



一九八七年九月二十三日

中国日环食观测研究文集

OBSERVATIONS AND STUDIES OF CHINA
ON ANNULAR SOLAR ECLIPSE OF
SEPTEMBER 23, 1987

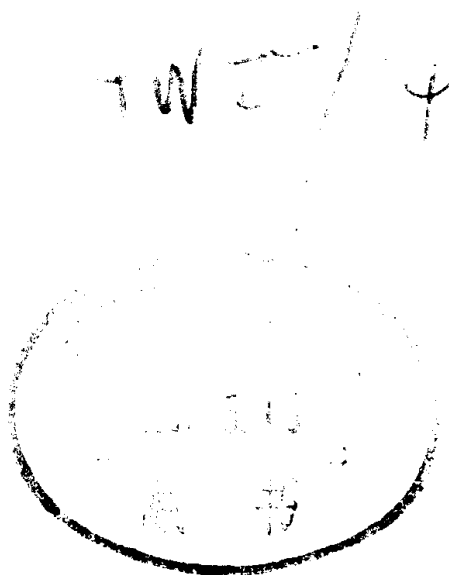
科学出版社

D182.2
ZGR

一九八七年九月二十三日

中国日环食观测研究文集

《中国日环食观测研究文集》编委会



科学出版社

1990

106633

内 容 简 介

1987年9月23日日环食主食带横贯我国大陆中部,这是自1941年以来难得的一次观测机会。为此,国家科学技术委员会和中国科学院组织了一次有射电、光学、电离层、日地物理、日射、气象等多学科的站网观测,取得了大量丰富而珍贵的观测资料。

本文集收集论文81篇,汇集了这次联测所得的各种实测结果,以及初步分析的论文报告和研究成果,可供太阳物理、空间物理、地球物理、电波传播、气象、水文等方面的科技工作者和高等院校有关专业师生参考,亦可作历史记录保存。

一九八七年九月二十三日 中国日环食观测研究文集

《中国日环食观测研究文集》编委会

责任编辑 方开文

科学出版社出版

北京东黄城根北街16号

邮政编码:100707

中国科学院印刷厂印刷

新华书店北京发行所发行 各地新华书店经售

*

1990年12月第一版 开本:787×1092 1/16

1990年12月第一次印刷 印张:35 1/2 插页:3

印数:001—580 字数:820 000

ISBN 7-03-001955-5/P·372

定价:38.00元



图1 太阳直接辐射、总辐射、散射辐射及分光谱辐射
观测仪器。(中国科学院地理研究所徐兆生 摄)

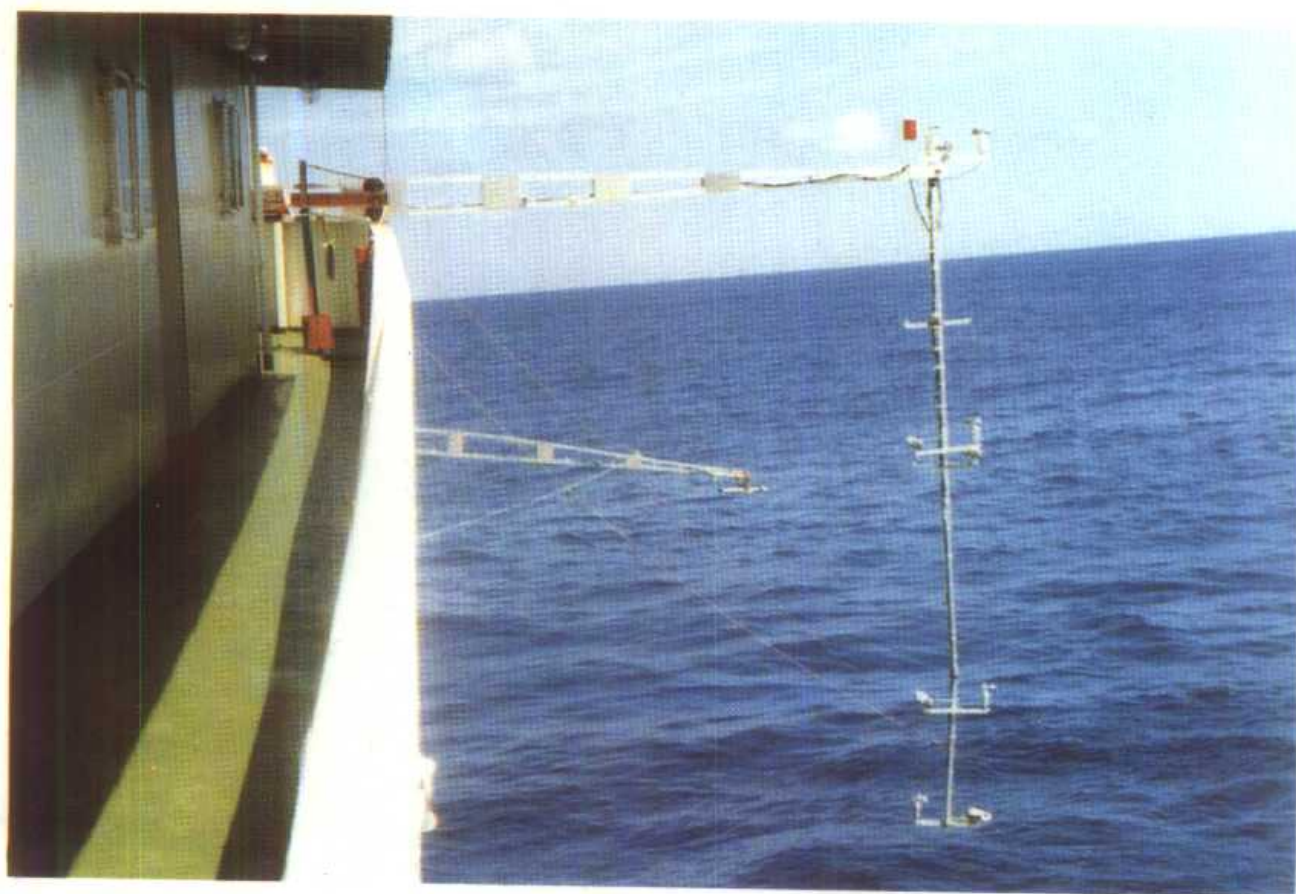


图2 洋面上不同高度风速及温度梯度观测仪器。(徐兆生 摄)

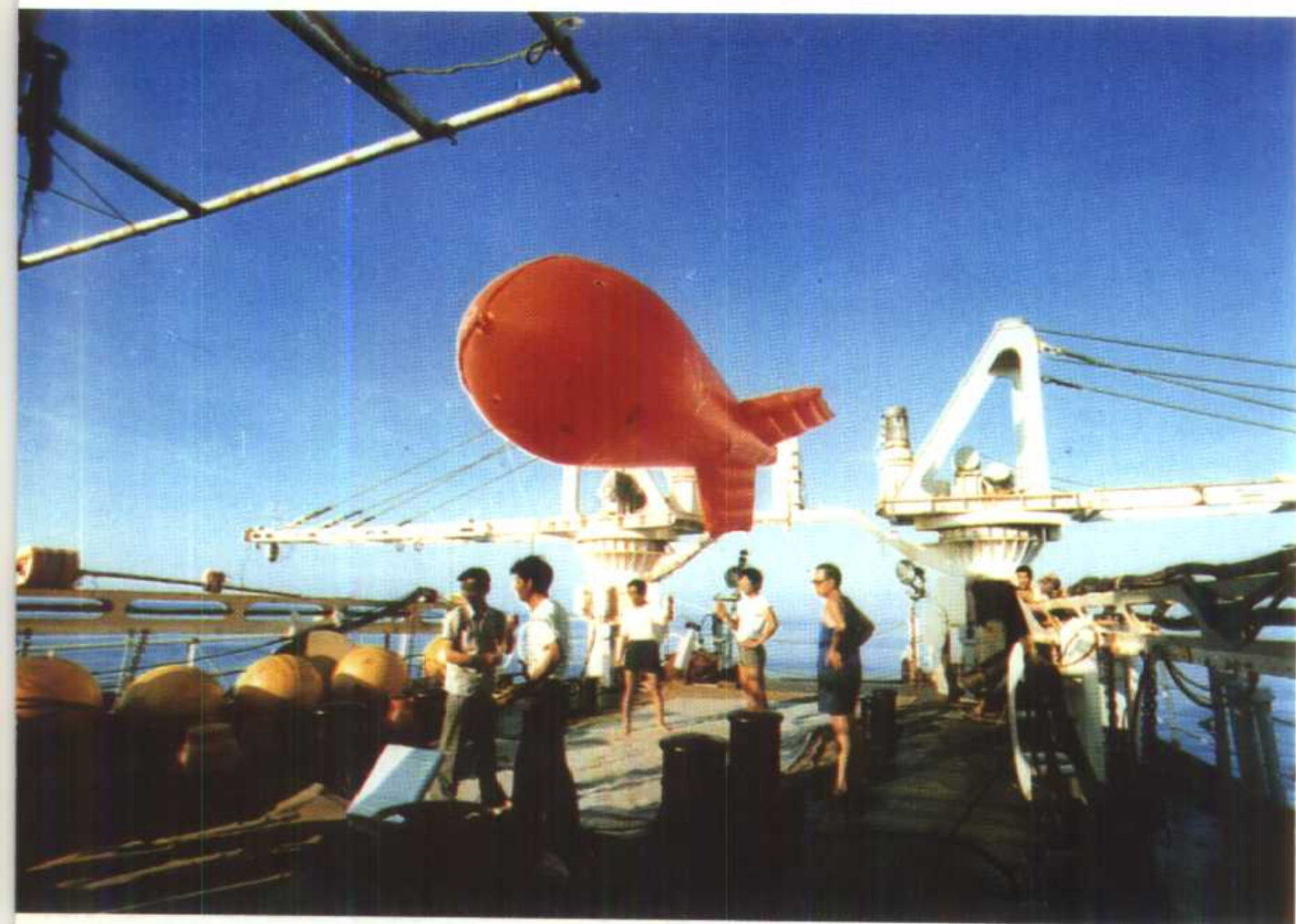


图3 系留气艇 5—800m 高空温度、风速、风向观测仪器。(徐兆生 摄)

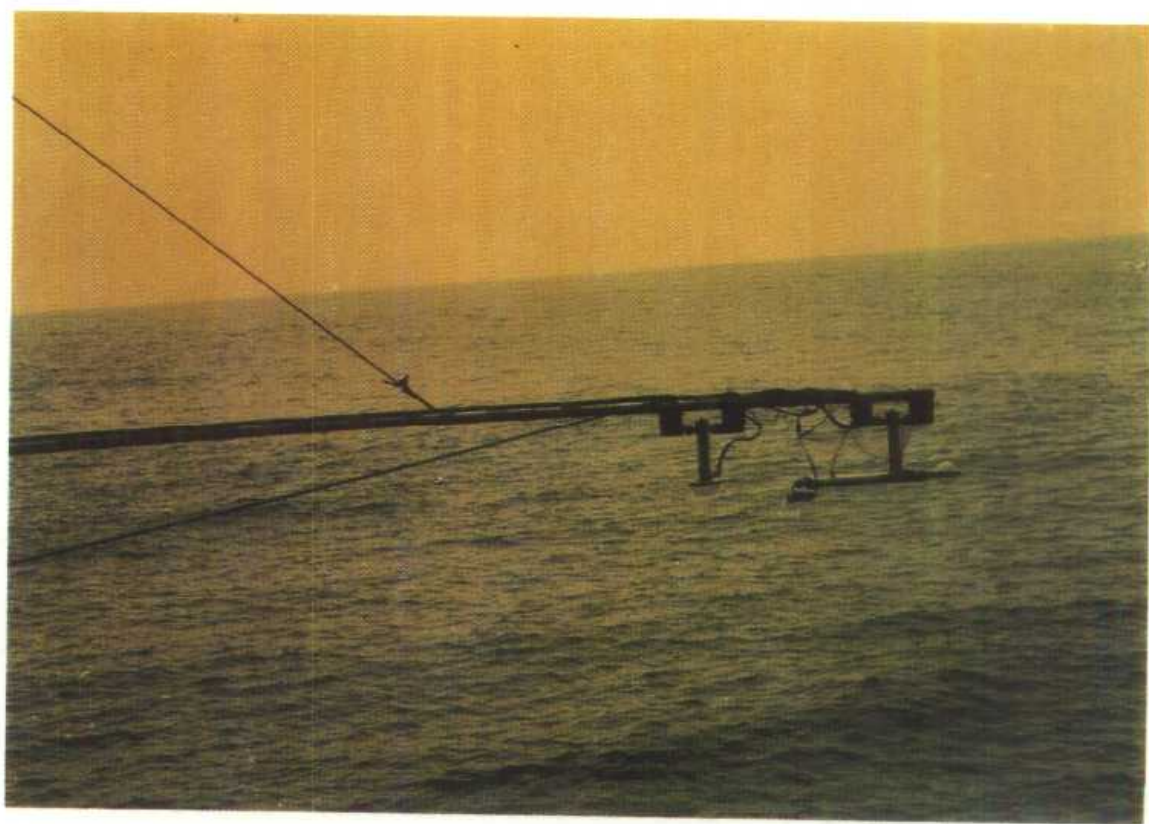


图4 洋面反射及洋面净辐射观测仪器。(徐兆生 摄)



图5 3500m 高空太阳辐射观测仪器。(黄河水利委员会水利科学研究所严忠信 摄)



图6 高空太阳辐射观测队。(严忠信 摄)

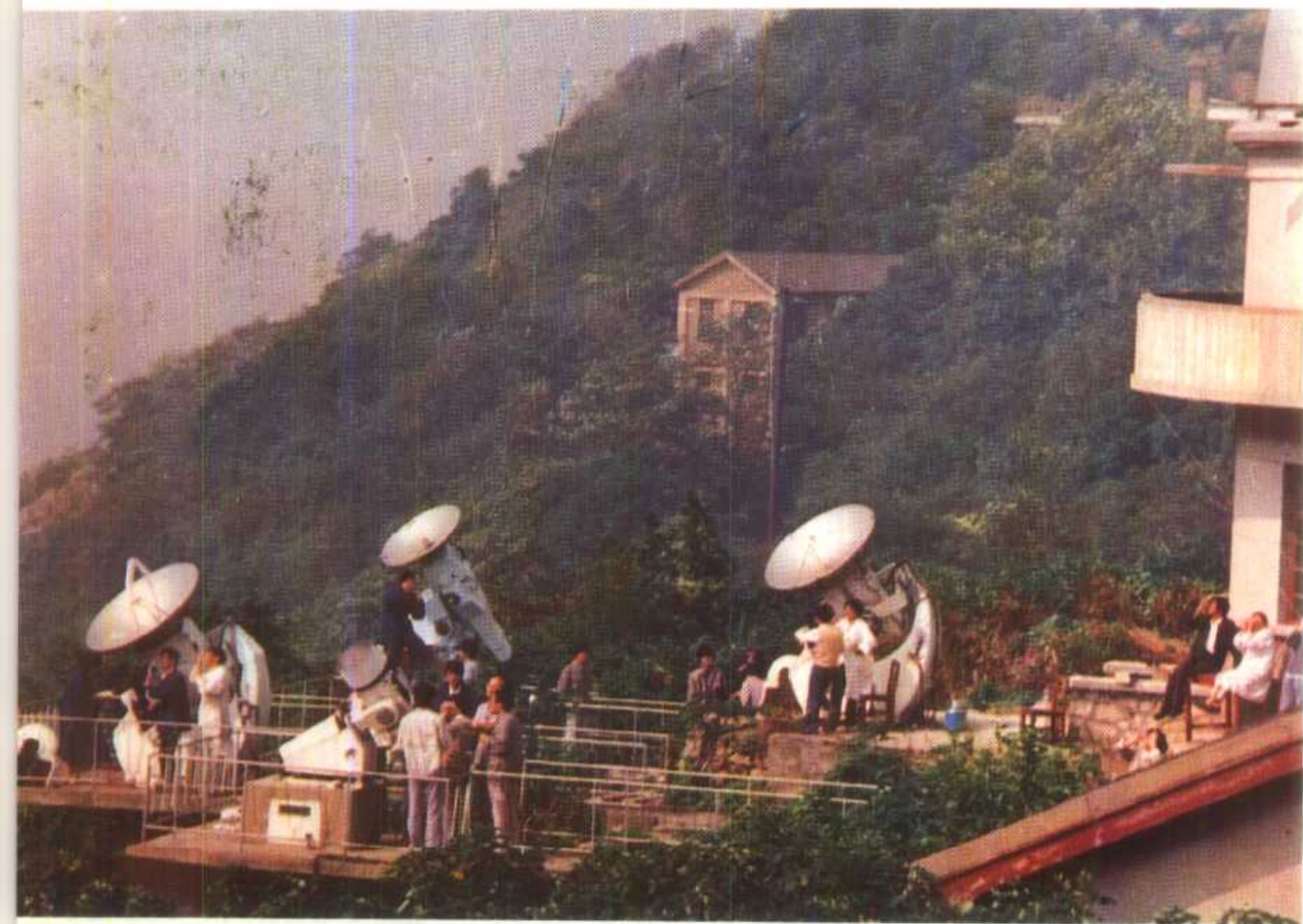


图7 日环食四波段射电联测。(中国科学院紫金山天文台唐永康 摄)



图8 日环食射电观测接收机和记录仪器。(唐永康 摄)

《中国日环食观测研究文集》编委会

主 编 陶诗言

副主编 万 籁 梁百先

编 委 (按姓氏笔画排列)

王 宜	王涌泉	刘 炎	纪树臣	庄洪春
肖 佐	李 钧	沈海璋	杜碧兰	邹进上
何友文	季国良	郑若霭	赵得秀	徐兆生
徐志根	翁笃鸣	傅立勋		

序 言

1987年9月23日日环食联合观测在国家科委和中国科学院组织下,在国家自然科学基金委员会和河南省人民政府支持下,由中国科学院、水利电力部、机械电子工业部、国家教育委员会、国家气象局、国家海洋局及国家地震局等部门所属的70多个单位的射电、光学、电离层、地磁、太阳辐射、气象等方面的199个台站及海洋科学考察船和观测飞机组成的观测网,经过周密的准备,认真的观测,已经圆满地完成了预定计划。这是我国日食观测史上一次规模大和成果多的观测。

这次日环食观测范围广,探测频谱宽。使用新的观测手段多,观测新项目也多。除对传统的重大科学理论有关的项目进一步积累丰富资料以外,同时更重视与国民经济有关的实际应用项目。对综合性的日地系统整体行为多学科联合观测也给予特别注意。因而取得了丰富的资料,有些是首次取得的新资料。这些资料不仅在中国科学史上有重要价值,在国际上也具有较大的意义,所以十分珍贵。

1988年1月4日至9日在北京召开了联合观测总结会议,决定对观测资料予以整理分析和出版,并在此基础上进一步开展多学科的联合研究,为此成立了1987年日环食观测成果编辑委员会。经过一年来的辛勤工作,射电及光学、电离层及日地物理、日射及气象等部分的资料分析处理已基本完成。本文集的出版将对我国高技术研究和太阳活动22周峰年联合观测研究产生积极的影响。希望今后对已取得的资料,继续深入分析研究,使我国日食观测和研究取得更大的进展。

周 光 召

1989年2月5日

PREFACE

Organized by the State Science and Technology Commission of China and the Chinese Academy of Sciences and supported by the National Natural Science Foundation of China and the People's Government of Henan Province, a coordinated observation on September 23, 1987 was successfully carried out. During the eclipse, a network was established for the acquisition of radio, optical, ionospheric, geomagnetic, solar radiation and meteorological data. It consisted of 199 observing land stations, an oceanic expedition ship and an airplane subordinate to 70 scientific research institutions from the Chinese Academy of Sciences, Ministry of Water Conservancy and Power, Ministry of Machinery and Electronics Industry, the National Education Commission, the State Bureau of Meteorology, the State Bureau of Oceanography and the State Bureau of Seismology. The observation was well prepared and attentively performed. It is a large-scale and fruitful solar eclipse observation.

With a wide range of disciplines, a broad frequency spectra, various new observational methods and many new observational programs, this observation not only further accumulated a wealth of data for the related traditional theoretical problems but also paid serious attention to the applied side which were relevant to the national economic development. Special attention was also paid to the multi-discipline observations of the comprehensive global characters of the solar-terrestrial system. These data are valuable to the progress of Chinese science and are also of scientific significance internationally.

A summing-up meeting for the observation was held in Beijing from January 4 to 9, 1988. An arrangement was made to analyze and publish the obtained data and to continue the multi-discipline studies. Accordingly an editorial board for the proceedings was established. Through one year's hard work the data reduction and analysis for the radio and optical, ionosphere and solar-terrestrial physics, and solar radiation and meteorological observations have been completed. The publication of these proceedings will produce positive influence on the research of high technology and the joint observation of the maximum year of the 22nd solar activity cycle. I hope that these valuable data will be further analyzed and studied in order to promote further progress of solar eclipse observations and researches in our country.

February 5, 1989

G. Zhou

目 录

序言.....	周光召 (xi)
---------	------------

(一)

日环食观测工作组织情况.....	日环食联合观测协调组 (1)
日环食观测研究成果综述.....	王涌泉 刘 炎 纪树臣 何友文 季国良 徐兆生 (3)
1987 年 9 月 23 日日环食的见食情况	何玉圉 (13)

(二)

1987 年日环食射电多波段联合观测的主要结果	刘 炎 纪树臣 (18)
昆明日偏食的射电多波段观测.....	纪树臣 杨荣邦 谢瑞祥 (39)
紫金山天文台 8.6mm 波段射电日食观测	
..... 孙九楨 徐之材 杨桂攀 梁镇猷 李 敏 周树荣 吴洪教 刘 炎 (47)	
1.46cm 波段的日环食射电观测研究.....	徐培源 赵银龙 (52)
2cm 波段射电望远镜的日偏食观测.....	
..... 高正民 霍采平 范 英 卞正旺 吴 俭 马开全 (59)	
2.56cm 波长的日偏食射电观测... 李煥矩 曾 文 张长清 黄润生 严云英 孟 萍 (66)	
紫金山天文台 3.2cm 波长的射电日食观测.....	
..... 周树荣 于兴凤 黄福泉 顾中元 温加新 赵爱娣 刘 炎 (72)	
南京大学 3.2cm 波长的射电日食观测.....	
..... 秦志海 江淑英 彭云楼 陈云霞 魏双林 毛昌莹 (79)	
利用 3.2cm 波长差瓣天线的射电望远镜观测日食.....	贾瑞进 王凤霞 赵益光 (86)
上海天文台 6cm 波长的日环食射电观测.....	季德盛 梁世光 秦德昌 孟 萍 (93)
波长 6cm 的日偏食射电观测.....	胡楚敏 李秀琴 武肖涛 (99)
昆明日偏食在波长 8.2cm 的射电观测.....	马 媛 纪树臣 陈国强 郭万辉 (101)
昆明日偏食在波长 10.6cm 的射电观测.....	纪树臣 杨开平 谢瑞祥 许 春 (106)
北京天文台 2840MHz 频率的日偏食射电观测	
..... 李小聪 刘绪昭 赵仁扬 金声震 王淑兰 马开全 (111)	
紫金山天文台 11.1cm 波段的射电日食观测	
..... 刘 炎 许富英 查德元 顾中元 樊忠玉 (117)	
昆明日偏食在波长 21.1cm 的射电观测.....	张 帆 纪树臣 赵日昇 (126)
1.42GHz 频率的射电日偏食观测	
..... 胡汉明 吕松泉 龚元芳 尚琼珍 施硕彪 纪树臣 (131)	
用米波动态频谱仪对一个日冕凝聚区掩食过程的观测.....	
..... 夏志国 陈敬英 闵茂林 郑向民 (135)	

日食的射电快速过程观测·····	高正民 秦志海 龚元芳 金声震 (143)
紫金山天文台多波段射电日食观测中双微机数据采集系统·····	顾中元 (147)
标准太阳半径改正数的测定·····	
·····	万 颖 赵君亮 储宗元 王如友 谈志祥 赵 刚 程宗颐 (155)
日食前后太阳黑子磁场的观测及其应用·····	
·····	罗先汉 严 昀 邓国祥 艾国祥 李 京 赵世清 (167)
昆明日偏食的光学观测·····	李琼英 李久康 马开全 赵世清 李 志 王洪照 (174)
紫金山天文台的日偏食光学观测·····	赵爱娣 樊忠玉 (181)
安阳日环食的白光照相观测及接触时刻的测定·····	孙锦龙 牛清海 赵建军 (187)
1987 年日环食射电多波段联合观测的资料分析方法要点·····	刘 炎 纪树臣 (191)

(三)

日环食对电离层总电子含量的影响·····	马健敏 龙其利 (204)
日环食期间卫星信标观测结果·····	雷源汉 张殿辉 叶冬英 梁百先 (209)
利用双频多普勒接收机观测日环食的电离层效应·····	刘培静 (213)
电离层总电子含量日环食的响应·····	刘选谋 刘荣道 江爱平 (217)
乌鲁木齐日环食电离层效应的观测与分析·····	李永生 何友文 (221)
上海日环食电离层特性·····	黄天锡 吴世才 杨承保 何 劲 郑 焰 (226)
日食对电离层特性参量的影响·····	张顺荣 杨承保 陈敬梧 (233)
广州站、海南站日食电离层效应观测与分析·····	何友文 (238)
短波天波雷达观测日环食电离层效应·····	焦培南 (245)
利用扫频后向散射法研究日环食的电离层效应·····	杨子杰 石振华 管荣生 (252)
日环食期间武汉电离层扰动观测·····	李 钧 万卫星 李利斌 吴振华 (262)
日环食期间电离层高频多普勒及 D 区吸收的连续监测·····	肖 佐 邹积清 张树礼 (267)
日食所致大气波动及其对电离层高频多普勒频移的影响·····	
·····	熊年禄 龙威灵 张训械 (271)
长波的日环食效应·····	何建良 张阿丽 (279)
日环食期间的 VLF 传播效应·····	赵协中 (283)
日环食对低频及甚低频电波传播的影响·····	
·····	潘炼德 苗永瑞 王发潮 王素琴 彭金凤 (290)
日环食对吱声和 VLF 电波传播的影响·····	彭丰林 董爱英 贺长明 (296)
日环食对短波授时的影响·····	陈洪卿 (300)
中层大气日食效应的研究·····	黄泽荣 沈 力 李文涛 (303)
日环食电离层吸收效应·····	黄庆铭 (308)
日环食期间地磁脉动观测资料的初步分析·····	王德驹 陈斯文 (312)
日环食期间的地磁效应·····	吴大传 赵正予 (318)
安阳日环食地磁效应的分析·····	刘长发 马石庄 徐元芳 杨永书 黄建中 (325)
日环食对地磁场光食效应的研究·····	马锦云 郭世琪 薛红宣 (331)
日环食的地磁效应·····	常方高 郭陶三 张金仓 (339)

日食与地球磁场扰动的关系·····	战淑芸 杨淑瑞 林玉英 赵得秀 (344)
宇宙线高频闪烁的初步研究·····	叶宗海 冯珠玛 朱邦耀 龚菊红 赵碧霞 (349)
日环食引起的低平流层和高对流层大气变化·····	秦国泰 马瑞平 田剑华 钟剑峰 (357)
日环食所产生的大气内重力波·····	谢金来 杨训仁 李启泰 (364)
日食期间地面大气电观测·····	·····庄洪春 罗福山 王迺权 牟 军 高 铭 叶晓蔚 张 健 (370)

(四)

日环食过程中的太阳辐射变化·····	季国良 江 灏 (382)
日环食对地面气象要素及大气环流的影响·····	江 灏 季国良 (391)
日环食期间太阳辐射的飞机观测·····	周克前 李汉侠 (398)
日环食期间太阳辐射能谱观测与分析·····	沈龙翔 高 锋 程广南 朱翠莲 (404)
日环食对太阳辐射和地面气象要素的影响·····	孙锦龙 赵自胜 牛清海 (408)
日食期间郑州辐射观测结果的分析·····	周克前 王庭梧 吴聆益 (416)
日食对太阳辐射影响的初步分析·····	张 敏 (422)
安徽宿县日食期间地面太阳辐射和气象要素的测量·····	项月琴 李建京 (426)
日环食期间山东禹城的太阳辐射特征·····	谢贤群 (436)
日环食期间山东禹城的近地面气象要素变化特征·····	谢贤群 (444)
北京日食期间太阳辐射的观测·····	周允华 赵文广 (451)
日食期间香河地区辐射和气象要素的变化·····	许 黎 (459)
香河地区日食期间的大气浑浊度·····	许 黎 (466)
日环食臭氧总量观测记要·····	赵延亮 (472)
日环食期间地面臭氧和太阳辐射·····	孔琴心 (475)
南京地面气象要素的日环食效应·····	王月莲 朱诗武 白晓华 (480)
日食对太阳辐射的影响·····	孙卫国 缪启龙 吴 惠 曾宪宁 顾映欣 (485)
日环食期间太阳辐射光谱变化分析·····	吴 惠 曾宪宁 孙卫国 缪启龙 (494)
西太平洋日环食过程中太阳辐射、海洋气象观测及其日食效应的分析·····	徐兆生 (499)
日环食大气重力波观测分析·····	朱诗武 王月莲 (508)
日食引起大气重力波的探讨·····	金一诤 (514)
日环食对全国太阳辐射影响的分析·····	缪启龙 曾宪宁 徐志根 时建华 (521)
日环食期间我国地面气象要素概况分析·····	吴 惠 徐志根 (529)
日食对下垫面温度的影响·····	董振国 (535)
植物气孔导性对日食的响应·····	王 宏 (542)
附录 日环食观测项目一览表·····	(547)

封面为日环食时出现的贝利珠,中国科学院上海天文台观测队摄。

CONTENTS

Preface.....	<i>Zhou Guangzhao</i> (ix)
--------------	------------------------------

PART ONE

The whole organizing course of observations of the annular solar eclipse	 <i>Coordinating group of joint observations of the annular solar eclipse</i> (1)
The overview of the results of observations and studies of the annular solar eclipse	<i>Wang Yongquan, Liu Yan, Ji Shuchen, He Youwen, Ji Guoliang, Xu Zhaosheng</i> (3)
The circumstances of the annular eclipse on September 23, 1987.....	<i>He Yunan</i> (13)

PART TWO

The main results of the multi-frequency joint radio observations of the annular solar eclipse in 1987	<i>Liu Yan, Ji Shuchen</i> (18)
Multi-frequency radio observations of the partial solar eclipse in Kunming	<i>Ji Shuchen, Yang Rongbang, Xie Ruixiang</i> (39)
Radio observation of the solar eclipse at 8.6 mm wavelength at PMO	<i>Sun Jiuzhen, Xu Zhicai</i>
<i>Yang Guipan, Liang Zhenyou, Li Min, Zhou Shurong, Wu Hong'ao, Liu Yan</i> (47)	
Radio observation and study of the annular solar eclipse' at 1.46 cm wavelength	<i>Xu Peiyuan, Zhao Yinlong</i> (52)
The observation with a radiotelescope at $\lambda = 2$ cm during the partial solar eclipse	<i>Gao Zhengmin, Huo Caiping, Fan Ying, Bian Zhengwang, Wu Jian, Ma Kaiquan</i> (59)
Radio observation of the partial solar eclipse at 2.56 cm wavelength	<i>Li Huanju, Zeng Wen, Zhang Changqing, Huang Runsheng, Yan Yunying, Meng Ping</i> (66)
Radio observation of the solar eclipse at 3.2 cm wavelength at PMO	<i>Zhou Shurong, Yu Xingfeng, Huang Fuquan, Gu Zhongyuan, Wen Jiaxin, Zhao Aidi, Liu Yan</i> (72)
Radio observation of the solar eclipse at 3.2 cm wavelength at Nanjing University.....	<i>Qin Zhihai, Jiang Shuying, Peng Yunlou, Chen Yunxia Wei Shuanglin, Mao Changjian</i> (79)
Radio observation of the solar eclipse at 3.2 cm wavelength using an antenna with differeme pattern	<i>Jia Ruijin, Wang Fengxia, Zhao Yiguang</i> (86)
Radio observation of the annular solar eclipse at Shanghai Observatory at 6 cm wavelength.....	<i>Ji Desheng, Liang Shiguang, Qin Dechang, Meng Ping</i> (93)
Radio observation of the partial solar eclipse at 6 cm wavelength	<i>Hu Chumin, Li Xiuqin, Wu Xiaotao</i> (99)
Radio observation of the partial solar eclipse at 8.2 cm wavelength at Kunming	<i>Ma Yuan, Ji Shuchen, Chen Guoqiang, Guo Wanhui</i> (101)

- Radio observation of the partial solar eclipse at 10.6 cm wavelength at Kunming *Ji Shuchen, Yang Kaiping, Xie Ruixiang, Xu Chun* (106)
- Radio observation of the partial solar eclipse at 2840 MHz frequency at Beijing Astronomical Observatory *Li Xiaocong, Liu Xuzhao, Zhao Renyang, Jin Shengzhen, Wang Shulan, Ma Kaiquan* (111)
- Radio observation of the solar eclipse at 11.1 cm wavelength at PMO *Liu Yan, Xu Fuying, Zha Deyuan, Gu Zhongyuan, Fan Zhongyu* (117)
- Radio observation of the partial solar eclipse at 21.1 cm wavelength at Kunming *Zhang Fan, Ji Shuchen, Zhao Risheng* (126)
- Radio observation of the partial solar eclipse at 1.42 GHz frequency *Hu Hanming, Lü Songquan, Gong Yuanfang, Shang Qiongzhen, Shi Shuobiao, Ji Shuchen* (131)
- Observation of a coronal condensation region with a radio-spectrometer at metric wavelength band during the eclipse *Xia Zhiguo, Chen Jingying, Min Maolin, Zheng Xiangmin* (135)
- Radio quick sampling observation during the solar eclipse *Gao Zhengmin, Qin Zhihai, Gong Yuanfang, Jin Shengzhen* (143)
- Dual-microcomputer digital collection system used in radio observation of the solar eclipse at the multiple wavelengths at PMO *Gu Zhongyuan* (147)
- Determination of correction to the standard solar radius *Wan Lai, Zhao Junliang, Chu Zongyuan, Wang Ruyou, Tan Zhixiang, Zhao Gang, Cheng Zongyi* (155)
- Observations of sunspot magnetic field around the solar eclipse and their applications *Luo Xianhan, Yan Xu, Deng Guoxiang, Ai Guoxiang, Li Jing, Zhao Shiqing* (167)
- Optical observations of the partial solar eclipse at Kunming *Li Qiongying, Li Jiukang, Ma Kaiquan, Zhao Shiqing, Li Zhi, Wang Hongzhao* (174)
- Optical observations of the partial solar eclipse at PMO *Zhao Aidi, Fan Zhongyu* (181)
- White-light photographic observation and determination of the contact moments at Anyang *Sun Jinlong, Niu Qinghai, Zhao Jianjun* (187)
- The main points of data analysis for the multi-frequency joint radio observations of the annular solar eclipse in 1987 *Liu Yan, Ji Shuchen* (191)

PART THREE

- The effect of the annular eclipse on the ionospheric total electron content *Ma Jianmin, Long Qili* (204)
- The satellite beacon observation results during the annular solar eclipse *Lei Yuanhan, Zhang Dianhui, Ye Dongying, Liang Baixian* (209)
- Ionospheric effects observed using the Doppler receiver of double frequency during the annular solar eclipse *Liu Peijing* (213)
- Response of the total electron content on the annular solar eclipse *Liu Xuanmou, Liu Rongdao, Jiang Aiping* (217)
- Observation and analysis of ionospheric effects during the annular eclipse at Urumqi *Li Yongsheng, He Youwen* (221)

Ionospheric characteristics over Shanghai during the annular solar eclipse	
.....	<i>Huang Tianxi, Wu Shicai, Yang Chengbao, He Jin, Zheng Yan</i> (226)
The effects of the annular eclipse on the ionospheric characteristic parameters	
.....	<i>Zhang Shunrong, Yang Chengbao, Chen Jingwu</i> (233)
Observation and analysis of ionospheric effects of the solar eclipse at Guangzhou and Hainan	
.....	<i>He Youwen</i> (238)
The observation of ionospheric effects during the annular eclipse by the sky-wave radar at short wave	
.....	<i>Jiao Peinan</i> (245)
A sweep-frequency backscatter study of the annular solar eclipse effects on the ionosphere	
.....	<i>Yang Zijie, Shi Zhenhua, Guan Rongsheng</i> (252)
Observation of ionospheric disturbances during the annular eclipse at Wuhan	
.....	<i>Li Jun, Wan Weixing, Li Libin, Wu Zhenhua</i> (262)
A continuous monitoring of the ionosphere by means of HF Doppler Shift and D-region absorption during the annular eclipse	
.....	<i>Xiao Zuo, Zou Jiqing, Zhang Shuli</i> (267)
The atmospheric wave produced during the annular eclipse and its effects on HF Doppler shift of the ionosphere	
.....	<i>Xiong Nianlu, Long Xianling, Zhang Xunxie</i> (271)
The effects of the annular solar eclipse on the LF radio wave propagation	
.....	<i>He Jianliang, Zhang Ali</i> (279)
The effect of the VLF propagation during the annular eclipse	
.....	<i>Zhao Xiezhong</i> (283)
The influence of the annular solar eclipse on the propagation of the LF-VLF radio waves	
.....	<i>Pan Liande, Miao Yongrui, Wang Fachao, Wang Suqin, Peng Jinfeng</i> (290)
The effect of the annular eclipse on tweek and VLF wave propagation	
.....	<i>Peng Fenglin, Dong Aiyang, He Changming</i> (296)
The influence of the annular eclipse on the shortwave timing	
.....	<i>Chen Hongqing</i> (300)
Study of the middle atmospheric disturbance during the annular eclipse	
.....	<i>Huang Zerong, Shen Li, Li Wentao</i> (303)
Ionospheric absorption effects during the annular eclipse	
.....	<i>Huang Qingming</i> (308)
A preliminary analysis of the geomagnetic pulsations during the annular eclipse	
.....	<i>Wang Deju, Chen Siwen</i> (312)
Geomagnetic effect during the annular eclipse	
.....	<i>Wu Dachuan, Zhao Zhengyu</i> (318)
An analysis of the effect on geomagnetic field of the annular eclipse at Anyang	
.....	<i>Liu Changfa, Ma Shizhuang, Xu Yuanfang, Yang Yongshu, Huang Jianzhong</i> (325)
Solar optical eclipse effects of geomagnetic field during the annular eclipse	
.....	<i>Ma Jinyun, Guo Shiqi, Xue Hongxuan</i> (331)
The effect of the annular eclipse on the geomagnetic field	
.....	<i>Chang Fanggao, Guo Taosan, Zhang Jincang</i> (339)
The relationship between the solar eclipse and the geomagnetic disturbance	
.....	<i>Zhan Shuyun, Yang Shurui, Lin Yuying, Zhao Dexiu</i> (344)

Preliminary study of cosmic ray scintillations at high frequency	
..... <i>Ye Zonghai, Feng Zhuma, Zhu Bangyao, Gong Juhong, Zhao Bixia</i>	(349)
The influence of an annular eclipse on the upper troposphere and lower strato-	
sphere..... <i>Qin Guotai, Ma Ruiping, Tian Jianhua, Zhong Jianfeng</i>	(357)
On the atmospheric gravity waves during the annular eclipse	
..... <i>Xie Jinlai, Yang Xunren, Li Qitai</i>	(364)
Observation of atmospheric electricity during the annular eclipse on ground ...	
..... <i>Zhuang Hongchun,</i>	
<i>Luo Fushan, Wang Naiquan, Mou Jun, Gao Ming, Ye Xiaowei, Zhang Jian</i>	(370)

PART FOUR

The variation of solar radiation during the annular solar eclipse	
..... <i>Ji Guoliang, Jiang Hao</i>	(382)
The influence of the annular solar eclipse on the surface meteorological ele-	
ments and the atmospheric general circulation <i>Jiang Hao, Ji Guoliang</i>	(391)
Airplane observation of solar radiation during the annular solar eclipse	
..... <i>Zhou Keqian, Li Hanxia</i>	(398)
Observation and analysis of the solar direct radiation and spectrum data during	
the annular solar eclipse.....	
..... <i>Shen Longxiang, Gao Feng, Cheng Guangnan, Zhu Cuilian</i>	(404)
The influence of the annular solar eclipse on the solar radiation and the sur-	
face meteorological elements <i>Sun Jinlong, Zhao Zisheng, Niu Qinghai</i>	(408)
An analysis of solar radiation observed at Zhengzhou during the solar eclipse	
..... <i>Zhou Keqian, Wang Tingwu, Wu Lingyi</i>	(416)
A preliminary analysis of solar radiation during the solar eclipse	
..... <i>Zhang Min</i>	(422)
Observations of solar radiation and meteorological elements near ground surface	
during solar eclipse at Suxian County, Anhui Province	
..... <i>Xiang Yueqin, Li Jianjing</i>	(426)
The characteristics of the solar radiation at Yucheng, Shandong Province	
..... <i>Xie Xianqun</i>	(436)
The characteristics of the meteorological factors near the ground surface at	
Yucheng, Shandong Province..... <i>Xie Xianqun</i>	(444)
Observations of solar radiation during the solar eclipse at Beijing	
..... <i>Zhou Yunhua, Zhao Wenguang</i>	(451)
The variation of solar radiation and meteorological elements during the solar	
eclipse at Xianghe region	
..... <i>Xu Li</i>	(459)
Atmospheric turbidity at Xianghe region during the solar eclipse	
..... <i>Xu Li</i>	(466)
Observation of total content of ozone during the annular solar eclipse	
..... <i>Zhao Yanliang</i>	(472)
Ground ozone and solar radiation during the annular solar eclipse	
..... <i>Kong Qinxin</i>	(475)
The effect of the annular solar eclipse on the surface meteorological elements	
in Nanjing region..... <i>Wang Yuelian, Zhu Shiwu, Bai Xiaohua</i>	(480)
The influence of the solar eclipse on solar radiation	
..... <i>Sun Weiguo, Miao Qilong, Wu Xi, Zeng Xianning, Gu Yingxin</i>	(485)