

# 苔藓植物生物学

吴鹏程 主编



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## 内 容 简 介

全书共 17 章,就世界范围包括南极大陆在内的苔藓植物为研究对象,系统地介绍苔藓植物的分类、形态、细胞染色体、孢子形态、生理生化、分子生物、繁殖特性、组织培养、化学成分、生理生态、群落、区系与地理分布、化石、与环境的关系及经济用途。

本书供植物学、植物化学、林学、南极研究、环境科学工作者和大专院校有关专业师生参考。

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谨以此书献给  
中国苔藓植物学的奠基者  
——陈邦杰教授

Dedicated to  
Professor CHEN PANCHIEH.  
The Founder of Chinese Bryology

## 编写分工表

序	曾呈奎(中国科学院院士、中国科学院海洋研究所名誉所长)
前言	吴鹏程(中国科学院植物研究所研究员)
第一章	吴鹏程(中国科学院植物研究所研究员)
第二章	吴鹏程(中国科学院植物研究所研究员)
第三章	罗健馨(中国科学院植物研究所研究员)
第四章	张玉龙(中国科学院植物研究所研究员)
第五章	洪德元(中国科学院院士、中国科学院植物研究所研究员)
第六章	施定基(中国科学院植物研究所研究员)
第七章	施定基(中国科学院植物研究所研究员)
第八章	李燕红(美国密歇根理工大学博士)
第九章	何关福(中国科学院植物研究所研究员)
第十章	贾渝(中国科学院植物研究所助理研究员)
第十一章	汪楣芝(中国科学院植物研究所高级实验师)
第十二章	李燕红(美国密歇根理工大学博士)
第十三章	胡舜士(中国科学院植物研究所研究员)
第十四章	吴鹏程(中国科学院植物研究所研究员)
第十五章	陶君容 吴鹏程(中国科学院植物研究所研究员)
第十六章	赖明洲(台湾东海大学教授,兼中国科学院植物研究所系统进化开放实验室客座研究员)
第十七章	吴鹏程(中国科学院植物研究所研究员)

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- Preface Wu Pengcheng (Professor, Institute of Botany, Academia Sinica)
- Chapter 1. Wu Pengcheng (Professor, Institute of Botany, Academia Sinica)
- Chapter 2. Wu Pengcheng (Professor, Institute of Botany, Academia Sinica)
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- Chapter 5. Hong Deyuen (Member of the Academy of Sciences, Director of Laboratory of Systematic and Evolution Botany, Institute of Botany, Academia Sinica)
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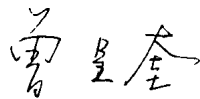
# 序

在植物界,苔藓植物历来被认为系一类由水生生活转为陆生生活过渡型的植物类群。目前地球上包括南极在内除 5 000 米以上高山及海洋外均可见苔藓植物的踪迹。

人类对苔藓植物的认识至少已有数百年的历史,直至 19 世纪末期至 20 世纪初期植物学家对苔藓植物才有比较科学系统的了解。半个多世纪以来,对苔藓植物的认识,开始从不同分支学科角度来研究,一门综合性研究苔藓植物的学科苔藓植物生物学开始产生。苔藓植物学家已不仅继续在发现新的分类群和一些形态特性,并且着手研究其次生代谢物质、细胞核型及至光合作用机制。在传统园艺上,苔藓植物仍然是极佳应用材料,但它们对大气污染的敏感指示,及至五倍子生产的冬寄主方面均显示着苔藓植物对人类的贡献。值得注意的,迄今苔藓植物的起源问题仍然是植物科学中一个重大的谜。

随着新的世纪的临近,人们已注意到 21 世纪将是一个生物学世纪,苔藓植物作为一个门类如何显示它的学科作用已不容忽视。我国在半个多世纪前以陈邦杰先生为代表的老一代苔藓植物学家率先开展了该学科的研究,培养了一批人才,为苔藓植物学成为一门独立的学科在我国的发展奠定了基础。最近 10 年来,苔藓植物的一些分支学科已在中国获得较大发展,然而仍须承认与国际上相比较,我国苔藓植物研究的一些分支学科水平存在较大差距。这就为中国苔藓植物学界提出一个迫切的任务,即如何来沟通国内与国外交流从而促进我国苔藓学科发展,以缩小这一差距。因此,一本能反映出当前苔藓植物研究水平的含有目前主要研究分支学科的专著显得极为重要。以中国科学院植物研究所各学科专家为骨干,联合台湾和海外学者共同编著一本中文本苔藓植物生物学专著是我国苔藓学科的一个创举。希望此书的出版能达到以下几个方面目标:一、推动中国苔藓植物学研究进入一个新的时期;二、向国际苔藓界显示我国极其丰富的苔藓植物资源的特色;三、为促使我国苔藓植物研究融入国际苔藓研究作出贡献。

中国孢子植物志编辑委员会主编  
中国科学院海洋研究所名誉所长  
中国科学院院士



1997 年 5 月

## FOREWORD

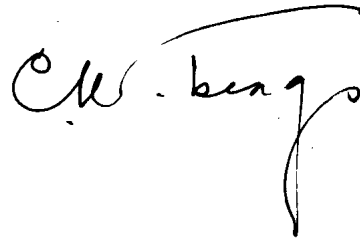
In the plant kingdom, bryophytes are recognized as organisms occupying habitats between the aquatic and the terrestrial living conditions. Recently, with the exception of the ocean and land above 5,000 meters altitude bryophytes can be found worldwide, including the Antarctica.

People have known bryophytes for hundreds of years. From the end of the nineteenth century to the beginning of twentieth botanists began to have relatively scientific systematic knowledge on bryophytes. For fifty years our understanding of bryophytes began to branch out to various angles. A comprehensive research science of bryophytes, bryological biology is established. Bryologists are not only to continue to discover new taxa and to describe some morphological characters of bryophytes, but they are also interested in the secondary metabolic chemistry, nuclear types and the mechanism of photosynthesis. However, in traditional horticulture bryophytes are still the best useful materials. In being a sensitive indicator to air pollution and the winter hosts in the production of gallnuts, the bryophytes have shown great contributions to mankind. It is also worthy of note that the origin of bryophytes is still a big scientific myth.

Following the approaching of the new century, people have recognized that the twenty-first century will be an era of biology. How can bryology magnify its scientific effect as an independent subject should not be overlooked. Half a century ago, represented by the late Professor Chen Panchieh, the former generation of Chinese botanists started to investigate mosses and liverworts. They have trained a group of leading bryologists and established the foundation for bryology to be an independent branch of science in China. In the recent decade, some branches of bryology have achieved relatively eminent development in China. However, we have to accept the fact that in comparison with the international standard there is still a large gap in our achievement.

This condition creates an urgent responsibility to the Chinese Bryological Society, in the effort to improve Chinese bryology and to shorten the research gap, through national and international communication. Consequently, a special publication which reflects the standard of current research and contains most of the main fields of bryology is very important. The major portion of this report was done by members of the Institute of Botany, Chinese Academy of Sciences. In collaboration with bryologists in Taiwan and specialists abroad, a special monograph on Chinese bryology, is a creative new work. We sincerely hope that the publication of this book would reach these goals:

1. To push the scientific research of Chinese bryology into a new period; 2. to exhibit the rich bryological resources of China; 3. To stimulate the research of Chinese bryology to enter the "melting pot" of knowledge in international bryology.

A handwritten signature in black ink, appearing to read 'C. K. Tseng'. The signature is fluid and cursive, with a long, sweeping underline that extends to the right and then curves downwards.

Tseng, C. K. (Zeng Chengkui)

Chief Editor of the Editorial Committee  
of the Cryptogamic Flora of China

Honorary Director of the Institute of Oceanography,  
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# 前 言

人类研究苔藓植物至少已有数百年的历史,但是,从多学科角度开展苔藓植物的研究还仅仅是半个多世纪之前。Frans Verdoorn 在 1932 年出版了名为《苔藓植物学手册》(Manual of Bryology)的专著,在这本书中首次介绍了苔藓植物学的 8 个分支学科,可以认为这是世界上第一本苔藓植物生物学专著。1981 年 D. H. S. Richardson 编写了《苔藓植物生物学》(The Biology of Mosses),书中简要地叙述了苔藓植物化石、水分和温度对苔藓植物光合作用的影响、形态特征以及与环境 and 人类之间的关系等。在《苔藓植物学手册》出版半个世纪以后,1983 年 Rudolf M. Schuster 组织了当代苔藓植物界的一些著名学者综合了最近数十年来的研究进展出版《新苔藓植物学手册》(New Manual of Bryology);其内容明显比先前出版的手册有了较大的提高,苔藓植物学的大部分分支学科被包含在此套上下两册巨著中。近年来以苔藓植物学进展或以系统苔藓植物学为名的一些专著,也介绍了苔藓植物学不同领域研究的新进展。这些著作各有其特色,为由不同学者发挥自己研究特长的集体合作。可是,迄今还没有一本书能全面反映全球范围内苔藓植物各学科的研究现状,并把它们融会贯通。另一方面,从国内植物学教科书内容来看,过去介绍给学生们的苔藓植物学基本知识,长期以来一直受传统的框框所束缚。纵观国内外苔藓植物目前研究状况,编写一本介绍当今以苔藓植物为研究对象、反映 90 年代的学术水平的专著确有必要,这是作者们编写本书的初衷。

我国目前从事苔藓植物的研究课题几乎百分之九十以上是经典分类学。然而,国内的植物细胞学家、植物生理学家、植物化学家、植物生态学家、古植物学家、孢粉学家们却已有兴趣于开展苔藓植物多学科的研究,因此,委托他们编写各有关章节使本书更富有学术性和权威性。

本著作旨在介绍世界上现已开展的有关苔藓植物各分支学科的研究现状,因此,书内所引证的材料力求包括最新的文献,但凡在学术上具有意义的材料,无论其发表年代的迟早仍然加以引用。书内各章均为一专门的分支学科,可各自独立成文。为使读者能掌握其全貌,各章除介绍主要内容外,分别扼要叙述各分支学科的研究历史,讨论有关分支学科对阐明苔藓植物进化上的意义,并附有关文献,从而使全书贯穿一个主题即苔藓植物的系统与进化。但因本书篇幅所限,不可能把现有有关的苔藓植物分支学科文献加以逐一引证,凡近似的文献均择其代表为例。

本书的撰写和出版得到国内外许多学者的指导、支持及帮助,中国科学院植物研究所王文采院士、汤彦承教授,上海复旦大学生命科学院教授兼上海自然博物馆植物馆馆长徐炳声教授和中国科学院孢子植物志编辑委员会常务副主编、中国科学院微生物研究所真菌地衣开放实验室学术委员会主任魏江春院士给予了指导并提出宝贵的意见。中国科学院植物研究所植物系统进化开放实验室主任洪德元院士在百忙中为本书精心撰写了苔藓植物的细胞染色体章节。台湾东海大学园景系赖明洲教授结合自己的教学和研究经验,专

门写了苔藓植物对环境的指示章节。何思博士和曾昭梅博士曾参与本书编写的初期工作。

本书还承美国密歇根理工大学李燕红博士执笔苔藓植物的生理生态和苔藓植物的群落两章节。中国科学院植物研究所学术委员会主任匡廷云院士和内蒙古大学草原研究所所长李博院士积极指导和支持本书的编著。本书整个工作得到中国科学院植物研究所领导及植物分类与植物地理研究室和植物标本馆领导的积极支持,所图书馆提供丰富的资料和书籍。在本书编著过程中,部分研究获国家自然科学基金委员会基金、中国科学院植物区系研究特别支持费以及国家南极委员会的资助。对此,一并表示衷心感谢。

书内大量丰富材料的引用和编著获得美国密苏里植物园主任、中国科学院院士 Peter H. Raven 博士、美国密歇根技术大学 Janice Glime 博士、英国 Reading 大学 R. E. Longton 博士、芬兰赫尔辛基大学 Timo Koponen 博士、加拿大阿尔卑特大学 D. H. Vitt 博士、美国密苏里植物园 M. R. Crosby 博士、R. E. Magill 博士、B. Allen 博士、美国密歇根大学 H. A. Crum 博士、美国田纳西大学 A. J. Sharp 博士、美国杜克大学 L. E. Anderson 博士、美国亨特利隐花植物实验室 R. M. Schuster 博士、美国纽约植物园 W. R. Buck、美国哈佛大学 B. C. Tan 博士、美国密苏里西南州立大学 P. L. Redfearn, Jr. 博士、美国伊利诺伊州立大学 B. Crandall-Stotler 和 R. Stotler 博士、德国植物生物化学研究所 S. Huneck 博士、德国弗里奇-席勒大学 R. Grolle 博士、德国波恩大学 J. -P. Frahm、德国哥丁根大学 S. R. Gradstein 博士、日本服部植物研究所 Zen. Iwatsuki 所长、日本广岛大学 H. Ando 博士、H. Deguchi 博士、日本 Takushima Bunri 大学药物研究所 Y. Asakawa 所长、日本东京极地研究所 H. Kanda 博士、荷兰莱顿大学标本馆 A. Touw 博士、B. O. van Zanten 博士以及澳大利亚南极委员会 R. D. Seppelt 博士的帮助和支持,谨一并致以深切的谢意。本书内的插图承田新智、郭木森两位先生精心绘制,贾渝、汪楣芝负责全书索引,并协助全书编辑工作。特致衷心感谢。

由于本书涉及面十分广泛,其编著任务是十分艰巨的,虽然作者们从 1983 年起即着手本书工作,他们又均系国内有关学科的专家,但这是多学科学者共同编写的尝试,谨希望此书能抛砖引玉,以推动今后更完善的苔藓植物生物学专著的问世。

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1997 年 5 月

## PREFACE

People began to study bryophytes several hundred years ago. Researches diversified into different branches only began half a century ago. In 1952, Frans Verdoorn published the first "Manual of Bryophytes" in which he introduced eight branches of bryology. It has been considered the first book of the "Biology of Bryophytes". In 1981, D. H. S. Richardson published "The Biology of Mosses" which contains fossils, the influences of water and temperature to the photosynthesis, of morphological characters and the economic value of bryophytes. Half a century after the publication of the first book of the "Manual of Bryophytes", Schuster in cooperation with several worldwide famous bryologists published two volumes of "New Manual of Bryology" in 1983. He summarized the data of recent advances and made great improvements. Most areas of bryology are included in these two volumes. Meanwhile, the "Advances of Bryology" and several other publications in systematic works continued to cover new discoveries in various fields of bryology. Each of these publications has its specific features from the cooperation of worldwide specialists of different fields. However, there has been no Chinese publication, which can reflect the present status of progresses in different fields of bryology. Moreover, the contents of the textbooks of botany in Chinese elementary and secondary schools cover influenced by traditional framework which is out-of-date for a long time. Considering the present domestic and oversea status of research in bryology, the compilation of the biology of bryophytes for introducing various fields of bryological research to the people within China and for communication to scientists abroad is urgent. This is the idea shared by all the contributors. As the compilation of an inventory of Chinese bryophytes is not finished more than 90% of our research projects are dealing with the taxonomy of mosses and liverworts. However, some of our plant cytologists, physiologists, phytochemists, paleobotanists and palynologists are interested in these branches of bryology. They have contributed reports for the related chapters in this book.

As the purpose of the compilation of this book is to introduce the present worldwide advances of different branches of bryology, we have reported as much of current data as possible. However, if some old literatures are significant in our science, they are also cited. In this publication, each chapter represents an independent field of bryology. It stands as an individual article. For the convenience of the readers, each chapter begins with the introduction of the history of that specific branch. The major portion consists of an itemized comprehensive report. In addition, there is some discussion on the evolutionary significance of that branch in bryophytes. Finally, important literature is added. The uniting principle is the systematics and evolution of the bryophytes. On account of limited space, only selections of important literature in various branches are

listed.

If this publication can achieve the function as a tool for bryological education, an inspiration for further research of mosses and liverworts, and a means of international communication among worldwide bryologists, it would have reached the goal which the contributors have hoped.

This publication covers a very wide scope. There has been no work that covers so diverse a field of studies of bryophytes. The editorial responsibilities have been very heavy. Although the editors began the compilation in 1983, we are specialists of our respected fields, and we do feel the limitations of our ability.

Our sincere appreciation goes to Professors Wang Wentzi, Member, Chinese Academy of Sciences; Tang Yanchen, Former Chairman, Department of Plant Taxonomy and Phytogeography, Academia Sinica, Beijing; Hsu Pingsheng, Life Science Academy, Fu Dan University and Deputy Director, Shanghai Natural History Museum, who kindly suggested the English title of this book; Wei Jiangchun, Member, Chinese Academy of Sciences, Chairman of the Scientific Committee, Open Laboratory of Systematic Mycology and Lichenology, the Chinese Academy of Sciences and Deputy Chief Editor, the Editorial Committee of Cryptogamic flora of China; who directed, supported and helped the compilation and publication of this work. We are deeply indebted to Professor Hong Deyuan, who with his busy schedule as Member of the Chinese Academy of Sciences and heavy duty as Director of the Laboratory of Plant Evolution and Systematic Botany, took time to prepare the chapter on cytology, chromosome and nuclear types of bryophytes; Professor Lai Mingjou, Department of Landscape, Tonghai University, who with his rich experience in teaching and research, contributed the chapter of bryophytes as an indicator of environment and Dr. Li Yanhong, Michigan Technological University, for two chapters on eco-physiology and communities of bryophytes.

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As the Chinese saying goes, We are throwing off a brick to attract valuable jade. We hope in future, there will be better and more perfect publications on Chinese bryophytes.

Wu Pengcheng  
Institute of Botany  
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# 目 录

序

前言

第一章 苔藓植物的研究简史	1
一、启蒙时期	1
1. 我国古代对苔藓植物的认识	1
2. 古希腊以后国外对苔藓植物的认识	2
二、经典分类学发展时期	3
三、多学科系统研究阶段	3
1. 多学科研究的进展	4
2. 国内外苔藓植物研究状况的比较	4
第二章 苔藓植物的分类及其系统排列	9
一、基本现状	10
二、苔类植物的系统纲要	10
1. Schiffner 系统 (1893—1895)	11
2. Verdoorn 系统 (1932)	12
3. Evans 系统 (1939)	12
4. Mueller 系统 (1951—1954)	12
5. Reimers 系统 (1954)	12
6. Schuster 系统 (1958—1963)	12
7. Hattori (服部) 系统 (1970)	12
三、藓类植物的系统纲要	13
1. Limpricht 系统 (1885—1903)	13
2. Brotherus 系统 (1901—1909)	13
3. 4. Fleischer 系统 (1920—1924) 和 Brotherus 系统 (1924—1925)	13
5. Dixon 系统 (1932)	13
6. Reimers 系统 (1954)	13
7. 陈邦杰 (Chen) 系统 (1963—1978)	14
8. Crosby 系统 (1980)	14
9. Vitt 系统 (1984)	14
四、苔藓植物科的新分类群及其意义	16
第三章 苔藓植物配子体与孢子体的基本构造	23
一、苔藓植物的一般特征	25
二、配子体的基本形态构造	28
1. 原丝体	28
2. 假根	28
3. 茎	29
4. 枝	31

5. 叶 .....	32
三、孢子体的基本形态构造 .....	37
1. 雌雄生殖器官着生类型 .....	37
2. 雄苞 .....	38
3. 雌苞 .....	38
4. 配丝 .....	38
5. 精子器 .....	38
6. 颈卵器 .....	38
7. 孢子体 .....	38
8. 蒴萼 .....	39
9. 脊部 .....	39
10. 茎鞘 .....	39
11. 蒴囊 .....	39
12. 假蒴萼 .....	39
13. 生殖托 .....	39
14. 蒴柄 .....	39
15. 假蒴柄 .....	40
16. 蒴帽 .....	40
17. 孢蒴 .....	40
18. 弹丝 .....	43
19. 孢子 .....	43
第四章 苔藓植物的孢子形态 .....	48
一、研究进展概况 .....	48
二、苔藓孢子的基本形态特征 .....	49
1. 孢子的极性 .....	49
2. 孢子的形状和大小 .....	49
3. 孢子的萌发孔 .....	50
4. 孢壁 .....	51
5. 纹饰 .....	53
6. 弹丝 .....	53
三、苔藓孢子的演化及其在分类学上的意义 .....	54
1. 与其他高等植物孢粉形态的比较 .....	54
2. 苔藓孢子的演化趋势 .....	55
3. 苔藓孢子在植物分类学上的意义 .....	55
第五章 苔藓植物的染色体和细胞分类 .....	61
一、简况 .....	61
二、苔藓植物的染色体数目 .....	62
1. 研究概况和若干基本概念 .....	62
2. 角苔类植物 .....	64
3. 苔类植物 .....	64
4. 藓类植物 .....	66
三、多倍化 .....	69
1. 种间多倍化 .....	69
2. 种内多倍化 .....	69
3. 多倍化的类型 .....	74

4. 多倍体的起源 .....	75
5. 多倍化和分布 .....	76
四、非整倍体 .....	76
1. 苔类和角苔类植物 .....	77
2. 藓类植物 .....	77
3. 非整倍性的起源 .....	78
五、减数分裂的不规则现象 .....	78
六、小染色体和附属染色体 .....	81
1. 苔类植物 .....	82
2. 藓类植物 .....	82
七、性染色体 .....	86
1. 苔类植物的性染色体 .....	86
2. 藓类植物中的性染色体 .....	87
3. 关于苔藓植物性染色体的评论 .....	88
八、异染色体和 Giemsa C 带分析 .....	89
1. H 和 h 染色体 .....	89
2. 结构异染色质与兼性异染色质 .....	90
3. Giemsa C 带 .....	90
九、核型分析 .....	92
1. 苔类植物的核型 .....	94
2. 藓类植物的核型 .....	95
十、细胞分类学 .....	96
第六章 苔藓植物的生理生化 .....	102
一、生理特性 .....	102
1. 细胞培养和组织培养 .....	102
2. 光合生理 .....	103
3. 无机化合物的吸收 .....	104
4. 生长调节活性 .....	105
二、生化机制 .....	107
1. 二氧化碳固定 .....	107
2. 糖代谢 .....	108
3. 氮代谢 .....	111
三、光合作用的进化 .....	116
第七章 苔藓植物的分子生物学 .....	122
一、叶绿体基因组 .....	122
1. rRNA 基因 .....	124
2. tRNA 基因 .....	124
3. RNA 聚合酶基因 .....	124
4. 核糖体蛋白基因 .....	125
5. 光合作用的基因 .....	126
6. 由氨基酸序列同源性推测的基因 .....	126
二、叶绿体基因组的分子进化 .....	126
1. 叶绿体的基因含量 .....	126
2. 叶绿体内含子的进化 .....	127
3. 叶绿体基因进化速率 .....	128



第八章 苔藓植物的生理生态	131
一、光与温度对苔藓植物的影响	133
1. 光与苔藓植物	133
2. 苔藓植物生活的温度界限	134
3. 极端温度对苔藓植物的影响	134
4. 苔藓植物对温度的适应	135
二、苔藓植物的水分关系	136
1. 苔藓植物对水分的吸收及导传	136
2. 苔藓植物体内的水分状况及其对代谢的影响	138
3. 植物的失水及其抗性	139
4. 苔藓植物的耐旱性	140
三、苔藓植物的矿质养分	141
1. 苔藓植物对矿质养分的需求及养分的来源	141
2. 苔藓植物对矿质养分的吸收及转移	141
3. 矿质养分的含量及其利用	142
4. 苔藓植物作为生境养分状况的指示者	143
第九章 苔藓植物的化学内含物	148
一、元素成分	149
二、糖类和糖醇	149
三、氨基酸及其衍生物	149
四、脂肪酸及其衍生物	149
五、脂族化合物	150
六、萜类化合物和甾醇	151
1. 单萜类	151
2. 倍半萜类	151
3. 二萜类	156
4. 三萜类	165
5. 甾醇类	170
七、酚性化合物	171
1. 酚醚类	171
2. 酚酸类和酯类	171
3. 1, 2-二苯乙烷衍生物	172
4. 1, 3-二苯基丙烷衍生物	175
5. 蒽满衍生物	175
6. 黄酮类化合物	177
八、生物碱类	198
九、生物活性物质	198
十、离体培养产生次生物质	200
十一、化学分类在苔藓植物方面的探讨	200
第十章 苔藓植物的生殖生物特性	210
一、无性生殖	211
1. 藓类的无性生殖	211
2. 苔类和角苔类的无性生殖	213
3. 各种器官的繁殖	213