
巨石阵——一个新石器时代的“天文台”.....	15
UGA: A Third Nonsense Triplet in the Genetic Code	26
UGA: 遗传密码中的第三个无义三联密码子	27
Specific Binding of the λ Phage Repressor to λ DNA	36
λ 噬菌体阻遏物与 λ DNA 的特异性结合	37
The North Pacific: An Example of Tectonics on a Sphere.....	48
北太平洋：一个球体上的板块构造实例	49
Observation of a Rapidly Pulsating Radio Source	68
快速脉动射电源的观测	69
Rotating Neutron Stars as the Origin of the Pulsating Radio Sources.....	86
旋转中子星作为脉动射电源的起源	87
Absorption Spectrum of Rhodopsin: 500 nm Absorption Band	92
视紫红质的吸收光谱：500 nm 吸收带	93
Evidence in Support of a Rotational Model for the Pulsar PSR 0833-45	108
支持脉冲星 PSR 0833-45 的旋转模型的证据	109
Detection of Water in Interstellar Regions by Its Microwave Radiation	122
通过微波辐射探测到星际空间中存在水分子	123
Early Stages of Fertilization <i>in vitro</i> of Human Oocytes Matured <i>in vitro</i>	132
体外成熟后的人类卵母细胞体外受精的早期阶段	133
Galactic Nuclei as Collapsed Old Quasars.....	146
星系核是塌缩的老年类星体	147

Evidence for Extraterrestrial Life: Identity of Sporopollenin with the Insoluble Organic Matter Present in the Orgueil and Murray Meteorites and also in Some Terrestrial Microfossils	172
地外生命存在的证据: 孢粉素与存在于奥盖尔陨星、默里陨星以及一些地球上微化石中的不溶有机质的同一性.....	173
Remains of Hominidae from Pliocene/Pleistocene Formations in the Lower Omo Basin, Ethiopia	180
在埃塞俄比亚奥莫下游盆地的上新世/更新世地层中发现的人科化石	181
“Anomalous” Water	208
“反常”的水.....	209
Superfluidity in Neutron Stars	214
中子星内部的超流.....	215
New Finds at the Swartkrans Australopithecine Site	224
在斯瓦特克朗斯南方古猿遗址的新发现	225
RNA-Dependent DNA Polymerase in Virions of RNA Tumour Viruses	256
致癌RNA病毒粒子中的RNA依赖性DNA聚合酶	257
RNA-Dependent DNA Polymerase in Virions of Rous Sarcoma Virus	272
劳斯肉瘤病毒粒子中的RNA依赖性DNA聚合酶	273
A Bonding Model for Anomalous Water	286
反常水的键合模型.....	287
Fertilization and Cleavage <i>in vitro</i> of Preovulator Human Oocytes	294
排卵前的人类卵母细胞在体外的受精和卵裂	295
Evidence that Polywater Is a Colloidal Silicate Sol.....	310
证明聚合水是胶状硅酸盐溶胶的证据	311
Human Blastocysts Grown in Culture.....	326
在培养基中生长的人类囊胚	327
The DNA Replication Mystery.....	332
DNA 复制之谜	333
Polywater and Polypollutants.....	336
聚合水与聚合污染物	337

Convection Plumes in the Lower Mantle	348
下地幔中的对流地幔柱.....	349
Implications of the “Wave Field” Theory of the Continuum from the Crab Nebula	356
蟹状星云连续谱“波场”理论的推论	357
Configuration of Amino-Acids in Carbonaceous Chondrites and a Pre-Cambrian Chert	368
碳质球粒陨石与一块前寒武纪燧石中的氨基酸构型	369
Amino-Acids, Aliphatic and Aromatic Hydrocarbons in the Murchison Meteorite.....	378
默奇森陨星中的氨基酸、脂肪烃和芳香烃.....	379
Ball Lightning as an Optical Illusion	388
球状闪电是一种视错觉.....	389
Polymorphism of Human Enzyme Proteins	396
人类酶蛋白的多态性	397
Experimentally Created Incipient Species of <i>Drosophila</i>	416
通过实验创建的果蝇端始种	417
Directed Genetic Change Model for X Chromosome Inactivation in Eutherian Mammals	432
真兽亚纲哺乳动物中X染色体失活的定向遗传改变模型.....	433
Pneumococci Insensitive to Penicillin	446
对青霉素不敏感的肺炎双球菌.....	447
Synchrotron Radiation as a Source for X-Ray Diffraction	454
作为X射线衍射光源的同步辐射.....	455
Mitochondrion as a Multifunctional Organelle	470
线粒体是一个多功能的细胞器.....	471
Transmission of Two Subacute Spongiform Encephalopathies of Man (Kuru and Creutzfeldt-Jakob Disease) to New World Monkeys	478
两种人类亚急性海绵状脑病(库鲁病和克雅氏病)传染给了新大陆猴.....	479
Inhibition of Prostaglandin Synthesis as a Mechanism of Action for Aspirin-like Drugs	490
抑制前列腺素合成是阿司匹林样药物的一种作用机制.....	491

Aspirin Selectively Inhibits Prostaglandin Production in Human Platelets	506
阿司匹林选择性抑制人血小板中前列腺素的合成	507
Indomethacin and Aspirin Abolish Prostaglandin Release from the Spleen.....	514
消炎痛和阿司匹林阻断脾脏前列腺素的释放	515
Possible Clonal Origin of Common Warts (<i>Verruca vulgaris</i>)	526
寻常疣为克隆性起源的可能性.....	527
Carbon Compounds in Apollo 12 Lunar Samples	534
阿波罗12号月球样品中的含碳化合物	535
Nonbiotic Origin of Optical Activity	556
旋光性的非生物起源	557
Establishment of Symbiosis between <i>Rhizobium</i> and Plant Cells <i>in vitro</i>	568
在体外建立根瘤菌和植物细胞间的共生关系	569
Re-Evaluation of the Palaeogeographic Argument for an Expanding Earth	586
再议有关地球膨胀的古地理学证据.....	587
“Self-Recognition” in Colonial Marine Forms and Flowering Plants in Relation to the Evolution of Immunity	596
群体海洋生物和开花植物中的“自我识别”与免疫进化的关系.....	597
Detection of Radio Emission from Cygnus X-1	624
探测到天鹅座X-1的射电辐射.....	625
Magnetospheric Electric Fields and the Super-Rotation of the Earth's Upper Atmosphere	628
磁层电场与地球高层大气的特快自转	629
Estimation of Nuclear Explosion Energies from Microbarograph Records	634
根据微压计记录估计出的核爆炸能量	635
Sex Pheromone Mimics of the American Cockroach	640
美洲蜚蠊的性外激素类似物	641
Monosodium Glutamate Induces Convulsive Disorders in Rats	648
谷氨酸一钠诱发大鼠痉挛性障碍	649
New Hominid Skull from Bed I, Olduvai Gorge, Tanzania	656
在坦桑尼亚奥杜威峡谷第I层中新发现的原始人类头骨	657

Non-Random X Chromosome Expression in Female Mules and Hinnies	676
母马骡和母驴骡的X染色体非随机表达	677
Non-Random Late Replication of X Chromosomes in Mules and Hinnies	688
马骡和驴骡中X染色体的非随机复制延迟	689
Evidence for Selective Differences between Cells with an Active Horse X Chromosome and Cells with an Active Donkey X Chromosome in the Female Mule.....	706
母马骡中含马活性X染色体的细胞和含驴活性X染色体的细胞之间选择 差异的证据.....	707
Bomb ^{14}C in the Human Population	712
进入人体的核弹 ^{14}C	713
Statistical Mechanics and Quantum Mechanics	728
统计力学和量子力学	729
Lithium in Psychiatry	736
锂在精神病学中的应用.....	737
Formation of New Connexions in Adult Rat Brains after Partial Deafferentation	746
部分传入神经阻滞成年大鼠脑内新联系的形成	747
Change in Methylation of 16S Ribosomal RNA Associated with Mutation to Kasugamycin Resistance in <i>Escherichia coli</i>	762
大肠杆菌中春日霉素抗性突变与16S核糖体RNA的甲基化变化相关.....	763
Problems of Artificial Fertilization.....	774
关于人工受精的几个难题	775
Tyrosine tRNA Precursor Molecule Polynucleotide Sequence	786
酪氨酸转运RNA前体分子的多聚核苷酸序列	787
Poly A Sequences at the 3' Termini of Rabbit Globin mRNAs.....	806
兔球蛋白信使RNA 3'末端的多聚腺苷酸序列	807
On the Mechanism of Action of <i>lac</i> Repressor	818
关于乳糖操纵子阻遏物的作用机理.....	819
Functional Organization of Genetic Material as a Product of Molecular Evolution.....	834
功能性遗传物质是分子进化过程中的产物	835

Covalently Linked RNA–DNA Molecule as Initial Product of RNA Tumour	
Virus DNA Polymerase	844
RNA肿瘤病毒DNA聚合酶的初产物是通过共价键连接的RNA–DNA分子	845
Titration of Oral Nicotine Intake with Smoking Behaviour in Monkeys.....	858
口服尼古丁的摄入量与猴子的吸烟行为	859
Redistribution and Pinocytosis of Lymphocyte Surface Immunoglobulin	
Molecules Induced by Anti-Immunoglobulin Antibody	866
抗免疫球蛋白抗体诱导的淋巴细胞表面免疫球蛋白分子的重分布和胞饮现象....	867
Immunoglobulin E (Reagin) and Allergy	890
免疫球蛋白E(反应素)与过敏反应.....	891
Egg Transfer in Domestic Animals	922
家畜卵移植.....	923
<i>In vitro</i> Culture of Rabbit Ova from the Single Cell to the Blastocyst Stage	936
兔卵子从单细胞到囊胚阶段的体外培养	937
Proposed Mechanism of Force Generation in Striated Muscle	942
横纹肌产生力量的建议机制	943
Molecular Evolution in the Descent of Man.....	970
人类起源过程中的分子进化	971
Logarithmic Relationship of DDE Residues to Eggshell Thinning	1010
DDE残留量对数与蛋壳薄化的关系	1011
Disagreements on Why Brown Pelican Eggs Are Thin	1020
在褐鹈鹕蛋蛋壳薄化原因上的不同意见	1021
Use of “Whole Egg Residues” in Pesticide/Eggshell Studies	1028
关于在杀虫剂/蛋壳研究中使用“全蛋残留数据”	1029
DDE in Eggs and Embryos of Brown Pelicans	1032
褐鹈鹕蛋和胚胎中的DDE.....	1033
Two Types of Mountain Building	1038
两种类型的造山运动	1039
The Macroscopic Level of Quantum Mechanics.....	1048
宏观层次的量子力学	1049

Computer Analyses of Gravitational Radiation Detector Coincidences	1060
引力辐射探测器符合计数的计算机分析	1061
Problems Still with Scrapie Agent.....	1074
关于瘙痒症病原体的待解决问题	1075
Influence of Continental Positions on Early Tertiary Climates.....	1080
大陆位置对早第三纪气候的影响	1081
Rapid Diagnosis of Scrapie in the Mouse	1092
快速诊断小鼠瘙痒症	1093
Scrapie Agent and Neurones	1102
瘙痒症病原体与神经元	1103
Problems of Predicting Earthquakes.....	1110
地震预报的风波	1111
Calcium Ions and Muscle Contraction.....	1124
钙离子与肌肉收缩.....	1125
The Solar Spoon	1132
太阳的调羹.....	1133
Transmission of Kuru from Man to Rhesus Monkey (<i>Macaca mulatta</i>) $8\frac{1}{2}$ Years after Inoculation.....	1154
接种 $8\frac{1}{2}$ 年后库鲁病从人传染到恒河猴(猕猴)	1155
Inhibition of Prostaglandin Synthetase in Brain Explains the Antipyretic Activity of Paracetamol (4-Acetamidophenol).....	1160
对大脑前列腺素合成酶的抑制可以解释扑热息痛(4-乙酰氨基酚)的退热 作用	1161
A Possible Role for Histone in the Synthesis of DNA	1168
组蛋白在DNA合成中的可能角色	1169
Biochemical Evidence for the Bidirectional Replication of DNA in <i>Escherichia coli</i>	1188
大肠杆菌DNA双向复制的生物化学证据	1189
Appendix: Index by Subject	
附录: 学科分类目录	1203

Volume V
(1966-1972)

Stonehenge—An Eclipse Predictor

F. Hoyle

Editor's Note

During the 1960s there was considerable interest in, and debate about, the purpose of the ancient Stonehenge monument in western England. While British astronomer Fred Hoyle was not the first to suggest that Stonehenge was used to predict eclipses, he does demonstrate here how it could more accurately predict them if the "Aubrey circle" represents the ecliptic (the plane of the Solar System, in which the planets orbit the Sun).

THE suggestion that Stonehenge may have been constructed with a serious astronomical purpose has recently received support from Hawkins, who has shown¹ that many alignments of astronomical significance exist between different positions in the structure. Some workers have questioned whether, in an arrangement possessing so many positions, these alignments can be taken to be statistically significant. I have recently reworked all the alignments found by Hawkins. My opinion is that the arrangement is not random. As Hawkins points out, some positions are especially relevant in relation to the geometrical regularities of Stonehenge, and it is these particular positions which show the main alignments. Furthermore, I find these alignments are just the ones that could have served far-reaching astronomical purposes, as I shall show in this article. Thirdly, on more detailed investigation, the apparently small errors, of the order of $\pm 1^\circ$, in the alignments turn out not to be errors at all.

In a second article² Hawkins goes on to investigate earlier proposals that Stonehenge may have operated as an eclipse predictor. The period of regression of the lunar nodes, 18.61 years, is of especial importance in the analysis of eclipses. Hawkins notes that a marker stone moved around the circle of fifty-six Aubrey holes at a rate of three holes per year completes a revolution of the circle in 18.67 years. This is close enough to 18.61 years to suggest a connexion between the period of regression of the nodes and the number of Aubrey holes. In this also I agree with Hawkins. I differ from him, however, in the manner in which he supposes the eclipse predictor to have worked. Explicitly, the following objections to his suggestions seem relevant:

(1) The assumption that the Aubrey holes served merely to count cycles of 56 years seems to me to be weak. There is no need to set out fifty-six holes at regular intervals on the circumference of a circle of such a great radius in order to count cycles of fifty-six.

(2) It is difficult to see how it would have been possible to calibrate the counting system proposed by Hawkins. He himself used tables of known eclipses in order to find it. The builders of Stonehenge were not equipped with such *post hoc* tables.

巨石阵——日月食的预报器

霍伊尔

编者按

在 20 世纪 60 年代，英格兰西部古老巨石阵的用途是大家非常关注和存在争议的问题。虽然第一个提出巨石阵是用于预测日月食的工具的人并非英国天文学家弗雷德·霍伊尔，但他在这里解释了在“奥布里环”代表黄道面（即太阳系的运行平面，所有行星都在这个平面内绕太阳运动）的前提下如何利用巨石阵更精确地预言日月食。

巨石阵可能是出于一个重要的天文目的而修建的，这一假设最近得到了霍金斯的支持。他指出^[1]，在该建筑的不同位置中存在着有天文学意义的准线。一些研究者曾质疑：在一个拥有如此多方位的布局中，这些准线是否应该被认为具有统计学上的显著性。最近我检验了霍金斯发现的所有准线。我认为这个布局不是随机的。正如霍金斯所指出的，有些位置与巨石阵的几何规律之间有特殊的关联，而主要的准线正是在这些特殊位置上发现的。其次，我还发现这些准线恰好就是能长期服务于天文学观测需要的准线，在本文中我会解释这一点。第三，根据更加细致的调查，在这些准线中看似存在的量级为 $\pm 1^\circ$ 的小偏差其实根本就算不上偏差。

在第二篇文章中^[2]，霍金斯又对早先的一个假说进行了研究，即认为巨石阵可能曾用于预报日月食。月球交点的回归周期为 18.61 年，这一周期在日月食分析中是非常重要的。霍金斯指出：有一个石标以每年 3 个洞的速率沿着由 56 个奥布里洞组成的圆周运动，旋转一周所用的时间恰好是 18.67 年。这和 18.61 年非常接近，因而说明月球交点的回归周期与奥布里洞的数量之间是存在相关性的。在这一点上我也同意霍金斯的观点。不过，我与他的分歧之处在于他所说的预测日月食的方式。显然，以下几条对其所持观点的反对意见看起来是合理的：

(1) 在我看来，假设奥布里洞仅仅是被用于计算 56 年的循环未免有点站不住脚。没有必要为了表示出 56 年的循环，而在这么大半径的圆周上以一定的间距建造 56 个洞。

(2) 很难解释古人是如何校准由霍金斯所提出的计算系统的。为了找到这一系统，他本人使用了已发生过的日月食的记录表。巨石阵的建造者们哪里会有这些在日月食发生之后才统计出的表格。

(3) The predictor gives only a small fraction of all eclipses. It is difficult to see what merit would have accrued to the builders from successful predictions at intervals as far apart as 10 years. What of all the eclipses the system failed to predict?

My suggestion is that the Aubrey circle represents the ecliptic. The situation shown in Fig. 1 corresponds to a moment when the Moon is full. The first point of Aries γ has been arbitrarily placed at hole 14. S is the position of the Sun, the angle $\odot$ is the solar longitude, M is the projection of the Moon on to the ecliptic, N is the ascending node of the lunar orbit, N' the descending node, and the centre C is the position of the observer. As time passes, the points S , M , N and N' move in the senses shown in Fig. 1. S makes one circuit a year. M moves more quickly, with one circuit in a lunar month. One rotation of the line of lunar nodes NN' is accomplished in 18.61 years. In Fig. 1, S and M are at the opposite ends of a diameter because the diagram represents the state of affairs at full Moon.

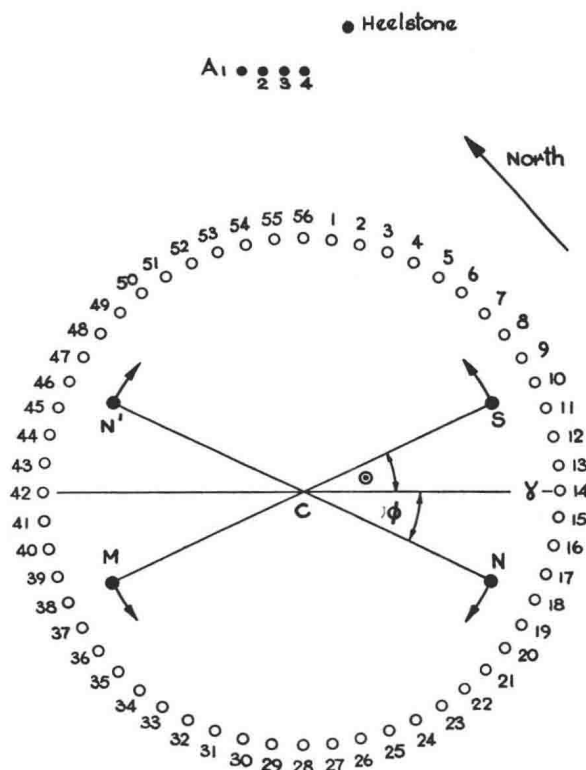


Fig. 1

If the Moon is at N , there is a solar eclipse if the Sun is within roughly $\pm 15^\circ$ of N , and a lunar eclipse if the Sun is within $\pm 10^\circ$ of N' . Similarly, if the Moon is at N' , there will be a solar eclipse if the Sun is within $\pm 15^\circ$ of coincidence with the Moon, and a lunar eclipse if it is within roughly $\pm 10^\circ$ of the opposite end of the line of lunar nodes. Evidently if we represent S , M , N and N' by markers, and if we know how to move the markers so as to

(3) 这种预报方法只预测出了全部日月食中很小的一部分。很难理解这些建造者们会因为成功预言间隔可达 10 年之久的日月食而得到什么好处。怎么解释那么多该系统没有预言出来的日月食呢？

我的观点是奥布里环代表了黄道。图 1 所示的位置对应于满月时的位置。任意取白羊座 γ 作为第一个点放在第 14 号洞处。 S 是太阳的位置， $\odot$ 角代表黄经， M 是月球在黄道面上的投影， N 是月球轨道的升交点， N' 为降交点，中心 C 是观测者所在的位置。随着时间的流逝， S 、 M 、 N 和 N' 点会按图 1 所示的方式运动。 S 每年转一圈。 M 运行得会更快一些，一个朔望月循环一周。两个月球交点所连成的直线 NN' 旋转一周的时间为 18.61 年。在图 1 中， S 和 M 位于一条直径的两端是因为这张图代表的是满月时的状态。

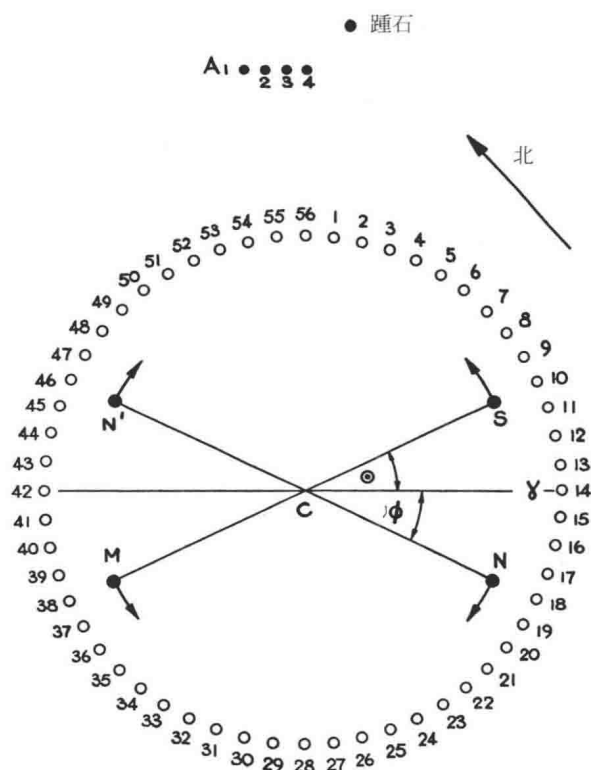


图 1

如果月球位于 N 点，那么当太阳在距离 N 点大致 $\pm 15^\circ$ 范围之内时就会发生一次日食；而当太阳在距离 N' 点 $\pm 10^\circ$ 范围之内时就会发生一次月食。同样，如果月球位于 N' 点，那么当太阳在距离月球位置 $\pm 15^\circ$ 范围之内时就会发生一次日食；而当太阳在距离两个月球交点连线的另外一端大致 $\pm 10^\circ$ 范围之内时就会发生一次月