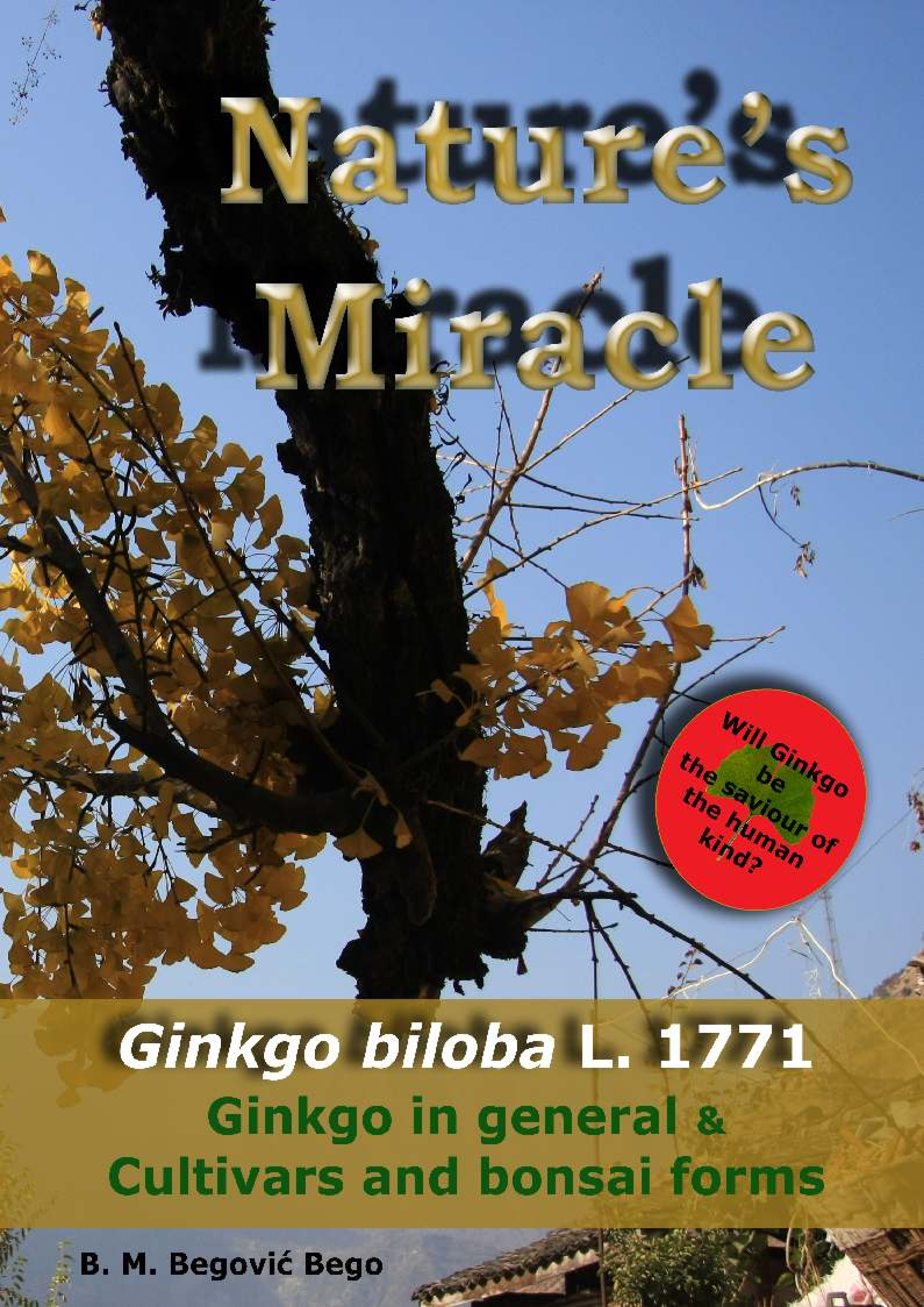
Nature's Miracle



Ginkgo biloba L. 1771

Ginkgo in general & Cultivars and bonsai forms

B. M. Begović Bego

Dear!

Currently is in the preparation the Book No. 2 (Vol 3-4) “Nature's Miracle - *Ginkgo biloba*” (see please pages 392-395).

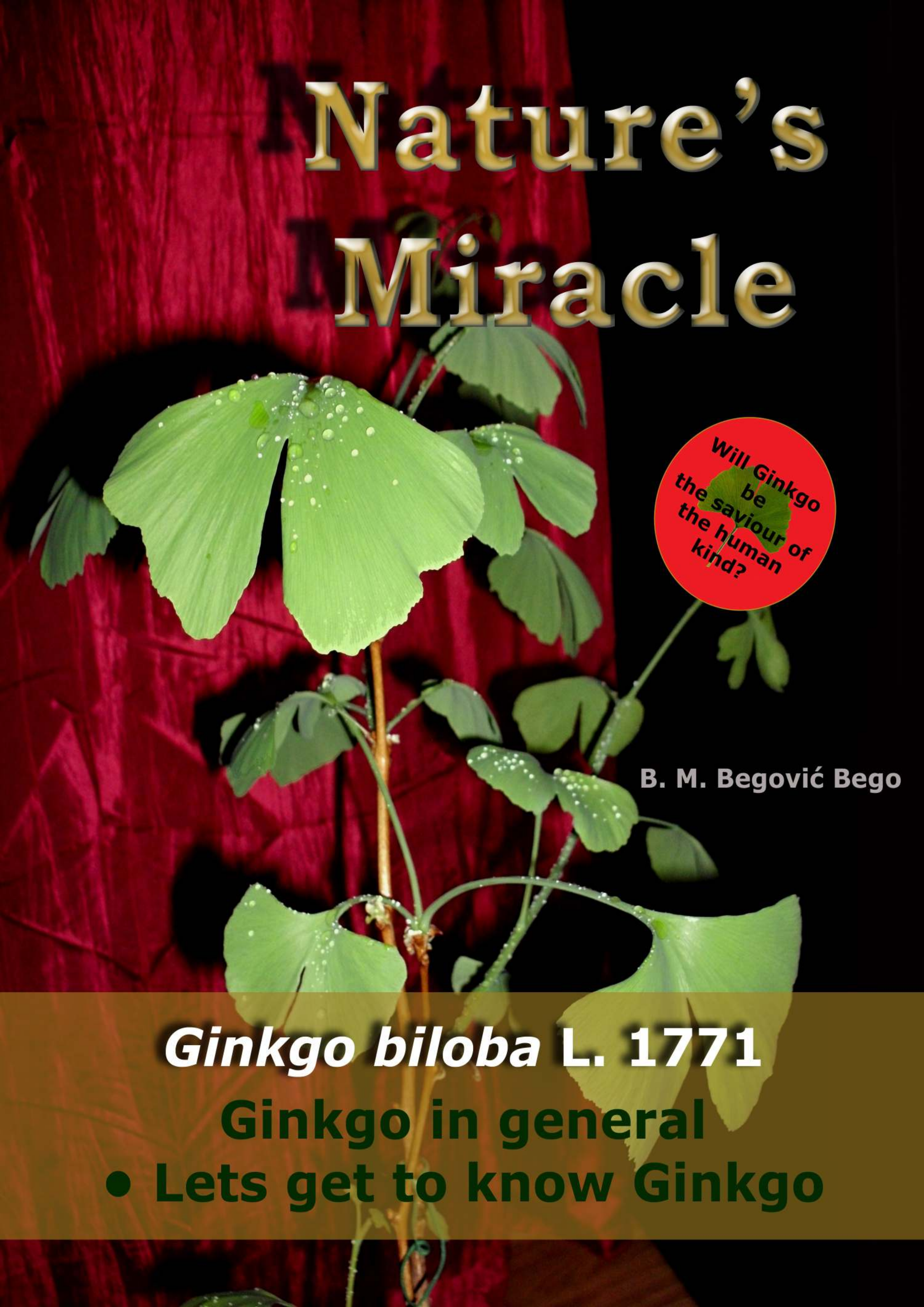
Please anyone who can help (suggestions, articles, tips, photos, etc. - or in any other way) to contact me by e-mails:

ginkgo.begovic@gmail.com
or
begovic.branko@yahoo.com

Thanks!

Address:
Branko M. Begović Bego
Otrovanec 60
33405 Pitomača
Croatia
(Tel. +385 98 1365 893)

For all information about Ginkgo, please contact me on e-mails.



Nature's Miracle

Will Ginkgo be the saviour of the human kind?

B. M. Begović Bego

Ginkgo biloba L. 1771

Ginkgo in general

• Lets get to know Ginkgo

Ginkgo biloba L. 1771

All about Ginkgo (or Maidenhair tree)

Volume 1

by Branko M. Begović Bego

Foreword (Vol 1-2) by

• Prof. Sir Peter Crane, Dr.Sc. *(Director of the Royal Botanic Gardens in Kew, London, UK, etc. and today - Yale School of Forestry and Environmental Studies at Yale University in New Haven, Connecticut, USA)*
• Prof. Peter Del Tredici, Dr.Sc. *(Senior Research Scientist Arnold Arboretum of Harvard University, Boston - Lecturer, Harvard Graduate School of Design, Cambridge, USA)*
• Prof. Ing. Pavel Hrubík, Dr.Sc. *(Slovak Agricultural University in Nitra, Slovakia)*
• Elvira Koić, Mr.Sc. (Gener*al Hospital Virovitica, Head of psychiatry, Virovitica, etc., Croatia)*
• Rade Rakić, M.S. *(Croatian Forests of Croatia, Head of botanical nursery, Krizevci, Croatia)*
• Assoc. Prof. Ing. Katarína Ražná, PhD. *(Department of genetics and plant breeding, Faculty of agriculture and food resources, Slovak Agricultural University in Nitra, Slovakia)*
• Prof. Zhi-Yan Zhou, Member of CAS - Academician *(State Key Laboratory of Palaeobiology and Stratigraphy, and Department of Palaeobotany and Palynology, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, China)*

The first and last pages: photo by Zhou Xiaolin from www.youduo.com, China (old Ginkgo tree in Lengqi, Western Sichuan, China.)

Nature's Miracle

Ginkgo biloba L. 1771

- All about Ginkgo
(or Maidenhair tree)

Vol 1
(Ginkgo in general
- Lets get to know
Ginkgo)

Branko M. Begović Bego

Pitomača, Croatia

Ginkgo biloba L. 1771

Ginkgo biloba L. 1771

• All about Ginkgo (or Maidenhair tree)

Volume 1

Foreword (Vol 1-2) by
Peter Crane (UK-USA), Peter Del Tredici (USA), Pavel Hrubík (Slovakia), Elvira Koić (Croatia), Rade Rakić (Croatia), Katarína Ražná (Slovakia), Zhi-Yan Zhou (China)

Title: *Ginkgo biloba* L. 1771

Author: B. M. Begović Bego

Manuscript Release Date: December 2010/October 2011

The original language manuscript: Croatian

English translation: Blanka Capić (Croatia)

Language: English

Graphic Design: B. M. B. Begović

All illustrations are indicated by the source - in the description.
Illustrations (pictures, graphics and decoration, etc.)
without a source - author: B.M.B. Begović (indicated by the logo)

CIP: No./br. 130313049 (City and University Library Osijek, Croatia - Gradska i sveučilišna knjižnica Osijek, Hrvatska)

Vlastita naklada - Self-Publishing
Branko M. Begović Bego, Otrovanec 60, 33405 Pitomača, Croatia
Contact:
ginkgo.begovic@gmail.com
begovic.branko@yahoo.com

ISBN 978-953-56963-0-8

Contents

Ginkgo in general - Lets get to know Ginkgo

Contents

Contents

Edition *Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree) consists of four separate but related books.

Volume 1: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of a whole which is mainly about the descriptive part of the Ginkgo: morphological characteristics, name, planting and reproduction, prevalence etc. So, there are only descriptive characteristics.

Volume 2: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of two parts: cultivars and bonsai forms.

Volume 3: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of a whole which is mainly about the pharmacy and medicine (the traditional and the modern), cosmetics etc.

Volume 4: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of a whole which is mainly about the religion, art, mythology, etc.

Each book can be separate unit, but all together make a complete whole about Ginkgo.

Ginkgo biloba tree foliage,
in Washington Square Park - Greenwich Village,
New York, USA. Photo by Hubert Steed, 2006.

The symbiosis of ancient history and modern technology and human life.

Foreword

“With apologies to the movie maker Woody Allen, Branko Begović Bego's four volume book could easily have been called “Everything You Ever Wanted To Know About *Ginkgo biloba*, But Were Afraid To Ask.” The author has not only scoured the deepest recesses of botanical libraries for obscure historical facts about the Ginkgo tree, but also the far reaches of the internet galaxy for the latest information about its worldwide distribution and medicinal uses. The result is the beautiful book you now hold in your hands (to say nothing of the three more volumes that are promised follow). The book is breathtaking in its scope, covering in great detail the topics of its discovery and naming by eighteenth century European travelers to Asia, its unbelievably long evolutionary history as documented in fossil deposits throughout the world, its ecology and current distribution as a wild plant in China, the anatomy and morphology of its stems, roots, leaves and reproductive cones, and finally the techniques of its propagation and cultivation from seed, grafting and cuttings. And all of this information is beautifully illustrated with photographs of ancient and young specimens growing throughout the world. In a true labor of love, Begović Bego has produced the definitive encyclopedia of *Ginkgo biloba*.”

Prof. Peter Del Tredici, Dr.Sc. *(Senior Research Scientist Arnold Arboretum of Harvard University, Boston - Lecturer, Harvard Graduate School of Design, Cambridge, USA) (2011/03/01)*

“It is a curious fact that most of the plants with which we share our world are the product of a dramatic evolutionary diversification that began around 135 million years ago: an explosion of diversity that has resulted in about 350,000 living species. However, we know from paleontology that this hyper-diverse group—the angiosperms or flowering plants—is just one among many lineages of seed plants, and that seed plants that goes much further back in geologic time. So to fully understand the angiosperms we must place them in a broader context of 450 million years of plant life on land, and to do that we must turn to the fossil record and also those four groups of living plants that enable us to understand how other kinds of seed plants live and reproduce.

This is the true significance of Ginkgo. The single living species stands distinct; not only from angiosperms but also from conifers, cycads and Gnetales. It has a fossil history stretching back at least 200 million years and its fossil record shows that it was once part of a diverse and important group of plants that declined as flowering plants diversified. Plants very similar to living *Ginkgo biloba* were one of the survivors of the massive vegetational transformation of 100 million years ago and have come down to us almost unchanged ever since. They survived the massive extinction at the end of the Cretaceous, and the changing climates of the past 65 million years. More recently, though, Ginkgo was assailed again by grinding cold, spreading from the north. The last great ice ages extinguished Ginkgo from most of the Northern Hemisphere.

Fortunately, however, Ginkgo managed to survive in southern and southwestern China. From those few safe havens with the help of people, over many centuries, Ginkgo has spread around the world again. It has returned once more to many of the places where it lived millions of years ago. The association of Ginkgo with people is a story of revival and resurgence, and a testament to the power of survival of a singular tree. This book is a celebration of the extraordinary life story of Ginkgo: one of the most remarkable, and most beautiful, of all the world's plants.”

Sir Peter Crane, FRS Dean, *(Yale School of Forestry & Evironmental Studies, USA) (2011/02/28)*

Foreword

"The stimulation for further evaluation and research of rare plant species *Ginkgo biloba* L. and its cultural expansion in Slovakia and Europe, was the book of Branko M. Begović: "Nature's miracle – *Ginkgo biloba* L. 1771 – All about Ginkgo (or Maidenhair tree)" (Vol 1-4). The monograph on the extent of more than 620 pages (Vol 1-2 has 400 pages) with over 1300 color illustrations, luxury edition, brings many interesting and valuable technical and scientific knowledge about the oldest tree species in the world - *Ginkgo biloba* L., originated in China.

The content of the book covers all the knowledge of the naming/terminology and Ginkgo classification, history of cultivation as fruit woody plants (fruit tree) morphology and evolution of Ginkgo's plants, detailed description, geographical distribution (area), cultivars, and varieties of trees, chemical composition and content of other substances, usable in pharmacology, medicine and Ginkgo in nutrition, planting and propagation of Ginkgo, mythology - religion - art.

Extremely valuable source of information for scientific and general public is the chapters References - links. About the *Ginkgo biloba* L. have been written many works (books, articles) and websites. All works are available in this book in chronological order, and above are available for further research and evaluation of Ginkgo in Europe and worldwide.

Our friend and colleague Branko Begović is a rare man, the creator (author) of numerous books and publications and about ornamental plants, especially about the introduced plants, which have important application in the stands in Slovakia, but especially in historic parks, gardens, but mainly in urbanized areas and urban communities, where it better tolerate changed climate and soil conditions.

Congratulations and thanks to the author of the monograph "Nature's miracle – *Ginkgo biloba* L. 1771 – All about Ginkgo (or Maidenhair tree)" (Vol 1-4)" Branko M. Begović Bego, for the unique work to this extent, the complexity of content, scientific and educational level have been in Europe (certainly in the world) and now the author successfully engage the challenge, and with his associates issues such valuable work in the English language.

The monograph of Branko M. Begović: "Nature's miracle – *Ginkgo biloba* L. 1771 – All about ginkgo (or maidenhair tree)" (Vol 1-4), is a comprehensive scientific work, of particular importance for the history of introduction and the possibility of deeper knowledge of plants (tree), which already existed before the world 200 million years, while maintaining the natural conditions only in the territory of China. Gradually it has been introduced nearly worldwide. Thanks to the author of monographs and friends of Ginkgo has been the extension of this tree in detail and evaluated in Croatia. An example of a small European country can by the size of the effort and the efforts of knowledge to enrich the world's knowledge."

Prof. Ing. Pavel Hrubík, Dr.Sc. *(Slovak Agricultural University in Nitra, Slovakia) (2010/09/15 & 2011/02/25)*

"By reading this book we become aware of how much Ginkgo means to the author and how much it will mean to all readers, or better yet - users manual. This is the result of fruitful cooperation between applied science and practical work by author and represents a personal and professional response to a specific narrow topic.

It is not easy to transfer their knowledge to others and there are even fewer practitioners who fail to apply science in real life, help others and improve the world. Branko Begović went just that way- in the direction of the applied sciences, and the lyrics have a special personal quality. Text is pronounced in an understandable and simple way, understandable and applicable, different from the usual strict advice of experts. Content that he offers is a credible, because of the expression and personal experience and gives us the courage to try to apply yourself and showing a knowledge or skill. It also inspires us that we also try to provide some answers in accordance with their experiences and so contribute to the common wealth shared. Practice is a starting point, although the theoretical starting points are always offered in the company. Therefore important literature and links which are studied during the preparation of this edition are listed and are also important.

She (the classic form or digital form) is for everyone, curious, students, professionals and patients. It was written with the intention to present the *Ginkgo biloba* and its path of history and the creation of seeds to the drug. In this process many are included and in the mosaic, and a kind of hierarch author connects them.

This is one of the first and unique manual of its kind in the world, and especially this part of Europe. From it we learn about the Ginkgo, about his beauty and impact on human health. Following this guide, we can say that the beautiful ancient *Ginkgo biloba* in China has settled permanently in Europe and the world.

It is primarily used for centuries in medicine to improve circulation and blood flow in the brain, arms and legs, concentration and memory recovery, relief of disorders of cerebral circulation, the appearance of dizziness, noises in the ears, headaches, insomnia, cramps and feeling of coldness in the hands and legs..."

Elvira Koić, M.Sc. *(General Hospital Virovitica, Head of psychiatry, Virovitica, etc., Croatia) - (2011/01/31)*

"These beautiful books I have in the hands expressed authors love by growing types of *Ginkgo biloba* - especially because this kind in the world has been little known.

The author of this edition with the clarity of text and a wealth of beautiful illustrations and charts give us something that will help us to get closer and more familiar with Ginkgo, its cultivation and care in the nurseries, crops and plantations. *Ginkgo biloba* is an attractive plant and all of us, ordinary lovers of plants we are lucky if you breed a plant that is perhaps a little unusual, or beautiful flowers, unusual or strange-stemmed leaves. Ginkgo is one such plant, especially as its beautiful foliage creates a magnificent atmosphere for eye and soul, and with it still has medicinal properties.

People will say that the *Ginkgo biloba* herb is known from the beginning, if so, and so is, then one should ask, and why it is written so little literature on the method of planting and cultivation in the world. Evidence for this is the book you hold in your hands, written in language which everyone can understand and without excessive theorizing the author has consistently carried out his idea and wrote the manual in the true sense, understandable to anyone who has even a minimal knowledge of botany.

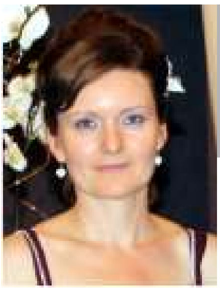
The author offers a book that will each producer (farmer), if he decides on the growing of *Ginkgo biloba*, on a smaller scale, enable a step forward in gaining knowledge necessary for safe and quality production. For ambitious growers this book provides guidance in the next steps toward mass production.

It can be said that it is a manual in the true sense of the word and is among the few such volumes.

And at the end of this short review, I must say that the purchase and planting of Ginkgo (*Ginkgo biloba*) is expensive and very demanding job. Therefore, this book will be an excellent manual to provide guidance when someone wants to grow Ginkgo, whether as a Horticultural plants or as a plant for medicinal purposes with this strange, rare and specific plant."

Rade Rakić, M.S. *(Croatian Forests of Croatia, Head of botanical nursery, Krizevci, Croatia) - (2011/01/08)*

Foreword



"The reviewed book is a complex, comprehensive work devoted to rare tree *Ginkgo biloba* L. The contents include all assessed properties, the text is written in high-quality technical terminology, which is also documented high level of expertise of the author works. Part of the text is a unique picture documentation, clear tables and charts, maps (almost all of the pictures are the work of the author).

Each main chapter contains the clear contents, list of available world literature, including the amount of Internet resources. This part of the work, as well, documents the efforts of many talents of the author of the book and is a valuable source of knowledge for other professionals who wish to pursue this issue. Particular attention is devoted to the publication and versatile medical properties and effects of extracts from leaves and seeds of *Ginkgo biloba*.

Book publication will be an excellent teaching aid for university students, researchers and practitioners because it provides a lot of knowledge about the exceptional value of trees, the history of the discovery, cultivation, propagation and use for health man. For us, in Slovakia is also a stimulus for further research and evaluation cultural extension of *Ginkgo biloba* L. in Slovakia. Congratulations and thank you author to release this unique book works."

Assoc. Prof. Ing. Katarína Ražná, Ph.D. *(Department of genetics and plant breeding, Faculty of agriculture and food resources, Slovak Agricultural University in Nitra, Slovakia) (2011/02/25)*

"Ginkgo is both a gift of the world to China, and a gift of China to the world."
Peter Crane: "Ginkgo: The Silver Apricot - A Life through Time"

I have a predestined relationship with the living fossil Ginkgo. Not only are we both native to China, but also I have devoted a considerable part of my academic career to the study of the geological history of this esteemed tree. I used to take it reasonably that Ginkgo belongs to China, because there are the oldest reliable fossil record dating back to about 170 Ma ago and also the 'missing link' in the evolution course of Ginkgo from their ancestors, needless to say the existence of natural populations and numerous old trees of thousand years old. When entering more deeply into the Ginkgo research, I became more and more aware of my narrower world view. There have been so many people from different countries and areas where even cultivated Ginkgo trees are rare, interested in and fond of Ginkgo, because it is so important and indispensible to people all over the world. It has been widely planted and cultivated for scientific studies, garden decorating and city greening, as well as medicine and daily life usages, and deeply integrated into human ethic, history, religions, culture, art and literature. To meet the increasing needs of people for multiple purposes, Mr. B. M. Begovic Bego of Croatia spent many years to compile the four-volume comprehensive manual about all aspects of Ginkgo with great enthusiasm, which is extraordinary rich in data and references, including numerous relevant web sites. It will certainly be of great help to people who wanted to know more about Ginkgo and to learn it from different sides, especially in this part of the world. It will also be very useful to cultivation and propagation of ginkgo trees for medicinal and other purposes.

Ginkgo which flourished widely on the earth in the geological ages and was once on the verge of extinction has been now rejuvenated, and it will bring benefit to people all over the world.

Ginkgo should belong to the whole mankind."

Zhiyan Zhou, Research Professor, Member of CAS - Academician *(Chinese Academy of Sciences, China) (2011/02/25)*

Introduction

When I start growing Ginkgo I could not imagine that love towards that plant will become so big that I will devote a part of my life to Ginkgo exclusively. For a long time I've been collecting all informational I could find about Ginkgo, but 2007 I tried to make a simple, clear edition there was many different problems. About Ginkgo there were so much written articles but first group of them was connected to Gingko's fossils ancestors. Second group was about medical use of Ginkgo; numerous articles, studies, chemical formulas, charts by experts and amateurs, both chemists and pharmacists. Besides those two groups of articles all other notes were superficial and shaped like news or advertisement for numerous industrial products based on Ginkgo's leaf or seed. On the other hand I found some articles where some part were studied in smallest details. There were no more information available on line, too.

And so I found myself in somehow tricky situation. How to present all about Ginkgo in the simplest but clear, interesting and still scientifically substantiated way? Have I succeeded – judge yourself.

By 2009 I have managed to make one info-edition (non-commercial: for my friends) on Croatian in which it was explained in short – what was Ginkgo. Besides I collected numerous notes and photos about growing Ginkgo (from friends and my own). In the mean time I contacted famous botanists and other scientists whose interest was Ginkgo. Some of them were: professor Pavel Hrubík (Slovakia), Katarína Ražná (Slovakia), Zhiyan Zhou (China) and Peter Del Tredici (USA). In their own way they warned me on different problematic s. And as mucha as I tried to find something about all of them, I could not. Thinking about it, decision has been made: in the existing edition “World of Ginkgo's” I will show all Ginkgo's connection. Those now and during history, just keeping in mind that all information is precise, accurate, clear, short and substantiated with scientific and other sources.

At the begging I was considering to make one separate book, but as I was making progress it was quite easy to see tree different approaches. First one is about plant itself, name, cultivation, prevalence, etc. Basically descriptional part. In this part we can count Ginkgo's use in horticultural purposes because it is tightly linked with cultivation.

Second part is very logical and it relates on Ginkgo's cultivar farming and cultivation of bonsai forms.

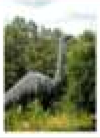
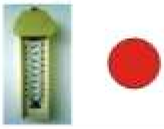
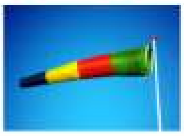
Third and fourth part is totally applicable because it relates to use of Ginkgo or some parts of him in medicine (alternative or official), culinary, religion, mythology, art, applied art, etc.

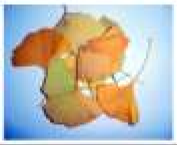
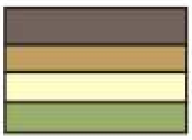
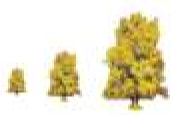
To publish all that in one book would definitely be to excessive and it would have no sense since it can be published separately and paired it would make a complete unity. Those are precise reasons that I've separated my work “*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)” in to the four books: Vol 1- 4.

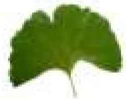
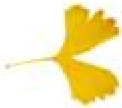
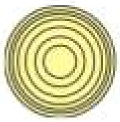
In this part (Vol 1) we bring you many descriptional data and information about cultivation, name, history, propagation and so on for the species *Ginkgo biloba*.

In memory of Dr. Marijan Jergović (1938-2010), Croatia.

Branko M. Begović Bego
(June, 2011)

	Ancestors: lived before 200 mill. years ago.
	Plants: male and female flowers
	Plants: male and female trees
	Survive: < 45°C
	Survive: < -30°C
	Bear snow
	Famous for bonsai
	Bear farming in the flower garden
	The fruit is similar to apricots
	In the fruits is seed
	For food: seeds and leafs
	Insects do not pollination
	Pollination: wind

	Likes: shadow-sun
	Likes: sun
	Leaf type: deciduous
	Tolerances: alkaline soils (pH<7.5)
	Toxicity: not (seed yes?!)
	Resistant to pests and pollution
	Likes: pruning
	Water needs: moderate
	Perfect ground: almost everything
	Medicinal plants
	Hardiness zones: 4/5-8/9
	Likes: deep soils
	Growth rate: moderate

	Tree size: large
 Cultivars:	cca 240
Max. years age:	cca 4500 years
	Spring and summer: green leaf
	Autumn: yellow leaf
	Extent trunk: large
	Sensitivity to fire: not
	Propagation: most male plants
Problems	Extinction of female plants
?	Female trees produce foul-smelling fruits

Basic information about Maidenhair tree (*Ginkgo biloba* L. 1771).

1

Nomenclature, taxonomic units and classifications, World names, names of origin, etc.

Foreword

Since Ginkgo managed to survive even in times of advanced human evolution (by that we mean period from befor two, three or more thousands of years) in only one smaller part of todays Souteast and East Asia (China, Japan, Korea and small circle aroun those countries) it is completely understandable that todays name Ginkgo has its base in languages that are native in that Area's.

Different plant and animal studdies through history emerged classification through which it is possible to easier reckognized individual plant or animal species, including Ginkgo.

As part of botany that deals with plant taxonoy and plant classification has developed through few last centuries it has brought out clearer scientificly based separations and grups in which Ginkgo is placed.

As Ginkgo arrived and settled in Europe and other parts of the World since people had no knowledge about this plant they named him in numerous names which they thouth it was appropriate no matter how strange in fact it was. But strange as it was in numerous countries it can be found in use even today.

1
Discussion on the origin of the name Ginkgo (as plants, fruits and leaves)

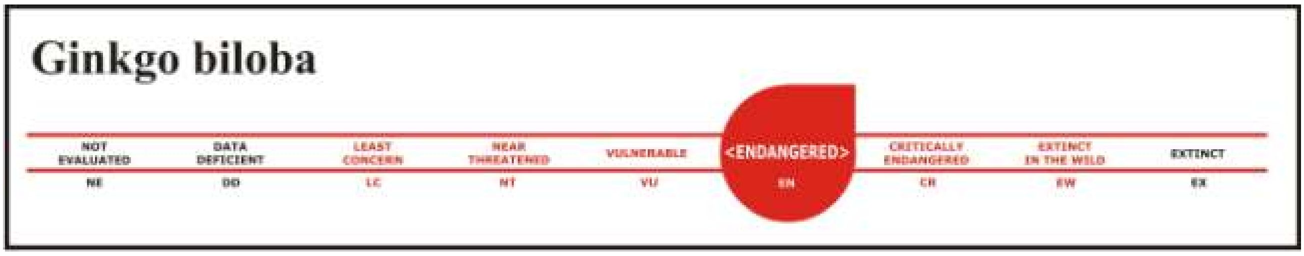
At the beggining it is important to say that the origin of todays valid and scientificly correct and accepted name for Ginkgo is covered with many secrets. Similar can be said for all other sinonims that came along through the centuries. So it can be said that scientsists are cofused when it is neccesarry to explain the origin of the Ginkgo name, and it is mostly ascribed to ginkgo teritory cultivated from motherland China in other areas, either linguar or cultural. All in all it is totaly understandable and it is not rarity especialy conserning plants coming from far East.

(China) Ginkgo today in it's motherland i.e. China that still holds last nature population of ginkgo from before 2-3 thousand years ago, in literal translation from chineese it is called „accient silver apricot", and it is meent the whole Ginkgo tree: accient 古– silver 銀– apricot 杏. If we put all three together we get term Ginkgo or in modern Mandarin Chineese *ya jiao* (*ya chio* = itcho, phonetic) or *yin xing* (*Yin Hsing*). In China in past to determant term for Ginkgo fruit, Ginkgo leaf or Ginkgo trunk they used separate word or words. So as it seems the oldest written term that determant Ginkgo as plant was known by 11th century as *ya* (鴨) *jiao* (脚) which connected together means „duck foot" or „foot from the duck" for it's resenblense to Ginkgo's leaf. In some places this term is connected to the vivid colours of mandarin duck (*Aix galericulata*) (19). Japaneese call her *icho ba*. Aproximately one century later (12-13th century) the term *yin xing* swows in China for the Ginkgo's fruit and for the ginkgo plant which means „silver apricot". A little later (14th century) in China also appears name *Bai* (白) *guo* (果) (or *pei kuo*) which means „white fruit", and it was, and still is in use to mark plant and fruit. When chineese write bai guo and mean tree then they add a sign that label tree: 白果樹. If they mean on Ginkgo's fruit or „white fruit" they add sign that label water and it looks like this: 水 果. Translated it would roughly be *bai guo ye* (or *bai guo ye* = Ginkgo leaf). Pronunciation depends on the nuances of a particular dialect, but not significantly. During the Song and Yuan dynasties

Aix galericulata - Mandarin Duck. In China, a symbol of love. Photo by Yoky. (19)

(960-1368) scientists mention few more names for Ginkgo as tree, leaf or fruit: *pei* or *bai yen* (白眼 – white eyes), *ling yen* (眼熱心 – spirit eyes), *jen hsing* or *xing* (螺母杏 – apricot nut) and in the late Middle Ages name *kung sun shu* (公孙树 or 树爷爷孙子– grandfather-grandchild tree) appears. Basicly it means that Ginkgo is planted for use of the future generations because from planted three use will have „children and grandchildren". (1, 2, 3, 4, 6, 7, 15, 22, 24, 25, 27, 35)

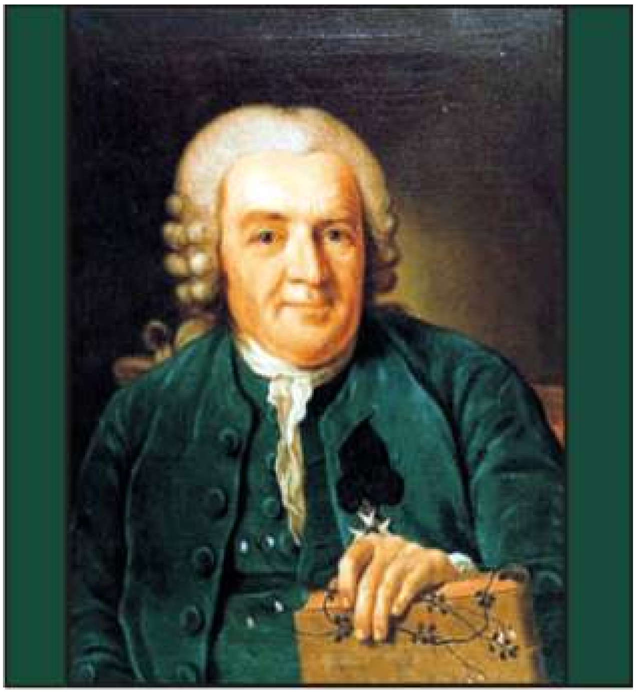
(Japan) Mandarin duck in this part of the world (China, Japan) simbolize love. Considering appriciation toward this particular bird and ginkgo plant it is not suprise that they made connection beetween them since Ginkgo's leaf resenblence towards duck foot and come up with a name for a plant known as *Ginkgo biloba*. In Japan mandarin duck it is called *icho ba*, which without doubt has it's roots in Chineese (*ya chio* or *jiao* = *itcho* = *icho*, jap.). It has been proveen that Ginkgo arrived from China to Japan before 1000 years it is understandable that they had to name him. Judging by the todays name for ginkgo as a plant *icho* or *ichou* (i-cho-to, phonetic) which was noted



Ginkgo biloba is an endangered species in particular because it was recently, for industrial exploitation, exclusively for the reproduction of male individuals, mostly by vegetative propagation. Therefore, there is a possibility that in due course become a Ginkgo plant only masculine without the possibility of natural reproduction semen because of the lack of individuals female. (17)

in 15 century (in this form noted in China even 500 years before) it is easy to conclude that together with the plant it came distorted chineese name which compared Ginkgo with duck foot = *ya itcho*. Almost simoultaneously in Japan appears name *ginnan* also (Kaempferi was published in 1712 "Amoenitatum." To a "*Ginkgo, vel. Gin an, Vulgate Itsjò. Nucifera Arbor folio Adiantino.*") (A) which in fact commes from chineese *yin hsing* (*xing*) and which is also mentioned (in a distorted form of phonetic transcription of Japanese characters) by Nakamura Tekisai (1629-1702) in his dictionary of plants "Kinmôzui" in 1660's. In fact Kaempferi used Tekisai vocabulary to made a version of "ginkgo" and from another Japanese version *Gin kyo* (*Ginkyo*), which is in use today. Later this term become generally accepted in scientific circles throughout the world which is completely defined by Linnaeus and added: "*biloba*". (1, 6, 7, 8, 10, 15, 16, 24, 27, 36) (B)

Famous chineese scinetists that deals with Ginkgo Zhiyan Zhou add that in modern official chineese that to determant Ginkgo it should writte (Latin transcription of Chinese characters by Chinese spelling - 2010) *yinxing* (tree), the leaf *yinxingye* (*ye* = leaf) and *baiguo* fruit or just *yinxing*. (25) (F)



Carl von Linné (1707-1778) - one of the most descriptive botanists of all time. He created the basis of botanical nomenclature. Author: Per Krafft, cca 1770. Oil on canvas. (18, 27)

Chinese porcelain bowl from the 16th century with duck motif and modified Ginkgo leaf. (20, 27)

Since terms for ginkgo in China and Japan has stayed practicly the same through centuries we can reasonably asume that in China the same terms for Ginkgo was in use even befor 2,3 or more thousands of years. So official name for this plant submerged from distorted japaneese prezentation Primarily by Kaempfer. In North and South Korea there are different terms for ginkgo from which some have connection with chineese terms. For example *baekgwamok* (from *baiguo*). Korean's call him *hangjamok*, *gongsonsu*, *apgaksu*, *okgwamok* or simply *ginkgo* which is modern term. (15, 16)

Ginkgo in Chinese and Japanese language and transcription. (27 etc.)

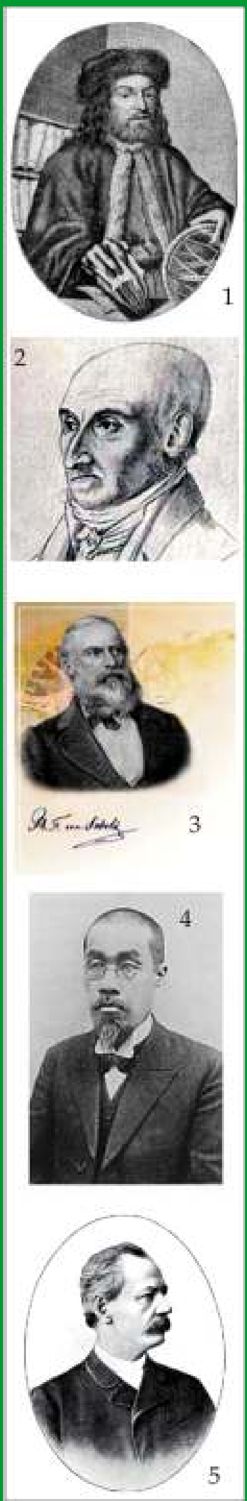
Left: *Adiantum capillus-veneris* L. (9, 50). Right: *Ginkgo biloba* L. These two plants have nothing in common except similar form leaves. But, it was enough to "maidenhair fern" put in a significant relationship with Ginkgo.

2
Recognized and not recognized nomenclature in the past and present

When ginkgo came to Europe and other continents, especially in North America botanists begin to name him quite distinctivly. But as no one before Kaempfer knew nothing about this plant, during 18 century, and later, numerous disscusions begans as also all sort of different attempts to clear out the dilema how to call this plant inside the officially acceptable botanical nomenclature. As Kaempfer has published his „Amoenitatum“ in 1712 all those who tried to name Ginkgo differently from him did not have any concrete base. Carl von Linné concluded that the most aceptable and correct one is the term written (or better yet suggested) by Kaempfer, based on his knowledge from Japan but insisted that species marks in Latin as a species that has a two-part leaf or leaf of two dissimilar surfaces, that is adding adjective "*biloba*" from the *bi* (*bi)* = bi, two, two + *lóbus*, *i*, *m* = flap, patch, part, flat, two irregular surfaces and irregular towels, etc. So it is proposed that plant should be called *Ginkgo biloba*, and since it has been suggested by just him in 1771 has been added bookmarks L. (as Linnaeus) and 1771 (when she suggested to Linnaeus). (D) The name became adopted by all the botanical society and institutions, since it was very reasonable. (8, 27, 40, 52 etc.)

In the following decades and centuries numerous botanists have tried to change this official name, but in most cases they determinate that all their names are not in unision with proper botanical nomenclature and taxonomy. So there were numerous sinonims and the most famous one is *Salisburia adianthifolia* which is in use even today.

Story goes as follows. Richard Antony Salisbury whose real surname was Markham was great english botanist-collector and trully fond of botany. His first garden was in Chapel Allertonu near Leeds, England. But his relationships with womens and catalogue printing of his botanical collection led him to serious familly an material troubles. After that he started to move a lot but continued to maintaine friendship with famous Sir James Edward Smith (founder of modern Linnéans Society in London 1788 and also the first president of the society). (C) Since Smith was very influential person in England in 1979 to honour his friend Salisbury he „rename“ Linnéans *Ginkgo biloba* in *Salisburia*. (E) Since it was not in accordance with botany rules this term was not accepted by most of the botanists. *Salisburia* in this part of Ginkgo's nomenclature supposed to change Kaempfer-Linné *Ginkgo* and besides that it was added the name of the genus



1. E. Kaempfer (1651-1716). 2. R. A. Salisbury (1761-1829). 3. P. F. von Siebold (1796-1866). 4. S. Hirase (1856-1925). 5. A. H. G. Engler (1844-1930). (8, 27)

Salisburia, called *adianthifolia* (*adiantifolia*). The name of the genus was gained from the name of the plant that has very similar leaf form to Ginkgo's leaf and it was *Adiantum capillus-veneris* L. (Venus hair - Maidenhair fern). But he has no connection to Ginkgo at all. It belongs to the family *Adiantaceae*, order *Pteridales* (ferns), or in a group of widely distributed wild and wild herbs which is protected in some countries even today. But it's leaf form has influenced in naming Ginkgo in numerous European nations, but not only Ginkgo but also names of some instinct genus of Ginkgo and his relatives, which are known only thanks to the preserved fossils. (10, 27, 47)

Besides above mentioned and the most famous sinonims in past two centuries there were a multitude of invalid names. One of the reasons was idea that maybe some other species of the genus *Ginkgo*, and the appearance of cultivars that were made by selection, mutation or otherwise. Here are some other sinonims for the type of *Ginkgo biloba* L. 1771 of which are still in some countries and some official use: *Ginkgo biloba* var. *epiphylla* (Makino 1929), *Ginkgo biloba* var. *fastigiata* (HJ Elwes - Henry A. 1906), *Ginkgo biloba* form *microsperma* (Sugim. 1977), *Ginkgo biloba* forma *parvifolia* (Sugim. 1977), *Ginkgo biloba* forma *pendula* (Van Geert) (Beissn. 1887), *Ginkgo macrophylla* (K. Koch 1873, *Pterophyllus salisburiensis* (J. Nelson 1866), *Salisburia adiantifolia* var. *pendula* (Van Geert 1862), *Salisburia biloba* (L.) (Hoffmanns 1824), *Salisburia ginkgo* (Rich. 1826), *Salisburia macrophylla* (Reyn. 1854) etc. Let us say that the Thunberg (1743-1828) accepted Linnéans nomenclature, so was often used in the literature to indicate the benefit of Ginkgo, *Ginkgo biloba* - Thunb. Flor. Jap. (D) (1, 2, 3, 4, 24, 27, 47)

3
Dedicated and improper and the official taxonomic classification of the species and genus *Ginkgo*

The evolutionary sequence that resulted in the appearance of species *Ginkgo biloba*, or Ginkgo fruit, still has many unknowns from a variety of reasons. Today we can follow this sequence from type *Tricophitys heteromorpha*, which is in direct relation with a type of *Ginkgo yimaensis* who appeared about 170 million years ago. On that sequence we can link recently discovered species of *Ginkgo apodes* (age about 121 million), and type of *Ginkgo adiantoides* (about 56 million years ago), which is basically a transitional link to the appearance of the preserved species *Ginkgo biloba*. Scientists agrees that this sequence can be traced more than 200 million years and *Ginkgo adiantoides*, according to some, is in fact a todays *Ginkgo biloba* with a very slight or almost no difference. (22, 27)

In the so-called alpha taxonomic classification, we have several categories of classification. These are basic. (1, 2, 3, 37, 48)

(Kingdom) *Plantae*
(urn:lsid:catalogueoflife.org:taxon:d755b8fe-29c1-102b-9a4a-00304854f820:ac2010) (2, 3)

(Division) *Ginkgophyta*
(urn:lsid:catalogueoflife.org:taxon:d7692f06-29c1-102b-9a4a-00304854f820:ac2010) (2, 3)

(Class) *Ginkgoopsida*
(urn:lsid:catalogueoflife.org:taxon:d7693046-29c1-102b-9a4a-00304854f820:ac2010) (2, 3)

(Order) *Ginkgoales*
(urn:lsid:catalogueoflife.org:taxon:d7693186-29c1-102b-9a4a-00304854f820:ac2010) (2, 3)

(Family) *Ginkgoaceae*
(urn:lsid:catalogueoflife.org:taxon:d76932c6-29c1-102b-9a4a-00304854f820:ac2010) (2, 3)

(Genus) *Ginkgo*
(urn:lsid:catalogueoflife.org:taxon:d9996700-29c1-102b-9a4a-00304854f820:ac2010) (2, 3)

(NCBI Taxonomy) (21) cellular organisms
Eukaryota
Viridiplantae
Streptophyta
Streptophytina
Embryophyta
Tracheophyta
Euphyllophyta
Spermatophyta
Ginkgophyta
Ginkgoopsida
Ginkgoales
Ginkgoaceae
Ginkgo
Ginkgo biloba

In presentation such as this one it is neccessary to say something about history of studying Ginkgo in general, even only about some important moments to comprehend origin, classification, evolution, etc. After Ginkgo was brought to Europe, and during 18 century in North America it is obvious that scienetists had to solve or try to solve many misteries and vagueness. Crusial role in it had numerous botanists and other scienetists.

Physiscian and botanists Engelbert Kaempfer (1651-1716) in fact has only described appearance of Ginkgo in Europe, and made Drawing (A) and first one introduced new plant from egzotic Japan in which he stayed from 1690 to 1692 (he started his journey in September of 1689). He had countless unpleasentness with then Japaneese authorithy's which did not allow him to export many chineese cultural artefacts, plants, drawings, writings and similar. His expedition was organized by Dutch company Dutch (United) East India Company (1602-1798), which base was located on Deshima Island (Dutch: Desjima or Deshima, sometimes latinised as Decima or Dezima - Dejima = Jap.). This island was through 17 -19 century base to various commercial companies that communicated and trade with this part of the world i.e. Japan. Deshima is located on Nagasaki river next to the Nagasaki town and it had vital meaning since base was founded in 1635 by Portugal's. DEIC has hold monopol for a long period of years on trading with East including Japan. Kaempfer was the first one that brought ginkgo from Nagasaki to Europe but where has he planted this Ginkgo it is not known. During 18 century Ginkgo is beeing sporadically studied and additionally described by numerous English, French and German botanists. It has even been assumed that the Frenchman Andre Michaux has 1785 first brought ginkgo to America, but this was not true. In 1784 across the Atlantic he was transferred from England by William Hamilton. Indispensable contribution to the knowledge of Ginkgo goes to the Germans Philipp Franz von Siebold (1796-1866) and Joseph Gerhard Zuccarini (1797-1848) which has in the famous work 'Flora Japonica "(Leiden, 1835/42) introduced some wonderful drawings of Ginkgo (volume I, table 136) which they call in just listed synonym "*Salisburia adianhtifolia*". (8, 11, 12, 27, 46)

In 1771 Linnaeus founded the most appropriate botanical name *Ginkgo biloba*, and other botanists establish that it is a plant that is related to conifers, however they form section *Ginkgophyta* ie class *Ginkgoopsida* to which they grant an order *Ginkgoales* (Ginkgo - like plants). In the second half of the 19th century there are more and more fossils of plants that resembled more recently imported Ginkgo, and scientists began to suspect that the Ginkgo is directly related to conifers, and it was indicated by the appearance of leaves, seed appearance, and the fact that it is the bicameral plant, and many suggested that something is wrong. In 1896, Japanese professor Sakugoro Hirase (1856-1925) managed to discover that Ginkgo has a movable sperms. He was able to observe and record the entire process of egg fertilization and embryonic development of fruit on Ginkgo tree in the Botanical Garden of the Japanese Academy in Tokyo. That tree in question is still alive. Sometime later the same was discovered by professor S. Ikeno on the plant *Cycas revoluta* (which also has a long morphological history) and both (Hirase and Ikeno) were awarded in 1912 from the Japanese Academy in Tokyo. One year after Hirase's discovery, in 1897, professor Heinrich Gustav Adolf Engler (1844-1930), after Hirase demonstrated that ginkgo has a intermediate position between hardwoods and conifers, formed a new family - *Ginkgoaceae* (Engler 1897) in which he placed just one gender - *Ginkgo*. It was an important event in the history of maidenhair tree. (G) Let us also to add, that in the mid 19 th century German professor August W. Eichler (1819-1887) has assumed the same and formed a new and just listed family composed of conifers, but called *Salisburiaeae*, which also had only one species specified. But this information linked to the Eichler is not checked, although in his works he mention Ginkgo as *Salisburia*. (6, 7, 30, 32, 34, 38, 39)

4
The use of species name Ginkgo biloba in a variety of world languages

As the cultivation of Ginkgo from the beginning of 18 century began to spread around the world, plant received various names in various small and large nations. The main terms are reduced to a base that was constructed by Kaempfer, and it is "ginkgo" which is based on the speaking area. The significance had an identification with maidenhair or girl's hair, i.e. *Adiantum capillus-veneris* so the names on that basis are quite often. This name has nothing to do with names from China and Japan, so we could say that it is entirely of Western origin. (See pages 26-27)

Valorization

Since ginkgo as a plant in a culture of human civilization emerged relatively early, about 4-5000 years ago, it is understandable that people used him in a variety of purposes, finally in the diet and medical treatment, and named him specifically. Natural habitat, where up to that time Ginkgo survived was China, so the first name derived from this part of the world. As the habitat of Ginkgo spread solely by human intervention over Korea, Japan, to Europe, America and other continents names have changed, and adjusted to the language of a people from that area. Thus, from the original name for ginkgo generated in China like *Bai Guo* and *Yin Xing* emerged a variaty of different names.

The development of botany and collating the nomenclature and taxonomic classification unit formerly called Bai Guo becomes taxon and becomes named Ginkgo, which is according to some Japanese sources derived by E. Kaempfer, and later defined in the modern botanical nomenclature by Carl von Linné in the 1771 as *Ginkgo biloba* (ie - L. 1771) (D). By studying the evolution of ginkgo on the basis of fossils and through comparisons of morphological characteristics, scientists have come to the conclusion that Ginkgo is actually a plant that should be classified by itself and that is in fact a link between conifers and angiosperms. This is the precise value of this plant and it was discovered and proved at the end of 19 century by Japanese scientist S. Hirase. Until then, it was thought that on the Earth there is no longer preserved live plants that could be put in the link together with gymnosperms and flowering plants. *Ginkgo biloba* is the only representative of the (species) of the genus *Ginkgo*, and on the other hand the only representative of the family *Ginkgoaceae*. *Ginkgoaceae* are from the *Ginkgoales* plants who once had many representatives that are extinct. *Ginkgoaceae* belong to the class *Ginkgoopsida* which is the only one in the division of *Ginkgophyta*, i.e. *Ginkgoaceae* plants from the vegetable kingdom (*Plantae* - plants). Therefore, the Ginkgo is herb that has its roots and a direct connection with the plants from the period when they evolved and multiplied in general, and it was a few hundred million years ago.

USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN) (Online Database). National Germplasm Resources Laboratory, Beltsville, Maryland, USA. URL: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?17540

Latest media are now indispensable for any scientific work. So have their own importance and the study of Ginkgo. Below are three very important websites related to taxonomy and nomenclature of Ginkgo. (Pages 23-25)

USDA ARS United States Department of Agriculture
Agricultural Research Service, Beltsville Area
Germplasm Resources Information Network (GRIN)

GRIN Taxonomy for Plants

Common Names | Economic Impacts | Distribution | References | Links | Images

Please tell us why you value GRIN Taxonomy

Taxon: *Ginkgo biloba* L.

Genus: *Ginkgo*
Family: *Ginkgoaceae*
Nomen number: 17540
Place of publication: Mant. pl. 2:313. 1771
Typification: View record from Linnaean Plant Name Typification Project of the Natural History Museum of London.
Name verified on: 17-May-1995 by ARS Systematic Botanists. **Last updated:** 17-Oct-2001
Species priority site is: National Arboretum (NA).
Accessions: 3 in National Plant Germplasm System.

- List all available (and unavailable ☐) NPGS accessions (include images ☐) sorted by number ◉ or name ○.
- List all available (and unavailable ☐) NPGS accessions by country.

See also subordinate taxa:

- *Ginkgo biloba* forma *pendula* (no accessions)
- *Ginkgo biloba* forma *variegata* (no accessions)

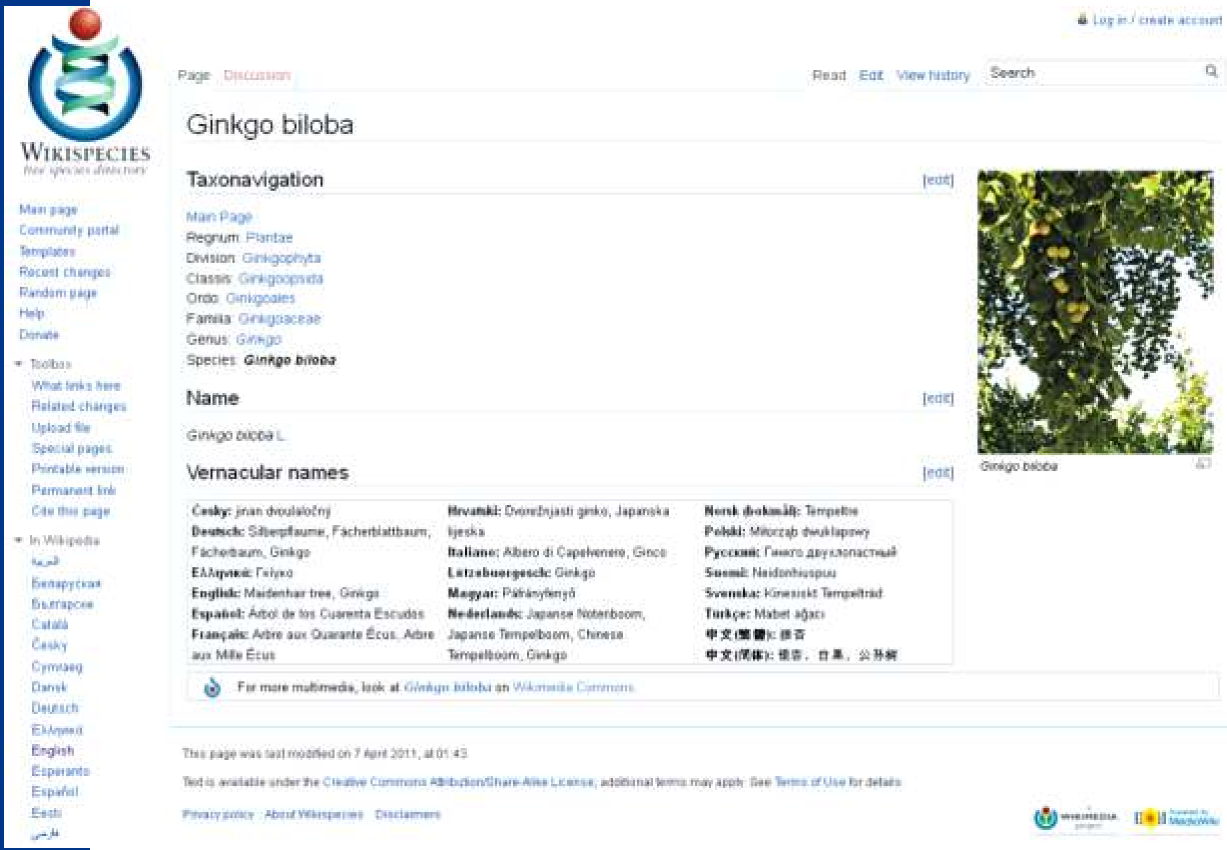
Common names:

- **ginkgo** (Source: World Econ Pl) – English
- **maidenhair-tree** (Source: World Econ Pl) – English
- **ginkgo biloba** (Source: Dict Rehm) – French
- **noyer du Japon** (Source: Dict Rehm) – French
- **Ginkgo** (Source: S. Reichel, p.c.) – German
- **Ginkgobaum** (Source: Dict Rehm) – German
- **icho** (Source: F JapanChw) – Japanese Rōmaji
- **eunhaengnamu** (Source: Kulturpflanze 34:101.) – Transcribed Korean
- **nogueira-do-Japão** (Source: Dict Rehm) – Portuguese

More:

- **see MMPND for additional names in foreign scripts**

Economic importance:



About the Ginkgo is a lot of data on a very popular Wiki website series (Wikimedia): http://species.wikimedia.org/wiki/Ginkgo_biloba.

Integrated Taxonomic Information System, www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=183269 (Welcome to ITIS, the Integrated Taxonomic Information System! Here you will find authoritative taxonomic information on plants, animals, fungi, and microbes of North America and the world. We are a partnership of U.S., Canadian, and Mexican agencies (ITIS-North America); other organizations; and taxonomic specialists. ITIS is also a partner of Species 2000 and the Global Biodiversity Information Facility (GBIF). The ITIS and Species 2000 Catalogue of Life (CoL) partnership is proud to provide the taxonomic backbone to the Encyclopedia of Life (EOL)).

Ginkgo biloba and its cultivars

If you would like to place an order or would like some helpful advice, please call us on 01903 891466 *Open 7 days a week*

The Ginkgo tree makes a remarkable feature in any garden and is renowned for its spectacular yellow autumn colour. Often seen as a large tree in parks and gardens there are many varieties of Ginkgo biloba available some of which can easily be grown in a small garden. All are very well suited to container growing where they will live happily for many years with minimal attention and occasional feeding. We have several ten year old specimens thriving in pots.

Ginkgos are remarkably easy to care for and will grow in most conditions from sun through to shade The Ginkgo tree is completely hardy and often makes an excellent alternative to the Japanese maple. There are particularly dwarf varieties such as Ginkgo biloba 'Troll' which has a very small habit right up to larger columnar growing trees such as Gingko biloba 'Tremonia'. There is a size and shape of Ginkgo for every garden - have a look below for further information.

To read more about growing and maintaining a Ginkgo tree, click here: Big Plant Nursery Guide to growing Ginkgo trees

Ginkgo biloba 'Autumn Gold'
- grows up to 8 metres
- open pyramidal habit
- specimen tree

Ginkgo biloba 'Barabits Nana'
- grows up to 2 metres
- dense, shrubby habit
- great in a container

Ginkgo biloba 'Chi Chi'
- grows 2 to 3 metres
- bushy, dense growth
- ideal for a pot on a patio

Ginkgo biloba 'Fairmont'
- grows up to 5 metres
- tall, slender growth
- adds height in a limited area

Ginkgo biloba 'Horizontalis'
- grows up to 1.5 metres
- wide, spreading habit
- ideal in a pot

Ginkgo biloba 'Mariken'
- grows up to 1.5 metres
- dense, compact growth
- great in a pot or open ground

Ginkgo biloba 'Saratoga'
- grows up to 3 to 4 metres
- pyramidal, shaggy habit
- specimen tree or pot growth

Ginkgo biloba 'Tremonia'
- grows 5 to 6 metres
- narrow, columnar habit
- specimen tree

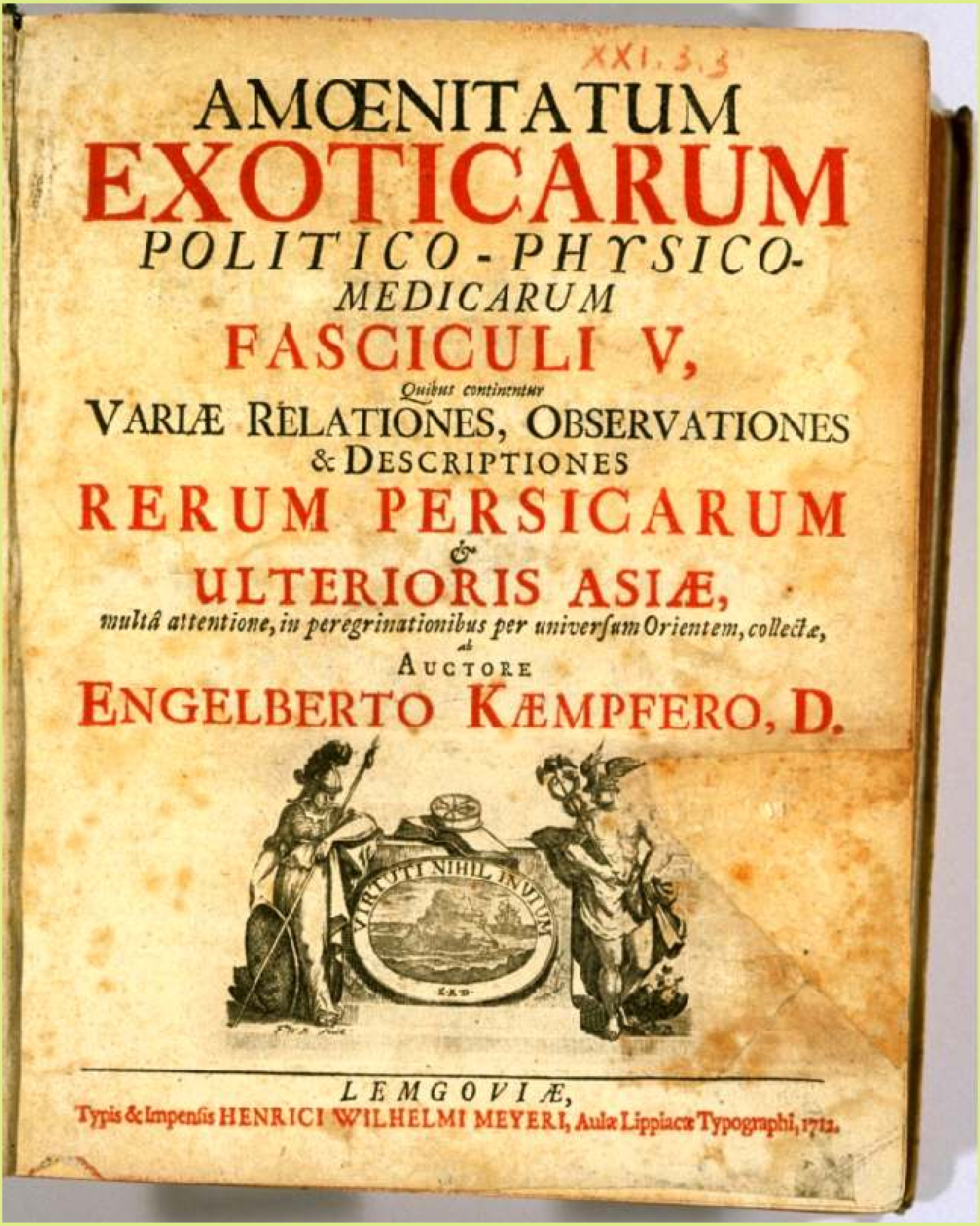
One of the many commercial website Nursery that specializes
in breeding and Ginkgo cultivars. This is front page Big Plant Nursery (England, UK)
http://www.bigplantnursery.co.uk/ginkgos.html

Ginkgo - in the languages of the World

(1, 3, 4, 15, 16, 17, 21, 22, 23, 28, 45) Many more names in here do not these countries and languages, see: http://www.websters-online-dictionary.org/ (Ginkgo)

Arabic	Mabad ag
Croatian	Ginko, Dvorežnjasti ginko, Dvolapi ginko, Dvokrpi ginko, Japanska lijeska
Czech	Jinan dvoulalocný, Ginkgo
Danish	Tempeltree, Tempeltrae
Dutch	Ginkgo, Tempelboom, Japanse notenboom, Waaierboom
English	Maidenhair tree, Ginkgo, Kew tree, Fossil tree, Temple tree, Gingko
Finnish	Neidonhiuspuu, Ginkgo, Temppelipuu
French	Noyer du Japon, Arbre Aux quarante é CUS, Arbre des pagodes, Arbre a noix, Ginkgo
German	Ginkgo, Ginkgobaum, Göethe Baum, Entenfussbaum, Fächerblattbaum, Mädchenhaarbaum, Weisse Frucht, Beseeltes Ei, Tausend taliru, Bajm, Elefantenohrbaum, Goldfruchtbaum, Silberaprikose, Tempelbaum, Japanbaum, Japanischer Nussbaum, Grossvater-Enkel-Baum
Greek	Gkigko dibola, Ginkgo, Γιγκο Gigko, Γινγκο Gingko, Γκίνγκο Gkingko
Hebrew	אונתי-גינקו דו.
Hungarian	Ginkgo, Páfrányfenyõ
Icelandic	Ginkgo, Musteristré, Musterisviður

	Indian (Hindu)	Balkuwari, Ginkgo
	Italian	Ginko
	Korean	Ginkgo, Hangjamok, Gongsonsu, Apgaksu, Okgwamok, Baekgwamok, Eunhaeng
	Lithuanian	Ginkmedis
	Norwegian	Tempeltre
	Polish	Ginkgo biloba, Miłorząb chiński, Miłorząb dwudzielny, Miłorząb dwuklapowy, Miłorząb japoński
	Portuguese	Nogueira-do-Japão, Ginkgo
	Russian	Ginkgo, Гинкго билоба, Гинкго двудольной, Гинкго двухлопастный
	Singapore	Pakgor Su
	Slovak	Ginko, Ginko dvojlaločné
	South African	Ginkgo, Maidenhair tree, Vreekboom
	Spanish	Árbol de oro, Árbol de las pagodas, Árbol de los cuarenta escudos, Árbol de los escudos, Gingo
	Swedish	Tempelträd, Ginkgo
	Syrian	Ginco, Ginkgo biloba
	Turkish	Fosil ağacı, Ginkgo ağacının, Japon eriği, Japon eriği olarak bilinir, Mabet ağacı
	Vietnamese	Quả su Bach, Bạch quả, C ây lá quat, Cãy bạch quả ginkgo
	Esperanto	Ginko

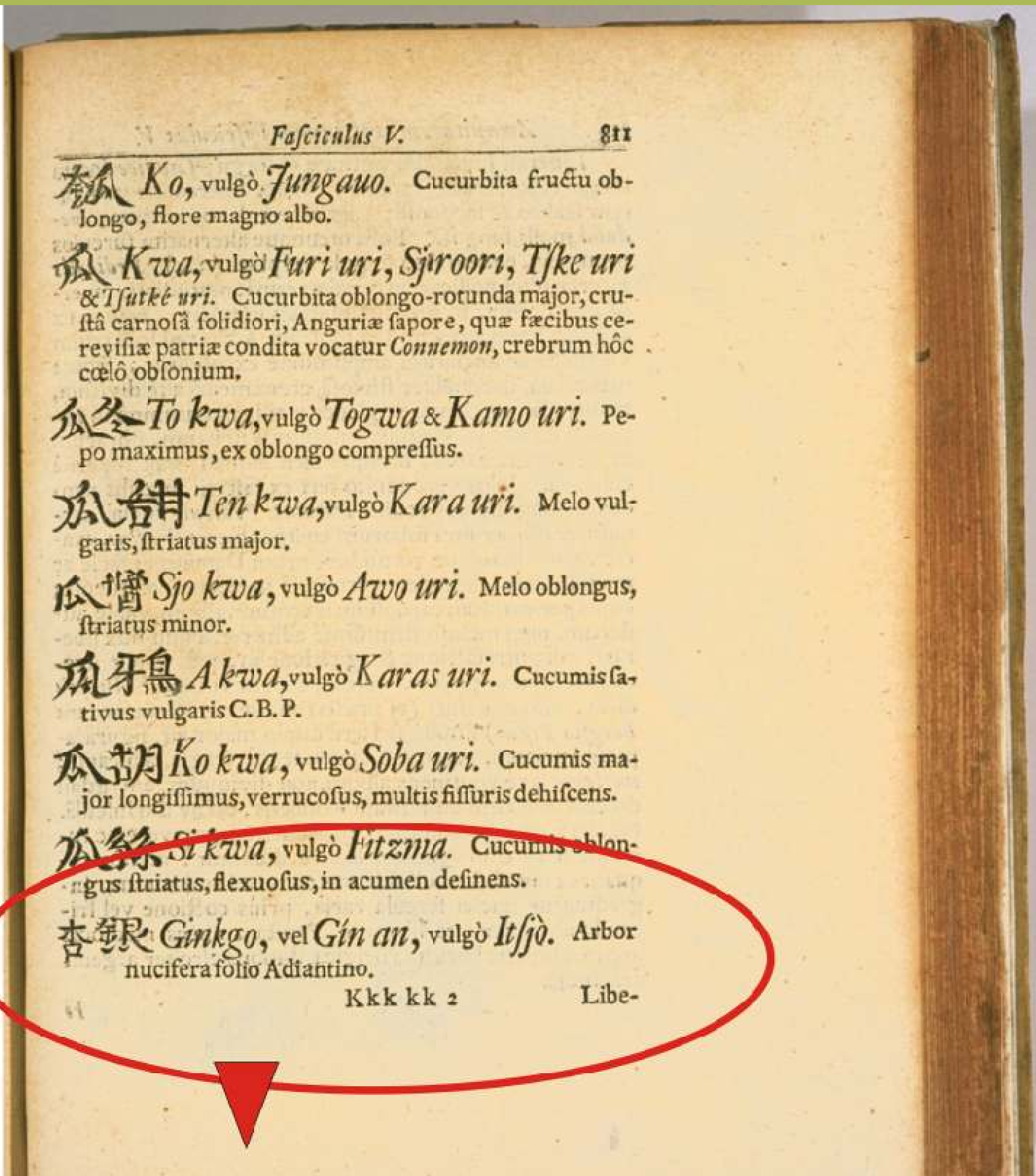


XXI.3.3

AMŒNITATUM
EXOTICARUM
POLITICO-PHYSICO-
MEDICARUM
FASCICULI V,
Quibus continentur
VARIÆ RELATIONES, OBSERVATIONES
& DESCRIPTIONES
RERUM PERSICARUM
&
ULTERIORIS ASIÆ,
multâ attentione, in peregrinationibus per universum Orientem, collectæ,
ab
AUCTORE
ENGELBERTO KÆMPFERO, D.

LEMGOVIÆ,
Typis & Impensis HENRICI WILHELMI MEYERI, Aulæ Lippiacæ Typographi, 1712.

Kaempfer, E., 1712. Amoenitatum exoticarum, Lemgoviae. (40)



瓠 *Ko*, vulgò *Jungauo.* Cucurbita fructu oblongo, flore magno albo.

瓜 *Kwa*, vulgò *Furi uri*, *Sjrroori*, *Tſke uri* & *Tſutké uri.* Cucurbita oblongo-rotunda major, cruſtâ carnoſâ ſolidiori, Anguriæ ſapore, quæ fæcibus cereviſiæ patriæ condita vocatur *Connemon*, crebrum hôc cœlô obſonium.

瓜冬 *To kwa*, vulgò *Togwa* & *Kamo uri.* Pepo maximus, ex oblongo compreſſus.

瓜甜 *Ten kwa*, vulgò *Kara uri.* Melo vulgaris, ſtriatus major.

瓜醬 *Sjo kwa*, vulgò *Awo uri.* Melo oblongus, ſtriatus minor.

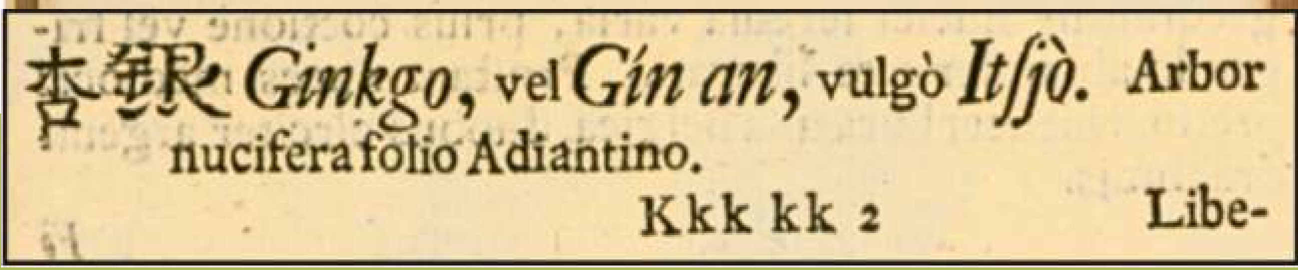
瓜牙鳥 *A kwa*, vulgò *Karas uri.* Cucumis ſativus vulgaris C. B. P.

瓜胡 *Ko kwa*, vulgò *Soba uri.* Cucumis major longiſſimus, verrucoſus, multis fiſſuris dehiſcens.

瓜絲 *Si kwa*, vulgò *Fitzma.* Cucumis oblongus ſtriatus, flexuoſus, in acumen deſinens.

杏銀 *Ginkgo*, vel *Gín an*, vulgò *Itſjò.* Arbor nucifera folio Adiantino.

Kkk kk 2 Libe-



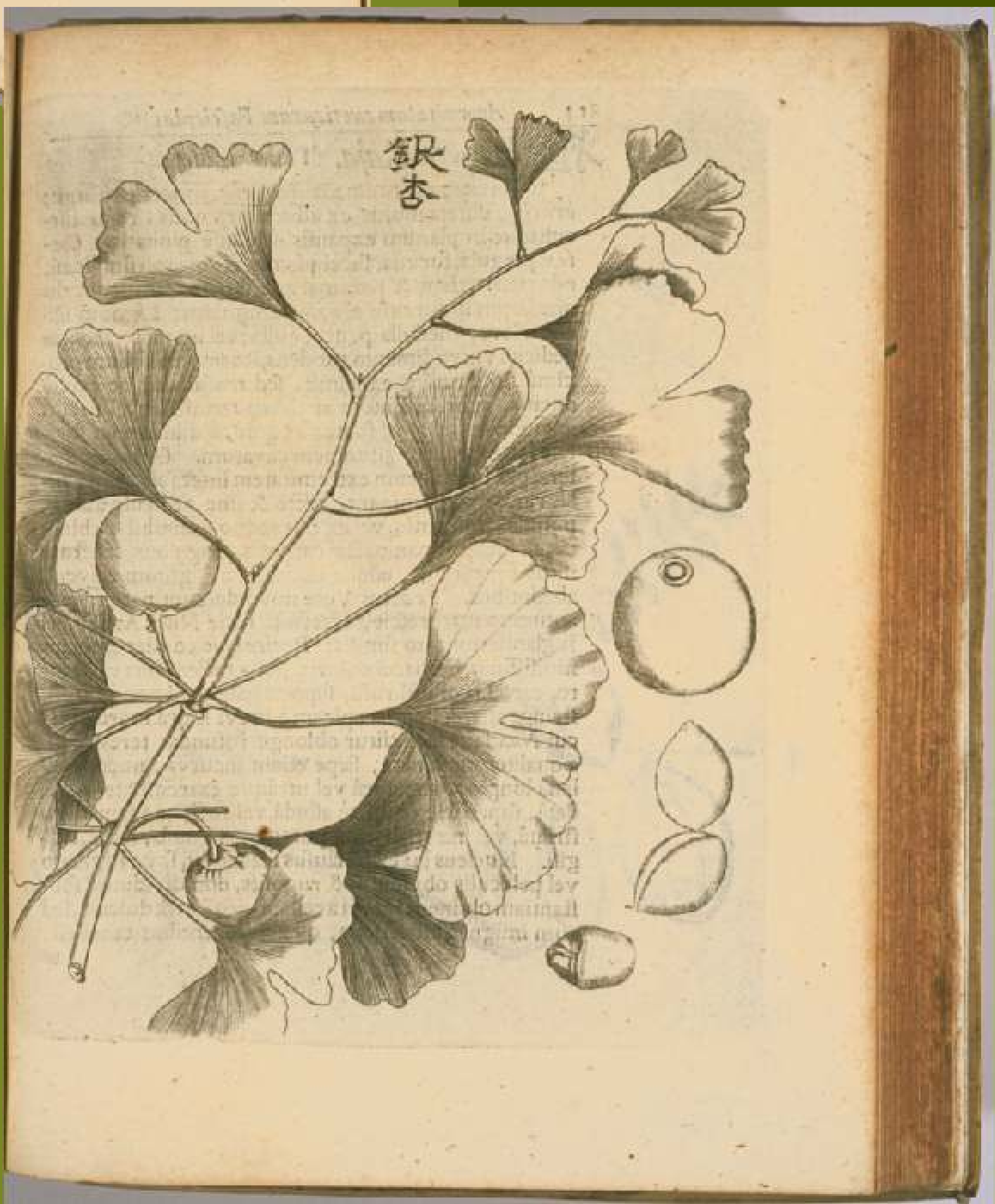
杏銀 *Ginkgo*, vel *Gín an*, vulgò *Itſjò.* Arbor nucifera folio Adiantino.

Kkk kk 2 Libe-


812 *Amœnitatum exoticarum Fasciculus V.*

Liberali Juglandis vastitate exsurgit; *Caudice* dorsali longo, recto, crasso, ramoso; cortice cinereo, ob vetustatem scabro & lacunoso; Ligno levi, laxo, infirmo; *medullâ* molli, fungosâ. Folia utcunque alternatim surculos occupant, eodem loco singula vel plura (3. 4). *Pediculis* incertæ inter pollicarem & palmarem longitudinis, superne compressis, in folii substantiam extensis. *Folium* ex angusto brevi principio in figuram Adianthini folii trium vel quatuor unciarum amplitudine expanditur; fronte orbiculari, inæqualiter sinuosâ, circâ mediū sæpè divisum, tenue, planum, læve, ex glauco viridans, autumnô in rubidum lutescens, virgulis tenuissimis striatum, fibrarum ac nervorum exors, utrâque facie æquali, basi supernè concavâ. Julos vere adulto fert ex fastigiis surculis pendentes longiusculos, polline refertos. *Pediculo* unciali, carnoso, crasso, ex sinu foliorum enato inhæret *Fructus*, exactè vel in oblongum rotundus, pruni Damasceni facie ac magnitudine, superficie verrucosâ in luteum languente; cujus pericarpium carnosum, succosum, album, valde austerum, nuci incluso firmissimè adhæret, à quo nux liberari, nisi putrefactione & agitatione in aquâ, prout Areca Indica, non patitur. Nux proprio vocabulo *Ginnan* dicta, pistaceæ nuci (ei præsertim, quam Persæ vocant *Bergidi Pistâi*) similis, sed fere duplo major est, figurâ lapidis Apricotii, putamine ligneo tenui, fragili, albicante; *nucleum* laxè continens album, non dividuum, amygdali dulcedinem cum austeritate exhibens, carne durjusculâ. Nuclei à prandio adsumpti coctionem promovere, ac ramentem ex cibo ventrem laxare dicuntur: unde nunquam ex mensâ secundâ solennis convivii omittuntur. Ingrediuntur nuclei fercula varia, priùs coctione vel frigendo ab austeritate liberati. Prostant nuces mediocri pretio, videlicet libra una Belgica, duobus circiter argenti drachmis.

Fi



Beautiful very old Ginkgo tree, Uba-jinja shrine, Miyagi Prefecture, Japan. Photos by Shouta Azumi (or “Bachstelze”), Japan.

A) Kaempfer, E. 1712. Amoenitatum Exoticarum, Lemgo (p. 811-812)

(English translation)

"Ginkgo or Gin an, vulgar Itsjó

Those are fruitful trees with leaves like Maidenhair fern. Fruit grows to the size of a walnut and has a long, straight, dense tree with many branches, chapped and rough bark in old age. Its wood is light, soft and weak and heart is soft and similar to a sponge. The leaves grow alternately on the branches, one or more (three or four) in one place and their steam is long, squeezed on the upper part and has capillaries through the leaf. The leaf is small in the beginning, however, after a short time becomes three or four inches wide and resembles the Adiantum leaf (Maidenhair fern), its outer edge is like a bow-shaped, irregular etched in the center of deep-etched, thin, smooth, dark green, but becomes yellow in autumn, and later turns into a red-brown, the leaf is striped with fine nerves throughout the entire surface (both surfaces are similar), but at the beginning of the leaf they are quite committed.

In late spring quite long, drooping tufts appear with a lot of pollen on the top of the branches. On meaty, strong stem, which is several inches long and comes from the same place as the leaf stalk, fruit hangs. Fruit is completely round or oblong shape, a shape and size of plums, and eventually becomes yellow. Tread is fleshy, juicy, white and rather heavy and it keeps itself on the seed that surrounds it, so that she can not get out. Covering decays in water and drains to get a clean nut (seed).

Walnut (seed) is called Ginnan and reminiscent on pistachios (in particular those which the Persians call "Bergjès Pistài"), but is almost double in size. It has the appearance of kernels of apricots and has a thin, fragile, whitish shell, which is unstructured white core, which has a mixed sweet and bitter taste like almonds and it is quite difficult.

Eaten after a meal helps digestion and it is good as a dessert after a sumptuous meal. They can also be served as the main ingredient in several meals, after you remove the bitter taste with cooking or roasting. The seeds are pretty cheap: Belgian pound (about 480 g) costs about two silver drachmas (about 7.5 g of silver)."

(Free translation from Latin into Croatian and English: Blanka Capić & B. Begović, Croatia. 2011/February)

B) Michel, W. 2005. On Engelbert Kaempfer's "Ginkgo"

Research Notes

(Kyushu University, Fukuoka, 6. Dec. 2005)

Revised (Fukuoka, 6 May 2011)

Many authors have questioned why Kaempfer apparently misspelled the name of the ginkgo tree in his ground-breaking Flora Japonica (Amoenitates Exoticae, Fasc. V). Other misspellings in his writings are less important, but the name Ginkgo was introduced into Carl von Linné's botanical nomenclature and is therefore permanently established in the botanical literature. Like many others, I initially believed that it was a mistake by an anonymous typesetter in Meyer's printing shop (Meyersche Hof-Buchhandlung) in Lemgo, where the Amoenitates Exoticae was printed under Kaempfer's supervision in 1712. However, closer examination of the source materials reveal that Kaempfer was the one responsible.

Kaempfer's use of the *Kinmôzu'i*

During his two-year stay (1689–1691) at the Dutch trading post of Dejima (Nagasaki, Japan), Kaempfer obtained two copies of the Kinmōzu'i, a pictorial dictionary edited by Nakamura Tekisai (1629–1702)[1]; both are now held in the Oriental Collections of the British Library. The Kinmōzu'i is a woodblock print that was used for educational purposes and had a marked influence on later similar publications. Some Western authors refer to it as an encyclopedia, but this is a gross exaggeration. The Kinmōzu'i does not address abstract ideas, famous persons or historical events. Rather, it describes 1484 plants, animals, the human body, selected tools and some clothes. Each page includes four frames containing simple illustrations depicting a particular item. The heading is carved in large Chinese characters, and a small amount of included text provides the Sino–Japanese and Japanese readings of these characters, and other colloquial names used in Japan.

Fig. 1a "GINKGO" in *Kinmôzu'i* (1666, private collection).

Fig. 1b GINKGO in *Kinmôzu'i* (1668, private collection).

Kaempfer's linguistic information about the ginkgo tree was taken from book 18 (fruits) of the second edition (1686). While the text in this edition was not changed, the illustrations show a slightly different arrangement (Fig. 1a/b). As Kaempfer could not read Japanese, he placed a reference number in each frame. Most of the botanical entries in his copies of the Kinmozu'i have a second number, placed next to the heading (Fig. 2). These numbers also appear in notes he made during his stay in Japan. Many of the explanations concerning Japanese books were probably given to him by his "assistant" Imamura Gen'emon Eisei (1671–1736), although some notes show that the trading-post interpreters Bada Ichirobei, Namura Gompachi and Narabayashi Shin'emon made important contributions to Kaempfer's botanical studies[2].

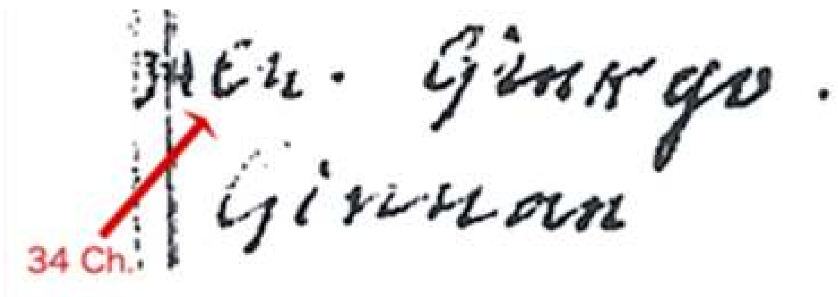


Fig. 2 Kaempfer's note on ginkgo in his Collectanea Japonica
(British Library, Sloane Collection 3062, fol. 256v).

Fortunately, the English physician and naturalist Sir Hans Sloane (1660–1753), one of the most eminent collectors of his day, retained many of Kaempfer's notes, which have survived to the present. In a manuscript volume titled Collectanea Japonica (British Library, Sloane Collection 3062), there are several pages listing the Chinese headings in the Kinmōzu'i[3]. The 34th heading is transliterated' wrongly as "Ginkgo" instead of the more appropriate "Ginkjo" or "Ginkio" (fig. 2). This shows that the long-lasting consequences of the incorrect spelling in Kaempfer's Flora Japonica were not the result of a misprint or misunderstanding during the preparation of the publication, but rather a small mistake by Kaempfer himself.

Fig. 3 Reference numbers in Kaempfer's copy of the Kinmōzu'i (British Library, Oriental Collections, Or.75.ff.1).

The numbers in Kaempfer's notes appear again in one of his copies of the Kinmōzu'i. Here, the frame numbered 296 shows a twig of the ginkgo with an additional number (34) included adjacent to the Chinese heading (Fig. 3). The readings of the two Chinese characters involved are given in Japanese as ginkyō, using the syllable characters gi-n-ki-ya-u, and alternatively as ginan[4] , which was written with the syllable characters gi-n-a-n[5]. The explanations are quite simple, providing further alternative names (fig.4)[6]. Thus there can be no doubt that Kaempfer's Japanese counterpart(s) knew how to read the two Chinese characters.

Fig. 4 Japanese explanation of ginkyo in the Kinmōzu'i (cf. fig. 3)

Unfortunately, Kaempfer's manuscript of the *Amoenitates Exoticae* is preserved only in fragments (British Library, Sloane Collection 2907), and nothing remains of the *Flora Japonica* other than an early draft of 32 pages, entitled "Fasciculus V". This deals with most of the plants in the published version, but gives only very short descriptions (two or three lines) for each item. A vertical line crossing the text on each page indicates that Kaempfer had produced a revised version. In this draft, reference is made to "Itsjo noki" (*Ichō-no-ki*) followed by the Latin word "DESCRIPTIO", but no reference to other names or translations. Evidently the word gingko was included at an advanced stage when he decided to include the linguistic information provied by the *Kinmōzu'i*.

Fig. 5 Amoenitates Exoticae, p. 811.

The letters *y* and *g* in Kaempfer's manuscripts

It could be argued that the letter g in Kaempfer's Collectanea Japonica (Fig. 3) was intended to be y, but in Kaempfer's handwriting each letter shows distinctive features (Fig. 6)[7].

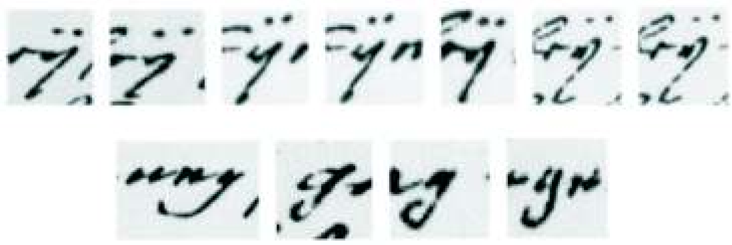


Fig. 6 The letters y (above) and g (below) in Kaempfer's manuscript Heutiges Japan (British Library, Sloane Collection 3060).

When Kaempfer wrote in Latin or used other foreign words, he used a different set of letters, following the custom of his era, but still added two dots above each y. Even when the dots were not present, the lower part of his letter y differed significantly from that in his letter g (Fig. 7).

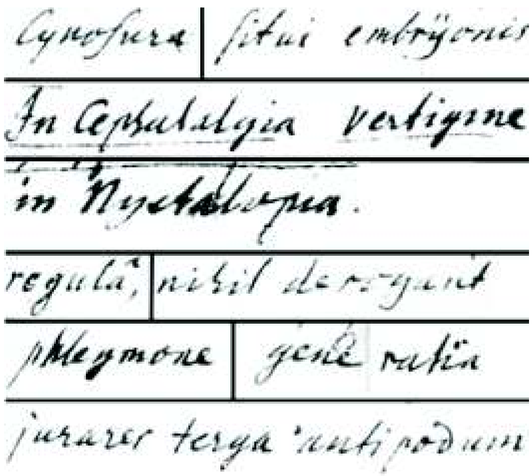


Fig. 7 The letters y and g in manuscript fragments of Kaempfer's Amoenitates Exoticae (British Library, Sloane Collection 3907)[8].

The Japanese syllables kyo or kyo in Kaempfer's manuscripts

Kaempfer's spelling of other Japanese words containing the syllable kyo or kyō (Fig. 8) also warrants examination.

Kaempfer's spelling	Modern transliteration (Chinese character)
Kiobas	Kyōbashi (京橋)
Tei Gjo	Teigyō (帝堯)
Gjo / Gio	Gyō (堯)
Gjogji	Gyōki (行基)
Gjosja	gyōja (行者)
Gjenno Gjosja	En-no-gyōja (役行者)
Nengjosi feja	nengyōji heya (年行司部屋)
Nengjosi	nengyōji (年行司)
Dsjo Kio	Jōkyō (貞享)
In Kjòo / In Kio	Ingyō (允恭)
Bugjo / Bugjos (*pl.*)	bugyō (奉行)
Dsi Sja bugjo	jishabugyō (寺社奉行)
Kjo kai	gyokai (魚貝、魚介)
Kingjo	kingyo (金魚)
Nîtzi Jósi / Nitz gjósi	nichigyōshi (日行使)
Dsjojosi	jōgyōji (常行司)
Kijo mòri / Kio mori / Kijomòri	[Taira-no-]Kiyomori [平]清盛
Kiomids / Kiomitz / Kijomitz	Kiyomizu (清水)

Fig. 8 Kaempfer's spelling of Japanese words containing the syllables kyo, gyo and ki-yo in his manuscript Heutiges Japan (British Library, Sloane Collection 3060).

Kaempfer clearly had great difficulty in distinguishing Japanese syllables such as ji and ja, which are not compatible with the German phoneme system. As with all Westerners at Dejima, Kaempfer tended to ignore certain phonemes or attributed them incorrectly to what he believed were similar ones in his native language. However, this was not the case for Japanese syllables such as kyo or gyo, which were quite consistently transliterated as kio/kjo and gio/gjo, respectively (Fig. 9). Occasionally Kaempfer was able to distinguish kyo from the syllable combination ki-yo, which is difficult even for advanced Western learners of the language. Examination of the Japanese plant names printed in the Amoenitates Exoticae leads to the same conclusion, with the only odd exception being “Ginkgo”.

Kaempfer's spelling	**Modern Transliteration (Chinese character)**	***Amoenitates Exoticae***
Kikjo	kikyō (桔梗)	p. 823
Uikio	uikyō (茴香)	p. 825
Kjoo	kyō (薑)	p. 826
Kjo	kyo (苣)	p. 831
Kjókuso	gyokusho (玉黍)	p. 835
Kjo	kyō (蕎)	p. 835
Sokio	sōkyō (皂莢)	p. 841
Jen no gjosa	En-no-gyōja (役行者)	p. 463
Rengjo	rengyō (連翹)	p. 907

Fig. 9 Kaempfer’s spelling of Japanese words containing the syllables kyo and gyo in the Amoenitates Exoticae.

Conclusion

Kaempfer’s representation of Japanese words was very inconsistent for certain phonemes. In addition, he was apparently careless about the significant difference between long and short vowels. However, a word such as ginky ōshould not have been an issue for him. As the syllables kyo and gyo are written as “kio”/“kjo” and “gio”/“gjo” throughout his manuscripts, Kaempfer should have chosen “Ginkjo” or “Ginkio” rather than “Ginkgo”. As his notes show, this mistake occurred in Japan. Following his return to Lemgo there would have been no way for him to check the validity of his transliterations, and “Ginkgo” thus found its way into the Amoenitates Exoticae, and from there into Linné’s nomenclature. One wonders what might have led to such a simple mistake being made. Perhaps Kaempfer and his Japanese counterparts had been sipping the liqueur that he mentions in the preface to The History of Japan, or perhaps it was one of those many sticky days that occur in Kyushu between May and September, when life slows and tiny details lose their importance.

1 Nakamura Tekisai: Kinmozu’i. Kyoto: Yamagataya, 6th year of Kambun Era [= 1666] (中村惕　取河　蒙　［京都］：山形屋、　文六弇 Nakamura Tekisai: Kinmozu’i, Kyoto: Kyukodo, 3rd year of Jokyo Era [= 1686] (中村惕　『　蒙　　换识：九　堂、　享三年).
2 Especially the senior interpreter Narabayashi Shin’emon (1648–1711), also known as Chinzan (　A林山), was well versed in medical and botanical matters. Wolfgang Michel: On the Background of Engelbert Kaempfer’s Studies of Japanese Herbs and Drugs. Journal of the Japan Society of Medical History, Vol. 48 (2002), No. 4, pp. 692–720.
3 British Library, Sloane Collection, No. 3062 (Collectanea Japonica), fol. 256v–263v, 265v– 280v.
4 唐音 (toin or to-on): Chinese readings introduced to Japan since the Kamakura period. This term is sometimes combined with later Muromachi-era translations, so-on (宋音), to make toso-on (唐宋音). These unsystematic readings were brought to Japan by monks and traders. They are confined to certain words, including futon (蒲　, chin. pútuán), andon (行　, chin. xíngdeng) and min (明, chin. míng).
5 The reading and writing of plant names in Chinese characters varies substantially depending on the century in which the particular Chinese name came to the archipelago. In the vastness of the Chinese empire, different characters (names) were sometimes used for the same plant. In other cases the same character was used for different plants. When such names arrived in Japan further misunderstandings occurred. Modern botanical publications prefer to use the botanical name and an established Japanese name in kana syllables.
6 Modern dictionaries read　杏 as ginnan (ぎんなん) and icho (いちょう). The Kinmozu’i also gives the

Chinese name ‘duck foot’ (脚, chin. yaqiăo, jp. okyaku), which refers to the shape of the ginkgo leaves, and ‘white fruit (tree)’ (白果, chin. báiguo, jp. hakka). However, it does not mention the old name ‘grandfather–grandson tree’ (公 O, chin. gongsunshu, jp. kosonju), which is said to be a reference to the long time required until the nuts of ginkgo trees can be harvested.
7 For more on Kaempfer’s transliteration of Japanese words, see Wolfgang Michel: Engelbert Kaempfers Beschäftigung mit der japanischen Sprache. In: Detlef Haberland (ed.): Engelbert Kaempfer. Werk und Wirkung. Stuttgart: Boethius, 1993, pp. 194–221.
8 For more on Kaempfer’s handwriting, see Engelbert Kaempfer: Heutiges Japan. Kritische Edition. Herausgegeben von W. Michel und B. Terwiel, München: Iudicium, 2001, Vol. 1/2, 757 pp.

C) The Linnean Society of London - “Spiritual founder Linné, and Smith, executor of the spiritual” (Source: http://www.linnean.org/index.php?id=50, http://www.linnean.org/index.php?id=51)

Sir James Edward Smith was born in 1759 in Norwich, the eldest son of James Smith, a wealthy wool merchant, and showed an early interest in flowers. His study of botany as a science began when he was eighteen and then, it is said, on the very day of Linnaeus' death. As it was possible at that time to attend lectures on botany only as part of a medical course, in 1781 Smith went to study medicine at Edinburgh University. Here he met Dr. Hope, Professor of Botany, and the first to teach the Linnaean system in Scotland. At the age of 22, Smith and a few friends decided to form a natural history society in Edinburgh through which they established a collection of Scottish native plants. Dr. Hope was made an honorary member.
In 1783, Smith returned to London to continue his medical studies under John Hunter and William Pitcairn. Following the death of Linnaeus in 1778 and then, five years later, Linnaeus' son, Carl (who had inherited his father's collection), Sir Joseph Banks, an acquaintance of Smith, was offered the whole collection for 1,000 guineas. Banks declined the offer, but urged Smith to make the purchase himself. Smith agreed, and the collection of nearly 3,000 books, plants, minerals, insects and manuscripts arrived in London in October, 1784. Smith hired rooms in Chelsea to display the collection. On the strength of the surrounding publicity, he was made a Fellow of the Royal Society.
In 1785, Smith, the Rev Dr Samuel Goodenough and Thomas Marsham agreed to form a new society dedicated to natural history. However, Smith, now aged 27, decided to take the grand tour of Europe and in 1786, financially supported by his father, he visited France and Italy as well as taking time to complete his medical doctorate in Leyden.
In February 1788, Smith returned to the coffee houses of London which formed the backdrop to the intensifying debate and discussion in the natural sciences. His interests increasingly moved away from his medical studies to focus more and more on natural history.
On Tuesday, 26th February 1788, the seeds of the natural history society that exists to this day were sown in the Marlborough Coffee House, London. The Society's first meeting took place on 8th April 1788 at Smith's home when the name The Linnean Society of London was taken, with Smith appointed as the first President - a position he held until the end of his life.
In 1790, Smith started on his first major work, English Botany, which brought him the acquaintance of leading botanists. In 1793, Smith published his book *Sketch of a Tour on the Continent*, describing his travels in Europe. As well as lecturing widely, he instructed Queen Charlotte and the Princesses in botany and zoology. In 1796, Smith married Pleasance Reeve, and subsequently moved to Norwich.
During 1784-1787 John Sibthorp, the Oxford Professor of Botany, was travelling and collecting plants in Greece and Asia Minor. On his return to England, he started working on the folio *Flora Graeca* (1806-1840), but died soon afterward. Smith was appointed as the "competent botanist" to prepare the work for publication. By the time of his death, Smith had completed seven and a half volumes of the work which included beautiful plates by Ferdinand Bauer.
At the turn of the 19th century, Smith published the first two volumes of *Flora Britannica*. This comprehensive flora of Britain was far superior to previous British floras, and even today remains valuable for its identification of plants mentioned in pre-Linnaean botanical literature. In 1808, Smith agreed to write for Abraham Rees, the editor of the *Cyclopaedia* or *Universal Dictionary*, eventually contributing 3,348 items on botany as well as brief biographies of 57 botanists.
Smith's health, never good, began to decline seriously during the last five years of his life. However, he was still writing, and his last book was *The English Flora* (4 vols., 1824-1828) a much expanded version of his earlier *Flora Britannica*. Smith died in 1828. He left all his own collections, Linnaeus' collections, and his books and prints, to his executor, William Drake, to be sold all together in one lot to a public or corporate body. These collections were eventually purchased by the Society for £3,150, a vast sum in 1828, and one which incurred a heavy debt which was not completely paid off until 1861.

Linnaeus was born in 1707, the son of a Lutheran clergyman, at Rashult in Sweden. He began to study medicine at the University of Lund in 1727, transferring to the University of Uppsala the following year. Linnaeus headed an expedition to Lapland in 1732, travelling 4,600 miles and crossing the Scandinavian Peninsula by foot to the Arctic Ocean. On the journey he discovered a hundred botanical species. In 1734, he mounted another expedition to central Sweden.
He undertook his medical degree in 1735 at the University of Harderwijk in Gelre, the Netherlands (which no longer exists), thence going to the University of Leiden for further studies. Also in 1735, he published *Systema Naturae*, his classification of plants based on their sexual parts. His method of binomial nomenclature using genus and species names was further expounded when he published *Fundamenta Botanica* (1736) and *Classes Plantarum* (1738). This system used the flower and the number and arrangements of its sexual organs of stamens and pistils to group plants into twenty-four classes which in turn are divided into orders, genera and species.

A Binomial Naming System

In his publications, Linnaeus provided a concise, usable survey of all the world's plants and animals as then known, about 7,700 species of plants and 4,400 species of animals. These works helped to establish and standardize the consistent binomial nomenclature for species which he introduced on a world scale for plants in 1753, and for animals in 1758, and which is used today. His *Systema Naturae* 10th edition, volume 1(1758), has accordingly been accepted by international agreement as the official starting point for zoological nomenclature. Scientific names published before then have no validity unless adopted by Linnaeus or by later authors. This confers a high scientific importance on the specimens used by Linnaeus for their preparation, many of which are in his personal collections now treasured by the Linnean Society.

Academic Career

In 1738, he went to Stockholm to practice medicine and lecture, and became a professor at Uppsala University in 1741, attracting students from many countries to his often crowded lectures. Twenty-three of Linnaeus' students themselves became professors and this spread his methods widely, as did his extensive correspondence with leading naturalists all over Europe. He was granted nobility in 1761, becoming Carl von Linné. He continued his work of classification and as a physician, and remained Rector of the University until 1772. In that decade, he suffered from strokes, ill health, and memory loss until his death in 1778.

D) CAR. A LINNÉ EQU. AUR. MANTISSA PLANTARUM ALTERA GENERUM editionis VI. & SPECIERUM editionis II. HOLMIÆ, IMPENSIS DIRECT. LAURENTII SALVII, 1771. (p. 313-314) & C. P. Thunberg, FLORA JAPONICA, LIPSIAE 1784 (p. 358-359)

"APPENDIX.

biloba. GINKGO. *Kæmph. amæn.* 811. t. 813.

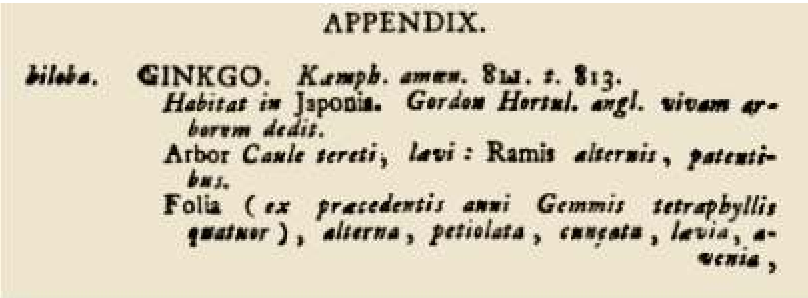
Habitat in Japonia. *Gordon Hortul. angl. vivam arborem dedit.*

Arbor *Caule tereti, lavi:* Ramis *alteris, patentibus.*

Folia *(ex pracedentis anni Gemmis tetraphyllis quatuor), alterna, petiolata, cuncata, læevia, avenia, suhtus, striata, extimo retundata, biloba, erosa, obtusa.*

Petioli *longitudine folii basii supra pubescentes, laves, teretes, supra plani, stricti, apice excurrentes utrinque sub folio. Fructificatio non dum innotuerat, prater ca quæ habes Kæmpherus."*

(Source: text continues the pagination of, and is bound with: Car. a Linné Mantissa plantarum. Holmia : Impensis Direct. Laurentii Salvii, 1767 (vol. I). This is my opportunity to specify that an exemplary preserved in the library Prof. Ž. Dolinar Ph.D. in Basel, Switzerland. I thank him posthumously on the part of a transcript from 2001.)


APPENDIX.

biloba. GINKGO. *Kæmph. amæn.* 811. t. 813.
Habitat in Japonia. *Gordon Hortul. angl. vivam arborem dedit.*
Arbor *Caule tereti, lævi :* Ramis *alternis, patentibus.*
Folia *(ex præcedentis anni Gemmis tetraphyllis quatuor), alterna, petiolata, cuneata, lævia, avenia,*

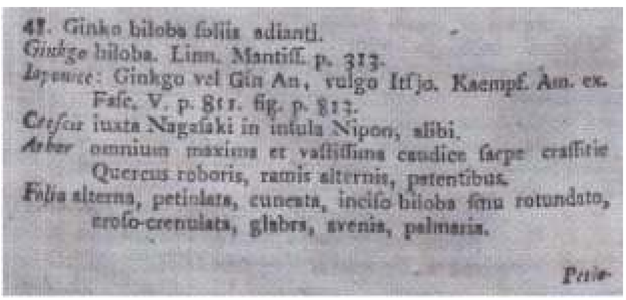

CAR. A LINNÉ
Equ. Aur.
MANTISSA
PLANTARUM
ALTERA
GENERUM editionis VI.
&
SPECIERUM editionis II.
HOLMIÆ,
Impensis Direct. LAURENTII SALVII,
1771.

Thunberg, Fl. Jap., 1784. pag. 358-359


CAROLI PETRI THUNBERG
FLORA
IAPONICA
PLANTAS
INSULARUM IAPONICARUM
SYSTEMA SEXUALE EMENDATUM
XX CLASSES, ORDINES, GENERA
ET SPECIES
LIPSIAE

"48. Ginko biloba foliis adianti.

Ginkgo biloba. Linn. Mantiss. p. 313.
Japonice: Ginkgo vel Gin An, vulgo Itsjo. Kaempf. Am. ex. Fasc. V. p. 811. fig. p. 813.
Crescit iuxta Nagasaki in insula Nipon, alibi.
Arbor omnium maxima et vastissima caudice saepe crassitie Quercus roboris, ramis alternis, patentibus.
Folia alterna, petiolata, cuneata, inciso biloba sinu rotundato, erofo-crenulata, glabra, avenia, palmaria.
Petiolus longitudine folii, basi supra pubescentes, semiteretes, apice utrinque in marginem folii excurrentes.
Flores forsan dioici, nunquam a me visi.
Drupa ovata, flavescens, glabra, magnitudine pruni carne austera.
Nux ovata, angulis duobus apiceque acutis, magnitudine amygdali, glabra, tenuis.
Nucleus pellicula albido-brunnea cinstus, viridi-albus.
Fructus, demto cortice, viridis a laponensibus editur; crudus, insipidus et amaricans est; levissime vero, ante detractionem *corticis* albi, super carbones assatus fatis bene sapit."


48. Ginko biloba foliis adianti.
Ginkgo biloba. Linn. Mantiss. p. 313.
Japonice: Ginkgo vel Gin An, vulgo Itsjo. Kaempf. Am. ex. Fasc. V. p. 811. fig. p. 813.
Crescit iuxta Nagasaki in insula Nipon, alibi.
Arbor omnium maxima et vastissima caudice saepe crassitie Quercus roboris, ramis alternis, patentibus.
Folia alterna, petiolata, cuneata, inciso biloba sinu rotundato, erofo-crenulata, glabra, avenia, palmaria.
Petio-

E) TRANSACTIONS OF THE LINNEAN SOCIETY. VOLUME III. MISSOURI BOTANICAL GARDEN. LONDON: PRINTED by J. DAVIS. SOLD AT THE SOCIETY'S HOUSE, No. 10, PANTON-SQUARE, COVENTRY-STREET, AND BY BENJAMIN AND JOHN WHITE, FLEET-STREET. M.DCC.XCVII.

(p. 330-332)

XXVII. *Characters of a new Genus of Plants named* SALISBURIA.
By James Edward Smith, M.D. F.R.S.P.L.S.
Read December 6, 1796.
SALISBURIA.
MONOECIA *Polyandria.*
CHAR. GEN.

MASC. *Amentum* nudum, filiforme. *Antheræ* incumbentes,
deltoideæ; loculis apice tantum connexis.
Fœm. folitarii. *Calyx* 4-fidus, perfiftens. *Drupa* fupera, globosa,
putamine triangulo. *Semen* albuminofum, bicotyledoneum.

SALISBURIA *adiantifolia*

Ginkgo, vel Ginan, vulgo Idsio, arbor nucifera, folio adiantino.
Kæmpf. Am. Exot. 811, cum icone.
Ginkgo biloba. *Linn. Mant.* 313.
Ginko biloba, foliis Adianti. *Thunb. Fl Jap.* 358.

DESCR. FRUCT. *Pericarpium*, *Drupa* pallide fusca, supera, globosa; *caro* dura, crassa, putamini aretissime cohærens; *putamen* tenue, osseum, ovale, triangulum, glabrum, apice acutum, uniloculare. *Semen* folitarium, ovale, basi angustatum, magnitudine fere putaminis; *integumenta* duo, fusca, membranacea; alterum putamini adhærens, alterum femini; *albumen* virescente-album, femini conforme, amygdalinum; *embryo* luteus, basi albuminis insertus, rectus, bicotyledoneus.

This is a large not inelegant tree, cultivated in China and Japan. The nuts are eatable, and fweet, but not produced till the tree arrives at a considerable age; nor has it been long enough in England to attain a sufficient degree of maturity. The male flowers however have been observed for these two years past, early in the spring, in Kew gardens. The tree itself has long been admired for its handfome fan-shaped leaves, cloven about half way from their summit; but they can by no means be termed *biloba*, or two-lobcd, as that denomination requires the segments should be rounded. These leaves are also irregularly notched like those of the *Zamiæ*, thickened at the margin, smooth, striated on each fide with numerous parallel nerves.

The genus is named in honour of *Richard Anthony Salisbury, Esq. F.R.S.* and *F.L.S.* of whose acuteness and indefatigable zeal in the service of botany no testimony is necessary in this society, nor in any place which his writings have reached.

Salisburia should be placed in the Linnæan system between *Querqcus* and *Juglans*. In that of M. de Jussieu it belongs to the sisth order of his 15th class, after *Taxus*, though it is not very nearly allied to any genus whatever. I have preferred *adiantifolia* for a specific name, becaufe *biloba* is not correct, and *adiantifolia* has not only been used long ago by Kæmpfer and Thunberg, bot is peculiarly apposite in this case; my friend whose name I wish the plant in question to perpetuate, having distinguished himself by the application of such comparative specific names, and preferring them to all others.

The generic name of *Ginkgo*, being equally uncouth and barbarous, was retained by Linnæus in an Appendix, only till the flowers should be discovered, and the plant referred to its proper place in the System.

F) Note from Prof. Zhiyan Zhou Ph.D. (State Key Laboratory of Palaeobiology and Stratigraphy, and Department of Palaeobotany and Palynology, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences) (30/6/2010 e-mail)

"Yajiao (new spelling - Hanyupinyin = the phonetic transcriptions of Chinese characters) means the foot (jiao) of duck (ya); yinxing means silver (yin) apricot (xing); baiguo (bai = white, guo = fruit); kungsunshu (now spelled as gongsunshu means grandfather (gong) grandson (sun) tree (shu) because of the longavity of the tree and that it takes many years (more than 20 years) after planted (by grandfater) to yield the fruit (seed) (and can be eaten by his grandson). Yachio, Yinhsing, peikuo are old spellings of yajiao, yinxing and baiguo respectively. I don't know Ling Xing which may be a wrong spelling of Yinxing. Now we called the tree Yinxing (shu), the leaf Yinxingye (ye means leaf) and the fruit baiguo or yinxing."

G) History of discovery of spermatozoids in Ginkgo biloba and Cycas revoluta,

Ogura Yuki

(Department of Botany, Faculty of Science, University of Tokyo, Tokyo, Japan)

Phytomorphology, (1967, vol. 17, p. 109 - 114)

lt is well known that the spermatozoids of *Ginkgo biloba* and *Cycas revoluta* were discovered in 1896 by S. Hirase and S. Ikeno, respectively, and that it was the first record which proved the existence of motile spermatozoids in gymnosperms. A short sketch of their discovery is given here, as a scene of botanical history in Japan at the end of the l9th century. The detailed description on the structure and development of sexual organs of these plants will not be given as it is not the object of this communication.

Spermatozoids in *Ginkgo biloba*

Sakugoro Hirase (1856-1925) was a drawing technician and was employed in 1888 at the College of Science, Imperial University, Tokyo, and engaged at the Botanical Laboratory to draw the plant specimens. He became an assistant and learned himself the techniqne of botanical studies and since 1893 began to observe the period of fertilization and embryo formation in *Ginkgo biloba* (Hirase, 1894a), which was not fully known, though it was investigated by some botanists such as Strasburger (1892). He made microscope preparations of the ovules of *Ginkgo* (Hirase, 1894b) and found a peculiar radiated structure, attraction sphere, in the pollen tube within the ovule, and further found the existence of two archegonia in the 'endosperm' and canal cells in the archegonium. He could trace the period of fertilization as the middle of September (Hirase, 1895a, b). Much attention was then centered to the peculiar body within the pollen tube, which was ellipsoid in form and provided with a snail-like coiled band, on which numerous cilia were borne. He considered such a body to be a spermatozoid and gave an address on April *25*, 1896, at the meeting of the Tokyo Botanical Society, under the title "Spermatozoid of *Ginkgo biloba"* (Hirase, 1896a). He found such a ciliated body only in microscopic preparations, hut he expected it to be motile. In order to observe the living spermatozoids, he cut numerous ovules and succeeded in finding the motile ones on September 9 of the same year, and gave an address about it on September 26, at the meeting of the Tokyo Botanical Society and published it in the Qctober number of the Botanicai Magazine of the Society (Hirase, 1896b). Further researches on spermatogenesis, fertilization and embryo formation were carried on, and the results were published a little later (Hirase, 1898; Fig. 1). Through his researches, the hfe history of *Ginkgo* was made clear. At Tokyo, pollination took place between the end of April and early May, and fertilization between the end of September and middle of October.

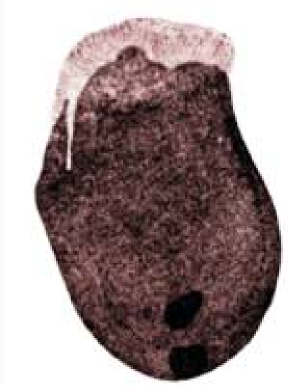


Fig. 1 — A spermatozoid of *Ginkgo biloba,* released out of the pollen tube; the spermatozoid body is partly covered by protoplasmic mass; cilia are drawn so finely that they are scarcely visible. x 750 (after Hirase, 1896).

After the discovery of spermatozoids his colleagues of the University discussed and reinvestigated his results, and confirmed them to he mostly correct. Some other workers also observed motile spermatozoids (Fujii, 1898, 1899a, 1899b, 1899c, 1900; Ikeno, 1899a, 1901; Miyake, 1902; Miyoshi, 1896).

Fig. 2 — Ginkgo biloba. A giant female tree in the Botanical Garden of the Imperial University of Tokyo, Koishikawa, Tokyo, from which Hirase discovered the spermatozoids; photographed nearly in 1900.

Shortly after his work on *Ginkgo,* Hirase left the University and became a teacher of a middle school at Hikone and then at Kyoto, and died at Kyoto in 1925. lt may be rememhered that he accomplished difficult researches on the life history of *Ginkgo biloba* by his own endeavour and ingenious experiments, notwithstanding he was not a trained botanist. The *Ginkgo* tree from which he used to collect his materials was a big female tree growing in the Botanical Garden of the University (Fig.2). This is still growing there.

Spermatozoids in *Cycas revoluta*

Seiichiro Ikeno (1866-1943) graduated in 1890 in botany from the College of Science, Imperial University at Tokyo, studied botany at the newly established College of Agriculture of the same University, and became an Assistant Professor.

He carried on investigations on *Cycas revoluta,* since 1895, in order to observe the structure and development of sexual organs, especially the process of fertilization and embryo formation, which was investigated to some extent by others, such as Treub (1881, 1884) and Warming (1877, 1879), in some species of the Cycadaceae. He made numerous microscopic preparations of the ovules of *Cycas* and observed canal cells in the archegonium which were at that time considered to be absent in the Cycadaceae (Ikeno, 1896a). During these observations he found, in the spring of 1896, the large body with a coiled band and provided with cilia within the pollen tube. lt was just the time when Hirase reported the existence of spermatozoids in *Ginkgo,* and Ikeno concluded such a body in *Cycas* also to be the spermatozoid, though he found it only in preparations, and announced it in the November number of the Botanical Magazine of the Tokyo Botanical Society (Ikeno, 1896c).

Further detailed work on the development of pollen tube, spermatogenesis, fertilization and embryo formation was carried on, and the life history of *Cycas revoluta* was described by him (Ikeno, 1898a; Fig. 3) a little later. He recognized that during spermatogenesis the centrosomal structure on one side of the sperm-body elongated into a blepharoplast, on which numerous cilia were borne (Ikeno, 1898c, 1899b).

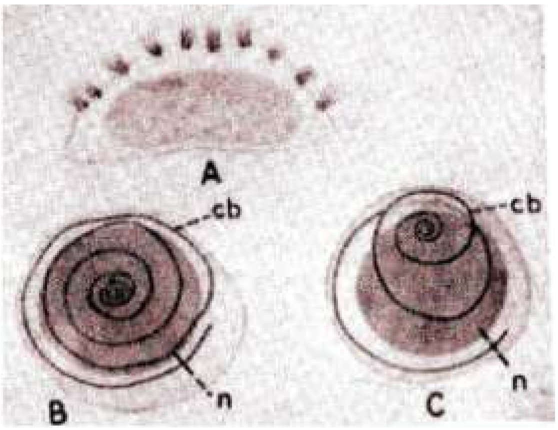


Fig. 3A-C - Spermatozoids of *Cycas revoluta (cb,* centrosome-band (blepharoplast) *; 'n,* nucleus). A. Median section, showing five turns of ciliated spiral band. x 270. **B**, **C.** Optical section, showing centrosome-band on which cilia are not shown. **B** from above; **C** from oblique side. x 110 (after Ikeno, 1898a).

Cycas revoluta was cultivated in Tokyo, but the seeds were not formed, as Tokyo was a little cold for fertihzation. Therefore, Ikeno and his colleagues collected the material from Kagoshima and Tanegashima, south of Kyusyu. *Cycas* trees from which Ikeno discovered the spermatozoids (Fig. 4) are still alive in the garden of the Kagoshima Prefectural Museum (formerly the Kogakukan). lt was ascertained by Ikeno that, at Kagoshima, pollination took place during June and July and fertilization during September and October. Kagoshima was far from Tokyo, and he could not collect fresh ovules as he wanted and, therefore, he lost the opportunity of observing motile spermatozoids. lt was Miyake (1905, 1906) who reinvestigated *Cycas* and observed motile spermatozoids at Naze of Oshima, Oshima Island, Kagoshima and Onezime of Kagoshima, Kagoshima Prefecture, at the end of September, 1899.

After his researches on *Cycas* Ikeno continued botanical studies as a Professor in the same College, until he retired in 1927. He died in 1943 at Tokyo. The microscopic preparations which he made during his investigations on *Cycas* are kept at present in the National Science Museum at Tokyo.

Fig. 4 - *Cycas revoluta,* male and female plants in the garden of the Kogakukan, Kagoshima, from one of which Ikeno discovered spermatozoids; photographed nearly in 1900.

Spermatozoids in Gymnosperms

Through the researches of Hirase, Ikeno and their colleagues the existence of motile spermatozoids in *Ginkgo biloba* and *Cycas revoluta* has been proved and, thus, Hirase and Ikeno are recorded in the history of botany as the first discoverers of spermatozoids in gymnosperms. The results of their study were described in some journals of Europe at the request of their editors (Hirase, 1897; Ikeno, 1896b, 1897, 1898h, l898c, 1901; Ikeno & Hirase, 1897), and their works came to be known throughout the world. The Imperial Academy of Japan awarded them prizes, in 1912, for their brilliant investigations.

In 1897 H. J. Webber of the United States of America found in *Zamia integrifolia* the peculiar structure occurring within the pollen tube and proved it to be a motile spermatozoid (Webber, 1897a, b). His work made the ohservations of Hirase and Ikeno much more authoritative. Webber (1897d, 1901a, 1901b) observed the spermatozoids also in *Zamia floridana* and *Z. pumila.* Since then researches on the structure and development of sexnal organs of gymnosperms, especially the Cycadaceae, have been carried on by many botanists and the existence of spermatozoids was reported early in the 20th century by Chamberlain in *Dioon edule* (1909), *Ceratozamia mexicana* (1912), *Macrozamia moorei* (1913) and *Stangeria paradoxa* (1916); and by Caldwell (1907) in *Microcycas calocoma.*

The existence of spermatozoids in *Ginkgo* and Cycadaceae considerably influenced our thinking on the phylogeny of plants. For example, *Ginkgo* which was considered as a member of the Taxaceae was shifted to a new family Ginkgoaceae (Engler, 1897), order Ginkgoales (Engler, 1898). lt strengthened also the theory of Hofmeister (1851) who maintained that the boundary between pteridophytes and gymnosperms might not be so rigid as was once considered, represented by the surviving links between two groups.

Botany of the l9th Century in Japan

lt may be pointed out that the influence of the discovery of spermatozoids in *Ginkgo* and *Cycas* has contributed to the progress of botany in Japan, because the knowledge of modern botany has been introduced just at the last quarter of the l9th century. lt may be said that in Japan the study of plants began since the l7th century, mainly in the study of herbs. Since the l8th century, especially the l9th century, there were famous herbalists who published important herbals. During this period some European natural historians or doctors visited and collected plants in Japan, which were described in Linnean system. Some of the books on these plants reached Japan and stimulated Japanese herbalists. In the 19th century some European books on plant morphology, anatomy and physiology were also introduced and a few of them were translated into Japanese. Some herbalists endeavoured to understand modern botany, and to regulate the classical study of herbs and modern botany. lt was, however, severely forbidden, on account of the policy of seclusionism, to communicate with foreign countries and to introduce the foreign articles, which made the introduction of modern botany very difficult.

Then the Meiji restoration of 1868 took place, and every political and social system was completely revised. The communication with foreign countries and the introduction of foreign articles became free and many Japanese visited European and American countries to learn the modern systems or sciences. In 1877 the Tokyo University[1] was established as the center of modern studies. The university consisted of four colleges, and in the botanical course, which belonged to the College of Science, lectures and experiments were undertaken, at first based on the text books of Europe or America, and professors and students tried to understand modern botany until they were able to undertake original investigations. Thus, in Japan, the last quarter of the l9th century was nothing but a cradle period of modern botany, and it was rather marvellous that important studies by Hirase and Ikeno were accomplished at that time. Their brilliant researches stimulated Japanese botanists so vigorously that they were able to make valuable contributions in the 20th century.

Classical herbalists and senior botanists passed away, but the historic *Ginkgo* tree at Tokyo and *Cycas* trees at Kagoshima might have seen the history of Japanese herbal and botany during several centuries, and might have stimulated, and are still inspiring the young students.

[1].The Tokyo University, established in 1877, changed its name as follows: Imperial University in 1886, Imperial University of Tokyo in 1897, and University of Tokyo in 1949.

Literature Cited

CHAMBERLAIN, C. J. 1909. Spermatogenesis in *Dioon edttle.* Bot. Gaz. **47**: 215-236.

— 1912. Morphology of *Ceratozamia.* Bot. Gaz. **53:** 1-19.

— 1913. *Macrozamia moorei,* a connecting link between the living and fossil cycads. Bot. Gaz. **55**: 141-154.

— 1916. *Stangeria paradoxa.* Bot. Gaz**. 61:**: 353-372.

CALDWELL, 0. W. 1907. *Microcycas calocoma.* Bot. Gaz. **44:** 118-141.

ENGLER, A. 1897. Die natürlichen Pflanzenfamilien. Leipzig.

— 1898. Syllabus der Pflanzenfamilien. Berlin.

FUJII, K. 1898. Has the spermatozoid of *Ginkgo* a tail or none? (In Japanese) Bot. Mag., Tokyo **12:** 287-290.

— 1 899a. Observation on the morphology of the pollen tube and the spermatozoid of *Ginkgo biloba.* (In Japanese) Bot. Mag., Tokyo **13:** 28-30.

— 1899b. Remarks on Mr Ikeno's remarks on my views regarding the morphology of the pollen-cells and the spermatozoid of *Ginkgo.* (In Japanese) Bot. Mag., Tokyo **13:** 65-73.

— 1899c. On the morphology of the spermatozoid of *Ginkgo biloba.* (In Japanese) Bot. Mag., Tokyo **13**: 260-266.

— 1900. On bicephalous spermatozoid of *Ginkgo.* (In Japanese) Bot. Mag., Tokyo **14:** 16-17.

HIRA5E, S. 1894a. Fecundation period of *Ginhgo biloba.* (In Japanese) Bot. Mag., Tokyo **8:** 7-9.

— 1894b. Notes on the attraction-spheres in the pollen-cells of *Ginkgo biloba.* (In Japanese) Bot. Mag., Tokyo **8:** 359-60; 361 -364.

— 1895a. Etudes sur le *Ginkgo biloba* (note pröliminaire). Bot. Mag.,Tokyo **9:** 239-240.

— 1895b. Etudes sur la föcondation et l´embryogönie du *Ginkge biloba* (1). J. Coll Sci. imp. Univ. Tokyo **8:** 307-3 22.

— 1896a. Spermatozoid of *Ginkgo biloba.* (In Japanese) Bot. Mag., Tokyo **10:**171.
— 1896b. On the spermatozoid of *Ginkgo.* (In Japanese) . Bot. Mag., Tokyo **10:** 325-328.
— 1897. Untersuchungen über das Verhalten des Pollens von *Ginkgo biloba.* Bot. Zbl. **49:** 33-35.
— 1898. Etudes sur la fécondation et l´embryogénie du *Ginkgo biloba* (second mémoire). J. Coll. Sei. imp. Univ. Tokyo **12:** 103-149.
HOFMEISTER, W. 1851. Vergleichende Untersuchungen der Keimung, Entfaltung und Fruchtbildung höherer Kryptogamen und der Samenbildung der Koniferen. Leipzig.
IKEN0, 5. 1896a. Note préliminaire sur la formation de la cellule de canal chez le *Cycas revoluta.* (In Japanese) Bot. Mag., Tokyo **10**: 61-63; 287-289.
— 1896b. Vorläufige Mitteilung über die Canalzellbildung bei *Cycas revoluta.* Bot. Zbl. **67:** 193-194.
IKENO, 8. 1896c. Spermatozoiden von *Cycas revoluta.* (In Japanese) Bot. Mag., Tokyo **10:** 367-368.
— 1897. Vorläufige Mitteilung über Spermatozoiden bei *Cycas revoluta.* Bot. Zbl. **69:** 1-3.
— 1898a. Untersuchungen über die Entwicklung der Geschlechtsorgane und den Vorgang der Befruchtung bei *Cycas revoluta.* J. Coll. Sci. imp. Univ. Tokyo **12:** 151-214.
— 1898b. Untersuchungen über die Entwicklung der Geschlechtsorgane und den Vorgang der Befruchtung bei *Cycas revoluta.* Jb. wiss. Bot. **32:** 557-602.
— 1898c. Zur Kenntniss des sog. centrosomähnlichen Körpers im Pollenschlauch der Cycadeen. Flora, Jena **85:**15-18.
— 1899a. On the spermatozoid and pollen tube of *Ginkgo biloba* and *Cycas revouta.* (In Japanese) Bot. Mag., Tokyo **13:** 3 1-34.
— 1899b. Opinion of various authors on the centrosome in the pollen tube of Cycadaceae and *Ginkgo.* (In Japanese) Bot. Mag., Tokyo **13:** 74-76.
— 1901. Contribution a l'étude de la fécondation chez le *Ginkgo biloba.* Annls Sci. nat., Bot. **13:** 305-318.
— & HIRA5E, 8. 1897. Spermatozoids in gymnosperms. Ann. Bot. **11:** 344-345.
MIYAKE, K. 1902. The spermatozoids of *Ginkgo.* J. appl. Microsc. Lab. Meth. **5:**1773-1780.
— 1905. On the spermatozoids of *Cycas revotuta.* (In Japanese) Bot. Mag., Tokyo **19:** 232-240.
— 1906. Über die Spermatozoiden von *Cycas revoluta.* Ber. dt. bot. Ges. 24: 78-83.
MIYOSHI, M. 1896. Remarks on Mr Hirase's spermatozoids of *Ginkgo biloba.* (In Japanese) Bot. Mag., Tokyo **10:** 409-411.
WARMING, E. 1877. Recherches et remarques sur les Cycadées. Overs. K. danske Vidensk. Selsk. Forh. 1877**:** 57.
— 1879. Contributions ä 1 (lhistoire naturelle des Cycadées. Overs. K. danske Vidensk. Selsk. Forh. 1879: 22.
WEBBER, H. J. 1897a. Peculiar structures occurring in the pollen tube of *Zamia.* Bot. Gaz. **23:** 453-459.
— 1897b. The development of the antherozoids of *Zamia.* Bot. Gaz. **24:**16-22.
— 1897c. Notes on the fécondation of *Zamia* and the pollen tube apparatus of *Ginhgo.* Bot. Gaz. **24:** 225-235.
— 1897d. Antherozoids of *Zamia integrifolia.* Rep. Br. Ass. Advmt Sci. 1897: 864-865.
— 1901a. Spermatogenesis and fécundation of *Zamia.* Bull. US. Dep. Agric. 2:100.
— 1901b. Further notes on the spermatogenesis of *Zamia.* Science, N.Y. **13:** 1254.
STRA5BURGER, E. 1892. Ueber das Verhalten des Pollens und die Befruchtungsvorgänge bei den Gymnospermen. Histol. Beitr. 4**:**1-58.
TREUB, M. 1881. Recherches sur les Cycadöes. Annls Jard. bot. Buitenz. **2:** 32-53.

* The depicted example from the botanical garden Todaifuzoku-Tokyo is of historical interest:

"The spermatozoid of *Ginkgo biloba* was first discovered in seeds of this female tree by Sakugaro Hirase, who was a teaching assistent in the Botanical Institute, Imperial University, and was studying the fertilization and embryo development in Ginkgo. This finding is believed one of the most important contributions from the early days of Japanese botany". Photo by Kawasaki Green Investigation, Japan.

S. HIRASE discovered the spermatozoids on the 9th of September 1896. He reported his findings on the 26th of September of the same year in the Tokyo Botanical Society. (Literature about this: Ogura, Y., Phytomorphology 17, 109 - 114 (1967).

(Source: http://kawasakimidori.main.jp/, http://www.biologie.uni-hamburg.de/b-online/e47/ginkgo.htm)

References

(correction approach to web sites 2010/09/17)

1. http://www.imaginatorium.org/sano/ginkgo2.htm
2. http://www.catalogueoflife.org/search.php
3. http://www.catalogueoflife.org/annual-checklist/2010/details/species/id/7434818
4. http://www.ubio.org/browser/details.php
5. http://xs4all.nl/~kwanten (The Ginkgo Pages by Cor Kwant)
6. http://www.flc.kyushu-u.ac.jp/~michel/serv/ek/amoenitates/ginkgo/ginkgo.html
7. http://qir.kyushu-u.ac.jp/dspace/bitstream/2324/2898/1/Ginkgo_biloba.pdf
8. http://www.phoenixbonsai.com/pre1800Refs/Kaempfer.html
9. http://www.funet.com/pub/sci/bio/life/warp/plants-English-Photolist.html
10. http://delta-intkey.com/britfe/www/adiacapi.htm
11. http://en.wikipedia.org/wiki/Dutch_East_India_Company
12. http://ginkgo.liste.free.fr/botanist.htm
13. http://www.1911encyclopedia.org/Gymnosperms
14. http://www.funet.com/pub/sci/bio/life/warp/plants-English-Photolist.html
15. http://www.cirrusimage.com/ginkgo_in_different_languages.htm
16. http://www.plantnames.unimelb.edu.au/Sorting/Ginkgo.html
17. http://www.iucnredlist.org/apps/redlist/details/32353/0
18. http://www.payer.de/fundamentalismus/fundamentalismus022.htm
19. http://commons.wikimedia.org/wiki/Aix_galericulata (by Yoky),
    http://www.birdskorea.org/Birds/Birdnews/BK-BN-birdnews-2009-12.shtml
20. http://www.hpwt.de/China/Porzellane.htm
21. http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?lin=s&p=has_linkout&id=3311
22. http://www.bonneplante.com/ginkgo_biloba.php
23. http://www.ars-grin.gov/~sbmljw/cgi-bin/taxon.pl?17540
24. http://ginkgo-biloba1771ginkgoeu.blogspot.com
25. Note from Prof. Zhiyan Zhou 2010/06/30 > ginkgo.begovic@gmail.com (China).
26. Anić, V. & Goldstein I., 2007. Rječnik stranih riječi, Zagreb.
27. Begović, B., 2009. Svijet ginka, Croatia (manuscript).
28. Beissner, L. & Fitschen J., 1930. Handbuch der Nadelholzkunde, Berlin.
29. Brent, E., 2004. The Royal Horticultural Society: A History 1804 - 2004., London.
30. Bulletin de la Société botanique de France, 1854. vol. 1, Paris.
31. Dern, F., 1838. Ginkgo biloba..., Allgemeine Gartenzeitung, vol. 6, 189-190.
32. Eichler, A.W., 1875. Blüttendiagramme, Leipzig, vol. 1, 65.
33. Elwes, H.J. & Henry A., 1906. The Trees of Great Britain & Ireland, 1, Edinburgh.
34. Enciklopedija – opća i nacionalna, 2005. vol. 7, Zagreb.
35. Engler, A., 1897., Die natürlichen Pflanzenfamilien, Leipzig.
36. Foster, A.S. & Ernest M. Gifford Jr., 1989. Morphology and Evolution of Vascular Plants.
37. Gibson, J.P. & Gibson T.R., 2007. Plant diversity.
38. Hirase, S., 1896. Spermatozoid of Ginkgo biloba. Bot. Mag., Tokyo 10, 171.
39. Hirase, S., 1896. On the spermatozoid of Ginkgo, Bot. Mag., Tokyo 10, 325-328.
40. Kaempfer, E., 1712. Amoenitatum Exoticarum, Lemgoviae, 811-813.
41. Koch, H.E.K., 1873. Dendrologie 2 (2), Erlangen.
42. Michel, W., 2005. On Engelbert Kaempfer's "Ginkgo", Kyushu University, Fukuoka, 6. Dec. 2005.
43. Nelson, J., 1866. Pinaceae.
44. Ogura, Y., 1967. History of discovery of spermatozoids..., Phytomorphology, vol. 17, 109 - 114.
45. Richard, C. & Richard A., 1826. Comm. Bot. Conif. Cycad.
46. Siebold, F. & Zuccarini J., 1835 – 1870. Flora Japonica. Leiden.
47. Smith, J.E., 1797. Trans. Linn. Soc., vol. 3, London, 330-332.
48. Steudel, E.T., 1841. Nomenclatur Botanicus, vol. 1, 493.
49. Šumarska enciklopedija, 1959, vol.1, Zagreb.
50. Thomé, O.W., 1885. Flora von Deutschland Österreich und der Schweiz, Gera.
51. Thunberg, C.P., 1784. Flora Japonica, Uppsala.
52. Vidaković, M., 1982. Četinjače, Zagreb.

Page 44: Ginkgo tree in Autumn. Photo by Josip Barišić, Croatia (2010) .

In the "Notes" used data from web sites: http://www.nhm.ac.uk/jdsml/research-curation/research/projects/linnaean-typification/detailimage.dsml?ID=401700, http://www.linnean.org/index.php?id=50, http://www.books.google.com, http://www.botanicus.org/name/Ginkgo_biloba, http://www.biologie.uni-hamburg.de/b-online/e47/ginkgo.htm, http://elib.doshisha.ac.jp/denshika/amoenitatum/210/img210.html

Briefly. Ginkgo. What is it?

Ginkgo (or Maidenhair tree) is one of the oldest species on this planet, growing almost unchanged 100 and more million years ago. These trees are grown as horticultural plants and on plantations for commercial use. The leaves have a specific form. The tree can live up to 4500, and often over 1000 years. Ginkgo grows very slowly and the trees can be very large. Ginkgo trees can be extremly large but they grow very slow. There are male and female plants. Female plants bears fruit in Autumn, which is similar to plums. The fruit is in the middle of a hard seed such as nuts and it can be used as food.

The Ginkgo is a unique tree with no close living relatives. For centuries it has been believed that Ginkgo has extincted in the wild, but now it is known to grow wild in at least two small areas in eastern and southeastern China.

The Chinese people traditionally use leaves and fruit nuts, for food and medicine. And although the fruits and leaves of this plant has been used in China for nearly 4-5,000 years, its usage in Western medicine did not begin until the 1950s. Ginkgo is a medicinal plant. Modern science has confirmed this. Major of Ginkgo leafs is being used for tea, and for Ginkgo extract from which we can get variety of medications. Today, Ginkgo is grown on all continents.

General information

Scientific name: *Ginkgo biloba* L. 1771
Pronunciation: gink-go bye-lou-buh

Common name(s): Maidenhair Tree, Ginkgo, Ginko, Gingko
Family: *Ginkgoaceae*

Clim. zones: 4/5 - 8/9 (optimal 6-9a)

Origin: China
Uses: Bonsai; wide tree lawns (>8 feet wide = >cca 2.5 m); medium-sized tree lawns (4-8 feet wide = 1.5-2.5 m); recommended for buffer strips around parking lots or for median strip plantings in the highway; specimen; sidewalk cutout (tree pit); residential street tree; tree has been successfully grown in urban areas where air pollution, poor drainage, compacted soil, and/or drought are common

Availability: generally available in many areas within its hardiness range

DESCRIPTION

Height: 50 to 75 feet (15 to 25 m)
Spread: 50 to 60 feet (15 to 20 m)
Crown uniformity: irregular outline or silhouette
Crown shape: round; pyramidal
Crown density: open
Growth rate: slow
Texture: medium

Foliage

Leaf arrangement: alternate
Leaf type: simple
Leaf margin: lobed
Leaf shape: fan-shaped
Leaf venation: parallel; palmate
Leaf type and persistence: deciduous
Leaf blade length: cca 2 to 4 inches (cca 5-12 cm)
Leaf color: green
Fall color: yellow
Fall characteristic: showy

Flower

Flower color: green
Flower characteristics: pleasant fragrance; inconspicuous and not showy; spring flowering

Fruit & seed

Fruit shape: oval; round
Fruit length: cca 1 to 1.5 inches (cca 2-3 cm)
Fruit in 1 kg: cca 200
Fruit covering: fleshy
Fruit color: green; yellow
Fruit characteristics: does not attract wildlife; inconspicuous and not showy; fruit, twigs, or foliage cause significant litter
Seed lenght: >0.5 inches (>1.5 cm)
Seed in 1 kg: cca 600-1200 piec.

Trunk & Branches

Trunk/bark/branches: droop as the tree grows, and will require pruning for vehicular or pedestrian clearance beneath the canopy; showy trunk; should be grown with a single leader; no thorns
Pruning requirement: needs little pruning to develop a strong structure
Breakage: resistant/not resistant

Current year twig color: brown; gray

2

The ancestors and relatives of *Ginkgo biloba*

Foreword

Incredible, but true is the fact, that the evolutionary development of Ginkgo can be traced, although sometimes without the consensus of scientists but primarily due to a lack of evidence, in staggering 300 million years. So nearly 10% of the total age of our planet today, which is estimated at slightly more than 4 billion years. This can not be said for any other living plant species.

Various climate change, natural disasters and many other things from the past have lead to the fact only one species of plants managed to survive and it is *Ginkgo biloba*, which had through overall period of its existence a whole lot of further and closest relatives and almost envious number of members of which most them are extinct.

Therefore, in this part we will attempt to form a clearer view in that part of the history of Ginkgo's ancestors and relatives, which is based solely on fossilized remains and today, scattered almost all over the World.

Ginkgo's ancestors lived in the period before the famous extinct animal species, such as dinosaurs. They lived in community with them, and they live after a dinosaurs as well.

1
History of paleobotanics research
Ginkgo biloba

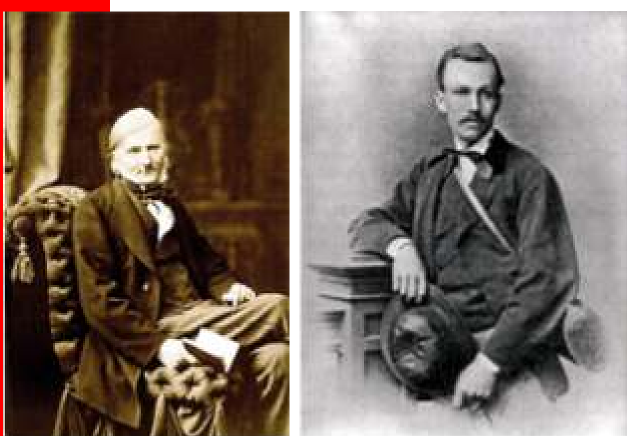
History of Ginkgo study in fact begins with the first description of Engelbert Kaempfer in 1712. After him, many botanists tryed to resolve the issue of the official name for this plant and tried to briefly describe her and gradually try to figure out something from the distant past of this plant, especially after they began increasingly finding out fossils that were similar to the "new" type and after they already accumulated certain knowledge about Ginkgo. Since the Middle Ages, and from an earlier time, collection of fossils was a widespread hobby, and in the 17 th century it was generally accepted that the fossils are remains of living organisms from the past. At the end of 18 century first scientific papers on paleobotanycs observations appear, while the official start of scientific botany is fixated on the year 1820 or on the issuance of the first volume of "Versuch einer geognostisch-botanischen Derstellung der Flora der Vorwelt" in 1820[th] by C. Sternberg. It means that this is the starting point for paleobotanyc nomenclature. In later years it leads to the development of paleobotanycal methods, classification of fossillized plants, including the establishment of the stratigraphyc paleobotany. How many and where were by those times found fossils that can be classified in Division *Ginkgophyta* today we can not know. It is quite certain that during the entire 19 th century it started to find out increasingly (at least recorded) fossils of ginkgos ancestors and relatives, especially because the morphological characteristics of *Ginkgo biloba* were already quite well studied, so specific fossil could be easier to identified. *Ginkgophyta* fossils were found in greatest numbers during the 20-th century on all continents, so they are also studied worldwide. (2, 4 etc.)

Among the first ones who describe and identify such fossils are Oswald Heer (1809-1883), the Frenchman Gaston de Saporta (1823-1895), then Swedish paleobotanists, a geologist and researcher Alfred Nathorst Gabriel (1850-1921), Fridoli Krasser (1863-1922), Lester F. Ward (1841-1913), Carl Rudolf Florin (1894-1965), W.A. Bell (1889-1969), A.C. Seward (1863-1941), F.A.

Gaston de Saporta (1823-1895). (2, 8)

Stanislavski, as well as many other paleobotanists and other scinetists of more recent times. In that category we can find Sergio A. Archangelsky, Peter Crane, Jiří Kvaček, Tom M. Harris, S. Oishi, V. A. Krassilov, T. Hori, H. Tralau, Shaolin Zheng, B. Zhang, S. E. Wang, W. N. Stewart, Elizabeth Kowalski, Gar W. Rothwell, Zhiyan Zhou and many others. The scientists who have studied or are still dealing with the study of *Ginkgophyta* fossils see also References. Most paleobotanists is directly related to various societies, institutions and departments of different academies and universities specializing exclusively for Paleontology, Paleobotanic, geology, or any other related sciences, without which the research is almost impossible. Over time many such institutions or departments was established around the world and they organize and conduct field and institutional research, and then publish the papers mostly in periodicals or scientific journals. Some of them are: "Paleobotanycal Section, Botanical Society of America", "Laboratory of Systematic and Evolutionary Botany, Institute of Botany, Chinese Academy of Sciences", "Paleobotanycal Society of India", "Paleobotany and Palynology, Florida Museum of Natural History", "Laboratory of Paleobotany and Palynology, University of Utrecht", "International Organisation of Palaeobotany".
(For more see website: http://www.equisetites.de/palbot/organisations/palbotcollection.html)

It is quite understandable that these fossils were and are studied the most in areas where there is most of them. That is associated with so-called. geological or paleobotanyc pools in which most fossils and *Ginkgophyta* are found. Nowdays most of them is on the earth's northern hemisphere and it is understandable because it is the largest onshore part although they are common also in one part of Australia, southern Africa and of South America. For discovered fossils numerous different names were given, and after many years, even centuries, scientists have gradually managed to agree an make a quite clear



Oswald Heer (1809-1883) and Alfred Gabriel Nathorst (1850-1921). (2, 9) picture of *Ginkgophyta* division, of which up to now only one species managed to preserve.

2
About finding fossils species *Ginkgo biloba*, his ancestors and relatives

Since the majority of genera, species and other relatives of today's Ginkgo (†) is extinct very long time ago, compared to the fossils of other species fossils of *Ginkgophyta* division can be found relatively rare. We have already mentioned that we do not know how many such fossils in the past were found until about the mid 19 th century and which remained not recorded because it was thought that this is some kind of unknown species. But there are certain charts from the registers sites of narrower or wider scale on which certain pools classified in specific geological periods from the past of the earth are marked. The most numerous members of *Ginkgophyta* lived on earth in Mesozoic age (Cretaceous, Jurassic and

Above left: finding fossils dinosaurs and Ginkgo in North America - the Cretaceous period.(15) Above right: Australia, Jurassic (25). Below: the locality of fossils from the Jurassic period in New South Wales. (14)

Triassic), at a time when dinosaurs walked the earth, and it is a period from before approximately 250-65 000 000 years (more precisely than before the 251-65.5 million years). Air, wildlife and other factors in that time were absolutely favorable for this plants. So from that period we can find diverse

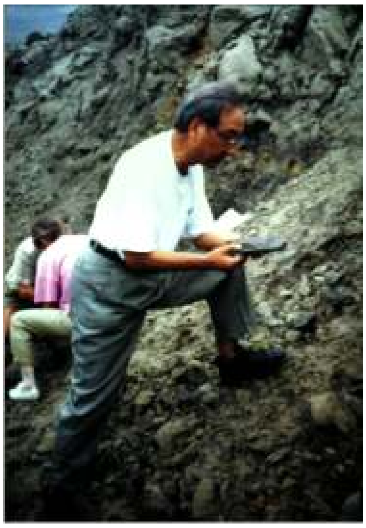
View of the Cairngorms National Park (Scotland). Here is probably was once rich in Ginkgo forests. (22)

and numerous plants remains similar to today's Ginkgo. Mostly fossilized leaves, fruits or seeds, and rarely young reproductive parts of plants, like the flower, pollen, and wood and the remains of young plants are found. Approximately at the time when dinosaurs start to disappear it is the time of successively disappearance of *Ginkgophyta* plants which clearly indicates their mutual participation in existence.

It is known that for a fossilization of a living organism it is necessary to have optimal conditions that accompany this process, and those are humidity, temperature, amount of oxygen, pressure, etc. Since earth's surface started cooling down and atmosphere from the past resulted in an increased presence of microcrystal's calcite. It seems that those conditions in the period of the Mesozoic Era were optimal in the coastal areas of temperate climate of the former Pangea continent which at that time had already begun to crumble and take more and more of current appearance of continents. This is one of the reasons why most fossils and ginkgos ancestors are found in the area of about 40 degrees north latitude, and finally between 40 and 60 degrees around 70% of all findings were found. Other fossils were found and are found in roughly similar coordinates and Southern latitudes - precisely north from 40 degrees down to around 20-th. Disintegration of Pangea wider coastal areas of moderate climate today are in fact both coasts of North America, south and west of South America, South Africa, the coast of Australia, the eastern parts of Asia, western and northern edges of Europe, and the area of Siberia and northern parts of Russia, and the northern parts of Central Asia. These are areas of just mentioned latitudes.

Fossils in general, and although *Ginkgophyta* remains we can found in sedimentary rocks formed by layered deposition so therefore such rock layers are often layered breaking. Sedimentary rocks comprise only 5% of the total volume of the Earth's crust, but about 75% of the area that is relevant for all human activity. Those

Prof. Zhiyan Zhou - gave a great contribution to the study of fossils of Ginkgo. (48, 49)



FOSSIL PLANTS

A TEXT-BOOK FOR STUDENTS OF BOTANY AND GEOLOGY

BY

A. C. SEWARD

VOLUME IV

GINKGOALES, CONIFERALES, GNETALES

CAMBRIDGE:
AT THE UNIVERSITY PRESS
1919

Seward, A., C., 1919. FOSSIL PLANTS, Cambridge. Vol. IV, Ginkgoales, Coniferales, Gnetales (p. 1-568).

are carbonate rocks mainly limestone and dolomite varieties mixed with various minerals and crystals. The precise content depends on the location as well as geological period to which they belong. The same can be said for the color. Material can be white than reddish to orange, red, brown, black or gray and it all depends in which conditions sediments were created and which chemical changes they experienced during this long period of time.

Similar can be said for the fossils remains itself. Most often there can be found in rock layers only leafs or some part of them and they were kept mostly after the deposition of mud, earth, sand and so on on some part of the plant. Fossil remains are often of different colors and it also depends on the conditions and environment where they originated. (1, 3, 5, 135, 401 etc.)

3
The earliest ancestors *Ginkgo biloba*

Although for the period of more than the entire century scientists agree or disagree in their statements about the origin or similar family ties for species of *Ginkgo biloba* with the extinct species it seems that this problem will not be fully explained for a long period of time. It will be very difficult to make objectively completely acceptable sequence of development, ie, evolution and everything that followed to todays maidenhair tree - present morphological image of that plant species. It should be said that for the division of *Ginkgophyta* and according to that for the genus *Ginkgo* also very slow evolution is characteristic.

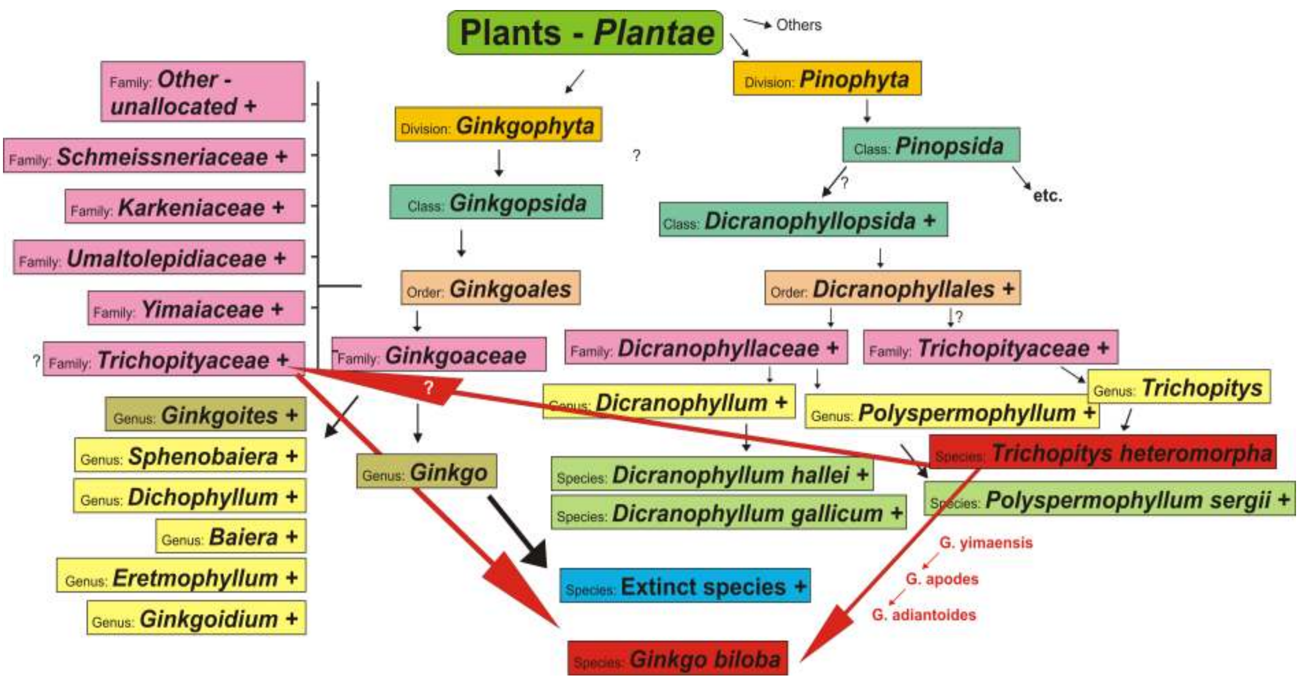
The remains of fossilized Ginkgo trees in the Petrified Forest State Park in the State of Washington (USA) on which are engraved drawings of prehistoric Indians. (23) Below: fossilized Ginkgo trees in the same park. Miocene Period (about 15 mill. years ago). (24)

Scientists today are still unsure and in doubts when it comes to the classification of plants which were at a turning point in the evolutionary cycle when *Ginkgophyta* division and *Pinophyta* started to form or when they began to distinguish plants that are now more similar to conifers that is which are located somewhere in the transitional stage between angiosperms and gymnosperms. It was found that the ginkgo is only survived species i.e. the connection between gymnosperms and angiosperms in the distant past. In paleo-filogenetics classification *Pinophyta* Division is formed and class *Dicranophyllopsida* is placed in her. *Dicranophyllopsida* is composed from one *Dicranophyllales* genus. In this sequence family of Dicranophyllaceae (†) and *Trichopityaceae* (†) follows, while directly included in genus *Dicranophyllum* (†) are genus *Dicranophyllum* (†), *Polyspermophyllum* (†) and *Trichopitys*. They all lived in the Permian period, particularly the lower Permian. In the previous two genuses several species was and they are undoubtedly closely related to gymnosperms today, while the evolutionary classification based on morphological similarities with *Trichopitys* is beeing placed in the same developmental series from which today *Ginkgo biloba* emerged. In this part of the evolution cycle scientists try to hold on for theories (which are mostly confirmed) about development of categorization and classification of forming *Ginkgophyta* Division which was formed on the basis of fossils from the Permian time (when a plant closest to today Ginkgo emerged - *Trichopitys heteromorpha* Saporta ie which already has some similarities with Ginkgo). And all that is based on the introduction of a single class called *Ginkgoopsida* from which they derived *Ginkgoales* plants (family *Ginkgoaceae*) and many other extinct plants from this class. According to current knowledge there were 6 families and there is a large number of plants that are not yet classified into any of them or in some another new family - but they are certainly related to ginkgo. For all those plants that can not be put into the evolutionary cycle of today's series of Ginkgo we say that they belong to a group of plants *Ginkgophyta*, and all of them are extinct, while only *Trichopitys heteromorpha* through evolutionary sequence had more ancestors of whom *Ginkgo biloba* survived.

Based on the morphological characteristics in the evolutionary sequence Ginkgo has been associated, as already mentioned, to the type *Trichopitys heteromorpha* who is from a period of about a 240-270 mill. years, the last period of the Paleozoic era.

From *Trichopitys* during the Triassic and Jurassic era following genera developed *Grenana* (†), *Karkenia* (†), *Nahvizdyella* (†), *Schmeissneria* (†), *Toretzia* (†) and *Umaltolepis* (†). From *Trichopitys heteromorpha* in the evolutionary series states new branches that followed with the appearance of species *Ginkgo yimaensis* which is directly related to today's Ginkgo, and appeared in the mid-Jurassic. Or we can say that genera *Ginkgo* appeared. Between *Ginkgo yimaensis* and *Ginkgo biloba* we have two more (found) links in this cycle and those are recently found species *Ginkgo apodes* whose age is estimated at about 121 million years and *Ginkgo adiantoides* who appeared at the beginning of the Eocene (about 56 million years) and is already almost completely identical with today's kind of *Ginkgo biloba*. The main characteristic of the evolution of *G. yimaensis* to *G. biloba* is reduced number of fruits or reproductive elements of plant and the gradual change in leaf appearance.

During the Jurassic and Cretaceous era Genus *Ginkgo* has a range variaty of species, which range spanned almost across the whole of the then earth's surface. Apart from this genus that has survived in the form of modern *G. biloba* in the period from the Triassic to Cretaceous existed several more genera of the family



Ginkgoaceae. See the table with a list of *Ginkgophyta* fossils. (1, 3, 5, 367, 401 etc.)

4
Plants division *Ginkgophyta*

If we want to talk generally about *Ginkgophyta* division then we must note that we will deal mostly with plants that have a common morphological tone in comparison to today maidenhair tree and any other interface. Until now it has been found a whole lot of different fossils which are beeing placed in the specified division. The classification up to now has not been accurately made because it has been found a multitude of endemic findings and endemic species or genera. All these plants were bicameral and leaf mainly consisted of leaf blades usually more rounded and sometimes blunt. Sometimes the leaf was very narrow and long and sometimes had the look of a blade of grass. In this division, we can enumerate the whole multitude of extinct species from which fossilized remains can be find today: *Baiera*, *Sphenobaiera*, *Ginkgophyllum*, *Dichophyllum*, *Primoginkgoxylon* are just some of them. They lived from the Triassic to the Paleogene. (A)

5
Trichopitys heteromorpha

Today in paleobotany prevailing opinion is that genera *Ginkgo* based on studies of the general morphological features has a direct connection to the extinct family *Trichopityaceae* (Meyen, 1987) from the *Ginkgoales* plants. This family has had only one genus - *Trichopitys*, which is attributed to one totally identified kind. These plants are the first ones that raised above the ground and lived in the Permian period: *Trichopitys heteromorpha* (described by Saporta, 1875, amended by Florin 1949).

The main fossils finding place is from the lower Permian period and it was found at the Lodêve (Hérault) site in southern France.

Basic features are swollen leaves about 3 cm long away from the central axis, which is only several millimeters thick, while the leaves are very narrow and densely arranged in relation to the axis. Seeds were found, which were at first described as the buds, but it has been reviled that it was a female who bears the reproductive organs that can easily be connected with Ginkgo. (1, 3, 5, 135, 401 etc.)

6
Genus *Ginkgo*

Judging by the selection of discovered fossils in the evolutionary sequences well as morphological characteristics that have the most points of contact as a separate genus appeared in late Triassic - Jurassic environment, gender which can be separated, so we can say that these are plants of the *Ginkgo* genus. In this part of the ginkgos evolution scientists formed several types (eg *Ginkgoites*-type, *Ginkgo*-type etc.) regarding to definition of this genus, however, it is clear that in this era large number of species appeared, from which each one have had unique and a certain period of existence. This genus has quite clearly singled out at late Triassic and early Jurassic (ie, about 200 million years), and from then until the end of the Mesozoic we can find a range of different species that can clearly be classified as a separate genus - *Ginkgo*. (A)

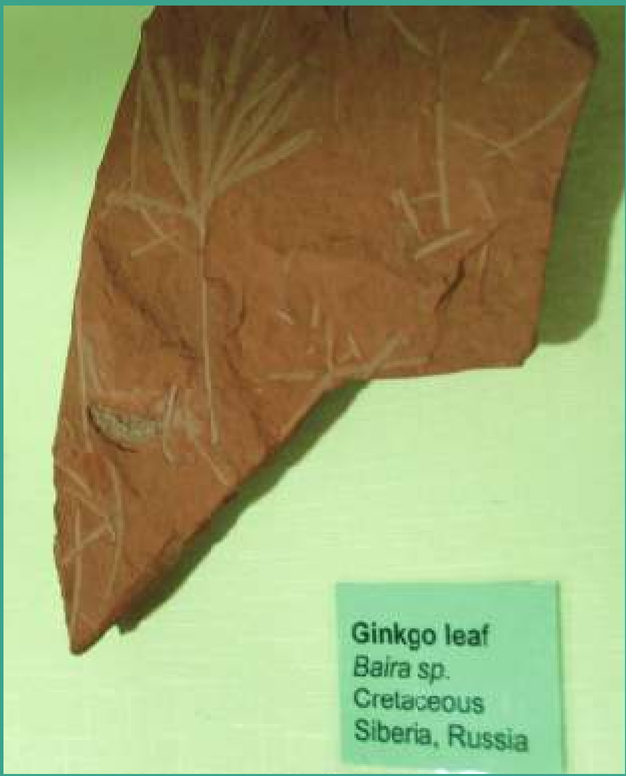
7
Ginkgo yimaensis

What was the sequence of the evolution of *Trichopitys* from the late Permian to the types that can be absolutely linked with today's kind of *Ginkgo biloba* specifically *G. yimaensis* that has fossils old 170 million years ago, today we still can not explain. For scientists there is no consensus in creating a line of evolution from the *Trichopityis G. yimaensis*, but in any case it is obvious, but it is not clear. *Ginkgo yimaensis* is the type characterized by the number of elements of reproduction (seeds), while the leaves were yet unscrewed each for himself, but madeout of a series of rather pointed leaf blades of leaf shapes. The leaf had 4-6 or more leaf blades. Creating a reconstruction based on a *Ginkgo biloba* characteristics it can be established that it is a species that definitely fits the evolutionary sequence that will gradually have less reproductive elements and that the leaves will gradually assume the appearance of species *G. Biloba* i.e. it will have less leaf blades and they will be more and more connected. (B)

It should be said that the reduction in the number of embryos in quantitative terms is present since *Trichopitys heteromorpha*, however, whether the species *G. yimaensis* was a plant that was actually a large tree we can not precisely determined. (1, 3, 5, 36b, 401 etc.)

8
Ginkgo apodes

Ginkgo apodes is species that was found 2003rd in China and there is no doubt that it is the link in the evolutionary chain of *Ginkgo biloba*. *Ginkgo apodes* (Zheng et Zhou, 2003) is characterized by an even smaller number of reproductive organs in relation to *G. yimaensis*. Leaf of this kind still has foliage leaf blade but they are already turning little by little into a separate whole, though still divided into several parts. In relation to *G. yimaensis* this is progress, because it gave a hint about compact structure of leaf configuration. *G. yimaensis* had almost completely detached leaf blades and basically leaf was composed from several distinct expression of divided unit. Discovery of *Ginkgo apodes* has made



Baiera sp., Cretaceous (age: about 90 mill. years). From Siberia, Russia. Photo by Michael Pop, USA (2009). Indiana University, USA. (40)

Fossilized Ginkgo trees in Ginkgo Petrified Forets Washington, USA, Miocene Period (about 15 mill. years ago). Photo by Paul Gordon, USA. (Petrified wood on exhibit at Ginkgo Petrified Forest State Park, Kittitas County, Washington, Kittitas County, Washington, USA)"

Mesozoic	Cretaceous	Late	Maastrichtian	70.6 ± 0.6*
			Campanian	83.5 ± 0.7*
			Santonian	85.8 ± 0.7*
			Coniacian	89.3 ± 1.0*
			Turonian	93.5 ± 0.8*
			Cenomanian	99.6 ± 0.9*
		Early	Albian	112.0 ± 1.0*
			Aptian	125.0 ± 1.0*
			Barremian	130.0 ± 1.5*
			Hauterivian	136.4 ± 2.0*
			Valanginian	140.2 ± 3.0*
			Berriasian	145.5 ± 4.0*
	Jurassic	Late	Hauterivian	150.8 ± 4.0*
			Kimmeridgian	155.7 ± 4.0*
			Oxfordian	161.2 ± 4.0*
		Middle	Callovian	164.7 ± 4.0*
			Bathonian	167.7 ± 3.5*
			Bajocian	171.6 ± 3.0*
			Aalenian	175.6 ± 2.0*
		Early	Toarcian	183.0 ± 1.5*
			Pliensbachian	189.6 ± 1.5*
			Sinemurian	196.5 ± 1.0*
			Hettangian	199.6 ± 0.6*
	Triassic	Late	Rhaetian	203.6 ± 1.5*
			Norian	216.5 ± 2.0*
			Carnian	228.0 ± 2.0*
		Middle	Ladinian	237.0 ± 2.0*
			Anisian	245.0 ± 1.5*
		Early	Olenekian	249.7 ± 1.5*
			Induan	251.0 ± 0.7*
Paleozoic	Permian	Lopingian (Late)	Changhsingian	253.8 ± 0.7*
			Wuchiapingian	260.4 ± 0.7*
		Guadalupian (Middle)	Capitanian	265.8 ± 0.7*
			Wordian/Kazanian	268.4 ± 0.7*
			Roadian/Ufimian	270.6 ± 0.7*

Table: geologic eras and periods in which it has grown and flourished life of Ginkgophytalean plants. (27)

significant contribution to the study of evolution of *Ginkgo biloba* species. (1, 3, 5, 401, 410 etc.)

9
Ginkgo adiantoides - *Ginkgo biloba*

Ginkgo apodes existed prior to about 120 million years and about 60 million years later appeared a species that already had the characteristics of a modern *Ginkgo biloba*. It is a kind from evolutionary chain - *Ginkgo adiantoides*. This species still has, in quantitative terms, more fruit with seeds for propagation, however, the leaf is almost identical to the type of *Ginkgo biloba*. Therefore, some scientists equate this two and insist that it is actually a *G. biloba*. Nevertheless, some differences exist in the leaf. Leaf of the species *G. adiantoides* is divided into two parts, just as it can be very expressive like in younger *G. biloba* plants. *G. adiantoides* has a leaf as a single surface with a very rounded outer edges and as age is concerned, we find fossils of only 10 million years old (Miocene period of Cenozoic era). At that time it is no longer possible to fully distinguish these two species. When presented to-do reconstruction, it is important to mention one simple guidelines professor Z. Zhou looks about the details of these plants; - "*Ginkgo biloba* bears the modern type (or the *G. biloba* type) ovule organs. The ovules (seeds) are 1-2 in number, but only one Matured and the other one aborted. The ovule (seed) is attached directly to the peduncle and there is no pedicel. *G. adiantoides* is similar in these respects to *G. biloba*. *G. yimaensis* bears the primitive type (or the *G. yimaensis* type) ovule organs. The ovules are more than 2 in number when Matured. They are not attached directly to the peduncle, but to the pedicels which are given off from the apex of peduncle dichotomously or in dichopodial pattern, so that the pedicels are always similar in length and thickness. *G. apodes* bears ovules organs morphologically intermediate between *G. biloba* and *G. yimaensis*. There is no pedicel as in *G. biloba*, but the mature ovules is more than 2 in number as in *G. yimaensis*. Please note that the detached aborted ovules usually leaves a scar on the peduncle." (49, etc.)*

10
Discussion on an isolated existence *Ginkgo biloba* on DNA analysis

Although ginkgo populations in nature preserved only in a few places in China today, to be more precise in the southeastern parts of China, today we can not claim with certainty on which locations are trees that grow as "wild" plants and where as propagated natural resources of *Ginkgo biloba*. *Ginkgo biloba* in the North American continent became extinct about 10 million years ago, in Europe about 17 million years, while in Japan and surrounding locations just prior to about 2-5 million years ago. It has been proven that it is not extinct in China and that gave us many legends and myths that speak of the survival and resuscitation of this plant species.

In order to determine in which areas of China is indeed a natural habitat of *Ginkgo biloba* various analysis were performed especially DNA analysis of a highly cultivated trees categories, as well as for those presumed to be a natural population. If we want to be short and say something about it then the situation looks like this. 2005 years comparison of results of DNA types for Ginkgo populations has been made from 8 sites throughout China. It was found that high genetic diversity of plants present in Ginkgo populations is in areas of the province of Chongqing and Guizhou, which show a direct relationship of this population with plants from the period of glaciations and the last ice age, and thus period by then.

Since Ginkgo in its life cycle and plant growth has different phases in which changes leaf shape and sometimes the whole plant many botanists have concluded that *Ginkgo biloba* is not the only one preserved species of the genus *Ginkgo*. But this proved not to be correct. Detailed morphological descriptions and studies have confirmed the existence of only one species. (1 - 5, 310, 401 etc.)

11
Overview of the morphological characteristics of extinct species gender *Ginkgo*

Starting from the Triassic until the end of the Cretaceous and later *Ginkgo* genus had many species which on their own had a distinct morphological characteristics. In close connection with this genus was genus *Ginkgoites* which also comes from the late Triassic until the Upper Paleogene. When it comes to identification of these plants scientists usually distinguish two types of leafs and ovulatory organs: *Ginkgo* and *Ginkgoites* (separate line in the long leaf blades). In fact it's probably the same genus (?) Most often these features as we have mentioned, are reflected in the leaf appearance and on all the reproductive organs (and fruit). All these plants were trees but trees form at the majority of species is not known. It is assumed that they have had similar forms of modern *Ginkgo biloba* tree. Some species had a leaf made from one single plate more or less notched. Some species had a leaf of just two or more leaf blades and most of the leaves and leaf blades was in blunt-ended curved shape. However, there are also species that had sometimes completely blunt, very jagged endings or even completely asymmetrical appearance rate (eg *G. digitata*). Some species had a small leaf and some had large leaf (eg *G. huttoni* - a large leaf, *G. dawsoni* - mostly small leaf). It is also important to mention that most species have had a leaf shaped from one plate with serrated edges, but in some species the leaf could almost be divided into six, seven or more equal parts. It is significant to say and that the leaf form has changed with the growth rate and plant age. All these plants are seed-reproduced and reproductive organs differed from species to species. Some scientists in the abnormal developement of forms of female reproductive organs of *Ginkgo biloba* can even see real female reproductive organs of some extinct species, which is still evolution and genetically modified. See graphs of various extinct species. (1, 3, 5, 401 etc.)

12
Features of geological periods in which they lived *Ginkgoales* plants

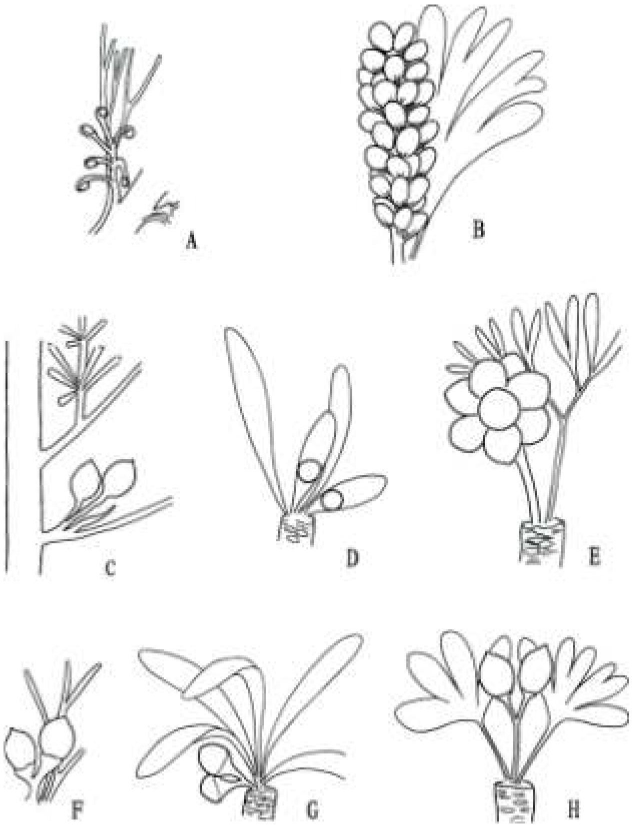
We have already mentioned that from the period of occurrence of *Ginkgophyta*, and it's Perm in the Paleozoic, until the end of the Mesozoic, when the population of this plants starts to decline, land part of the Earth called Pangea began to break even until the beginning of the Paleocene it was possible to discern contours of today's images of the continents. During the Mesozoic era in the northern hemisphere continent called Laurasia was formed. From him later Europe and Asia was formed. In the southern hemisphere there was super-continent Gondwana, from which originates Africa, South America, Australia, Antarctica and India. All these changes followed the changes in climate. As *Ginkgophyta* Division began to go lower in numbers in representatives at the end of Mesozoic era it was determined that it was the last period which was mainly Cretaceous age and was characterized climate mainly similar to the present continental climate. The Mesozoic period, when the dinosaurs lived today's ancestors of Ginkgo lasted more than 150 million years. The mysterious disaster that has befallen on the earth in Paleocene brought significant changes to the entire planet, including the division of *Ginkgophyta* plants. They literally started to die out.

13
The influence of climate and other elements on population gender *Ginkgo* and *Ginkgoales* plants in the past

Throughout the Mesozoic Era variety of climatic oscillations began to emerge in almost every aspect. Numerous studies have proved this. During the Permian and Mesozoic Era we can record a significant rise (and occasional lows) of CO_2 concentration, but it did not bother *Ginkgophytae* plants. This phenomenon is explained by increased volcanic activity. Let us say that the climate and general weather conditions where *Ginkgophyta* plants were grown were on average relatively warm but also in some parts wet. An excellent knower of thens circumstances, says that "Then *Ginkgoales* plants were present in very high taxonomical and morphological diversity. In geographical terms *Ginkgoales* plants were at that time most prevalent in the area Laurasie, (It was the Northern Continent - the South Continent was Gondwana). At that time they lived in different climatic conditions and in different habitats and they were very flexible, although their flowering was recorded in a temperate continental climate. From the late Cretaceous and throughout the Cenozoic era (approximately the last 80-90 million years ago) Ginkgo fruit is limited to the coastal environment." (401)

14
Preservation of fossils the *Ginkgo biloba* ancestors

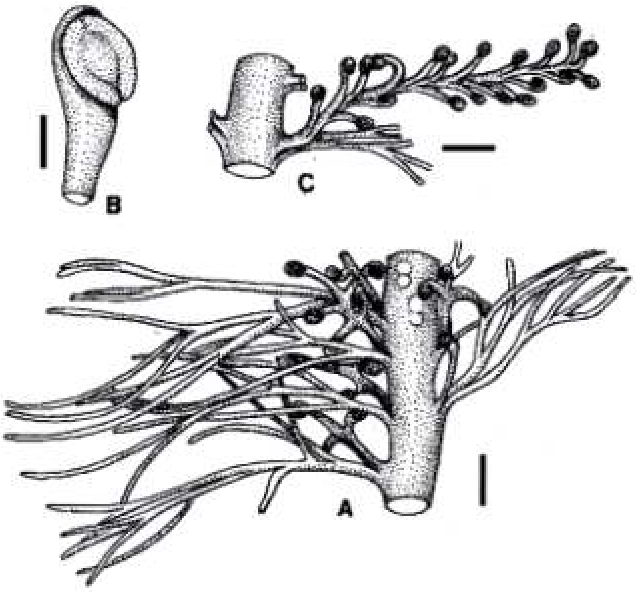
We have already mentioned that fossils that have anything to do with today's Ginkgo in the past and has been found up today is relatively small, taking into account the fossils of other plants. It is clear that the most important cause



Schematic drawings showing diversity of *Ginkgoalean* ovulate organs. (A) *Trichopitys* Florin; (B) *Karkenia* Archangelsky; (C) *Toretzia* Stanislavsky; (D) *Umaltolepis*; (E) Yimaia Zhou et Zhang; (F) *Grenana* Samylina; (G) *Nehvizdyella* Kvaček, Falcon-Lang et Dašková; (H) *Ginkgo* L. (Jurassic species) (based on Florin, 1949; Archangelsky, 1965; Krassilov, 1972; Stanislavsky, 1973; Zhou and Zhang, 1989, 1992; Samylina, 1990; Kvaček et al., 2005). (401)

Trichopitys heteromorpha. Up: fantastic photo-digital reconstruction by Studio SHIFT Chihiro Suzuki Photo (Japan). (28) Below: graphic reconstruction. (75) This reconstruction is approximate. (The reconstruction of *Trichopitys* is problematic and very curious!)

can be found in the age of fossils, but also an important factor is habitat types in which the plants lived. Judging by today's experiences we can say that when a fallen leaf, if there was no moisture (rain or proximity to water), will soon rotted or dried up and crumbed, and had opportunities to experience covering with the ground or some other material such as grass or resilient leaves, etc . If fallen fruit failed to reach the ground and starts sprouting at early vegetation, berries and seeds rotten or have been eaten by some species of dinosaurs and other herbivorous later. But in any case the reproductive organs had a greater chance to be saved, compared to the leaf. Jet more likely chances for fossilization for at least some part of the plants were in the destruction of a tree or a branch falling on the ground or in mud due to any natural disaster like lightning, storm or simply from old age.



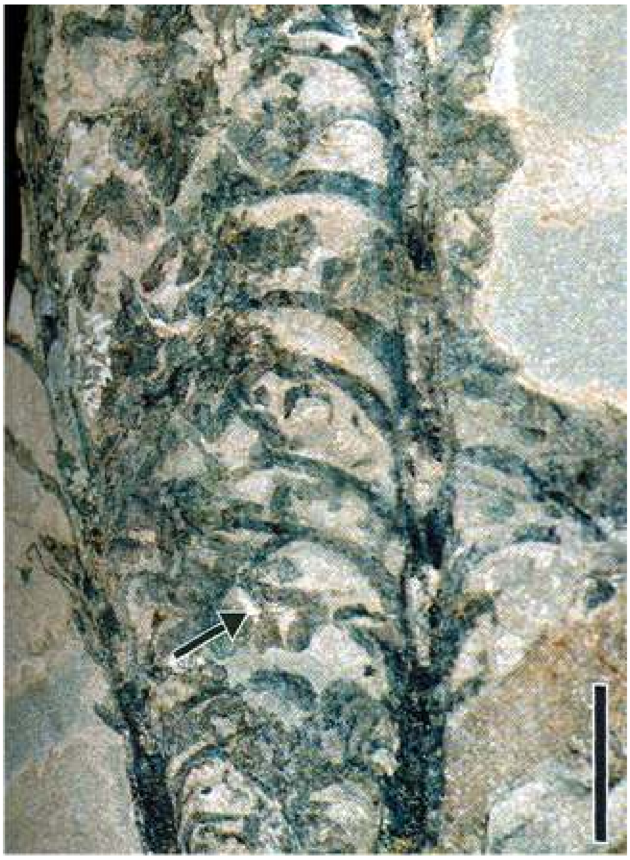
15
Something about the names of extinct species of the genus *Ginkgo*

Naming of extinct species of plants from *Ginkgophyta* division, or fossils of the same plants is based on various grounds. Some types are named after some botanists and other scientists (eg, *G. huttoni*, *G. dawsoni*, *G. samylinae*), some over the locations where they were found (*G. sibirica*, *G. australis*, *G. polaris*, *G. antarctica*, *G. orientalis*, *G. manchurica*, *G. asiatica*, *G. occidentali*, *G. altanensis*, *G. kamschatica*) or by the leaf form (*G. pilifera*, *G. adiantoides*, *G. longifolius*) and some purely tentative.

Valorization

Paleobotanical researches of *Ginkgophyta* Division begin around mid-19 century. Until now on the remains of this plants, was and still is being studied by numerous scientists. These plants have evolved and lived on onshore countries throughout the period of the Mesozoic, even in past 60 million years, but the number of species and genera was drastically reduced (after the disappearance of the dinosaurs), just one kind survived - *Ginkgo biloba*. This division of plants shared characteristic of quick adjustability, but it did not affect on the disappearance of its members.

Scientists generally agree that Ginkgo today has the evolutionary relationship with *Trichopitys* and in this chain also are *G. adiantoides*, *G. apodes* and *G. yimaensis*. *Ginkgophyta* Division had a wide variety of families, genera and species, and yet the whole picture is not entirely clear.



Trichopitys heteromorpha. The fossil was found in southern France. Permian Period. - = 1 cm. The arrow shows ovulating organs. (332)

Ginkgo genera itself is significantly correlated with native *Ginkgoites* (?), and both had during history variety of species by now extinct.

Trichopitys heteromorpha. Below: graphic reconstruction. (5)

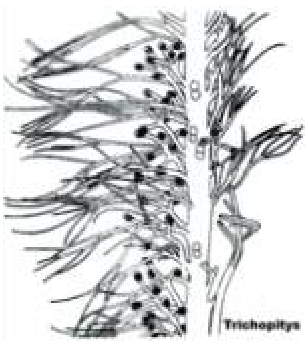
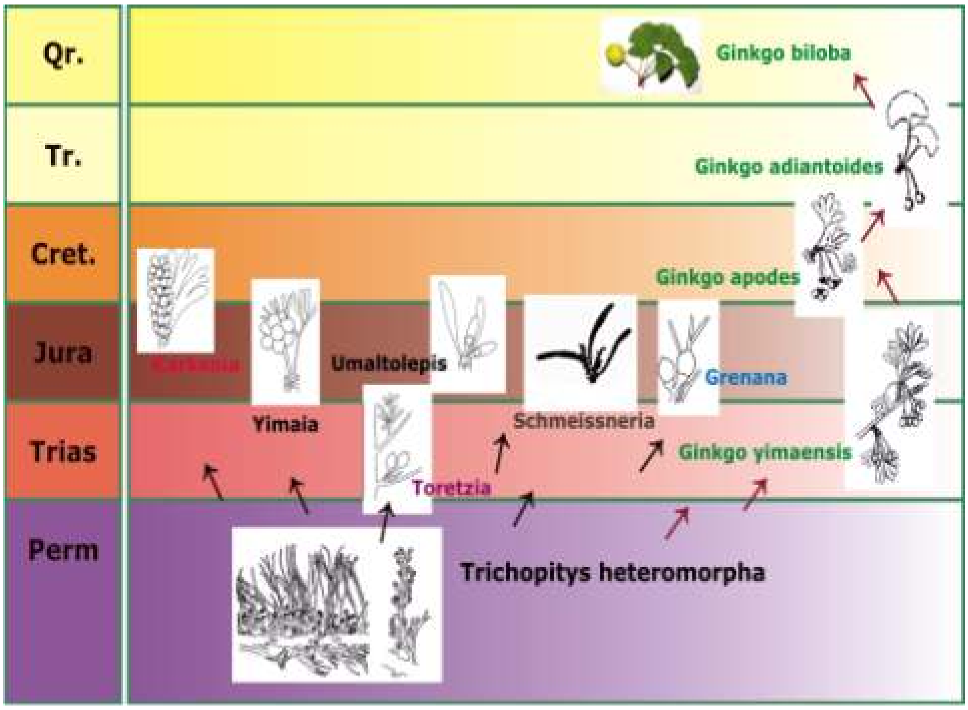
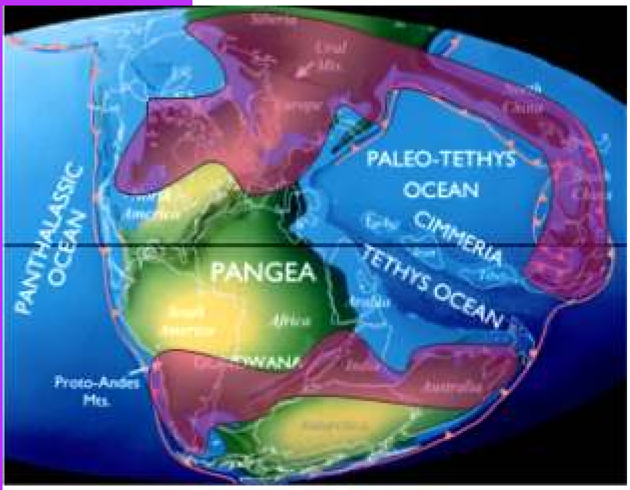
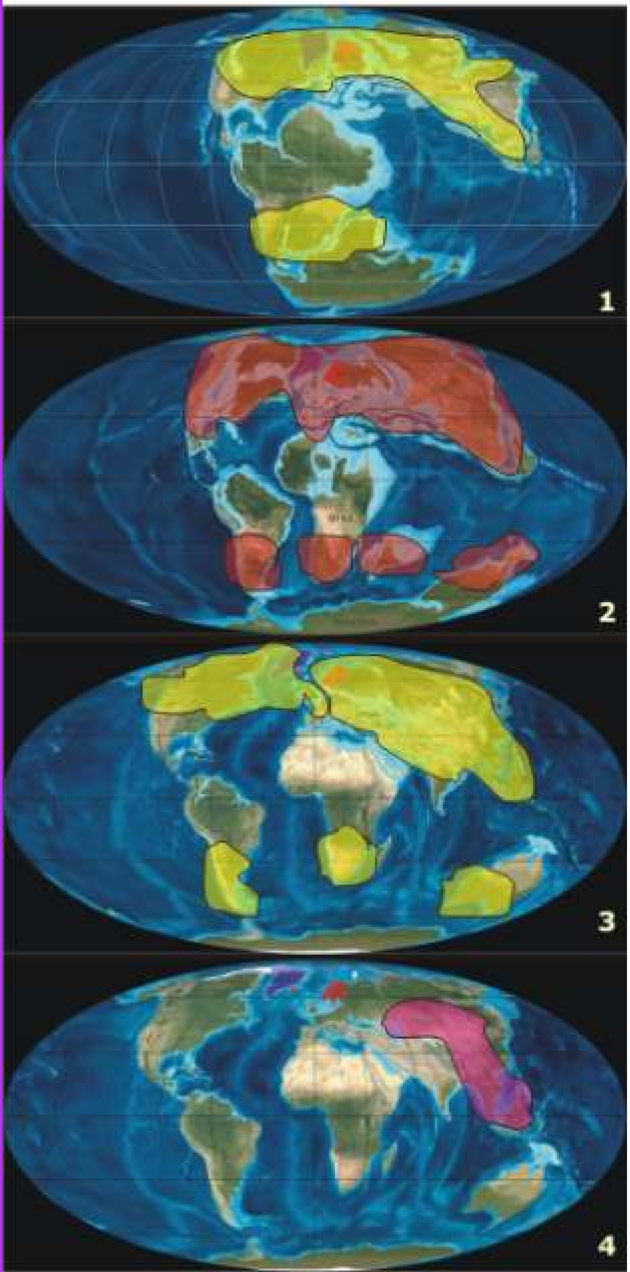


Table right: schematic drawing showing radiation of the different lineages of *Ginkgoaleans* from the archetype *Trichopitys*. (5, 401, etc.)







Red land is Scandinavia & blue is Greenland = landmark. Prevalence Ginkgophytalean plant (transparent sequences) 1. Jurassic Period 160 mill. years ago, 2. Cretaceous 85 mill. y. ago, 3. Eocene 40 mill. y. ago, 4. Neogene 7 mill. y. ago (cca).*

Prevalence division *Ginkgophyta* in Triassic Period - cca 210 million years ago.*

Black or white reconstruction *Ginkgo yimaensis*. (406)

Overall diversity changes of Ginkgoalean genera and morphogenera through geological ages in the world. (Source: 5, fig. 7)

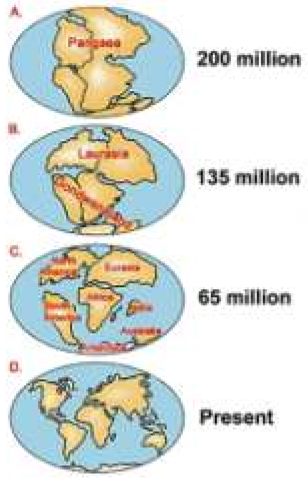
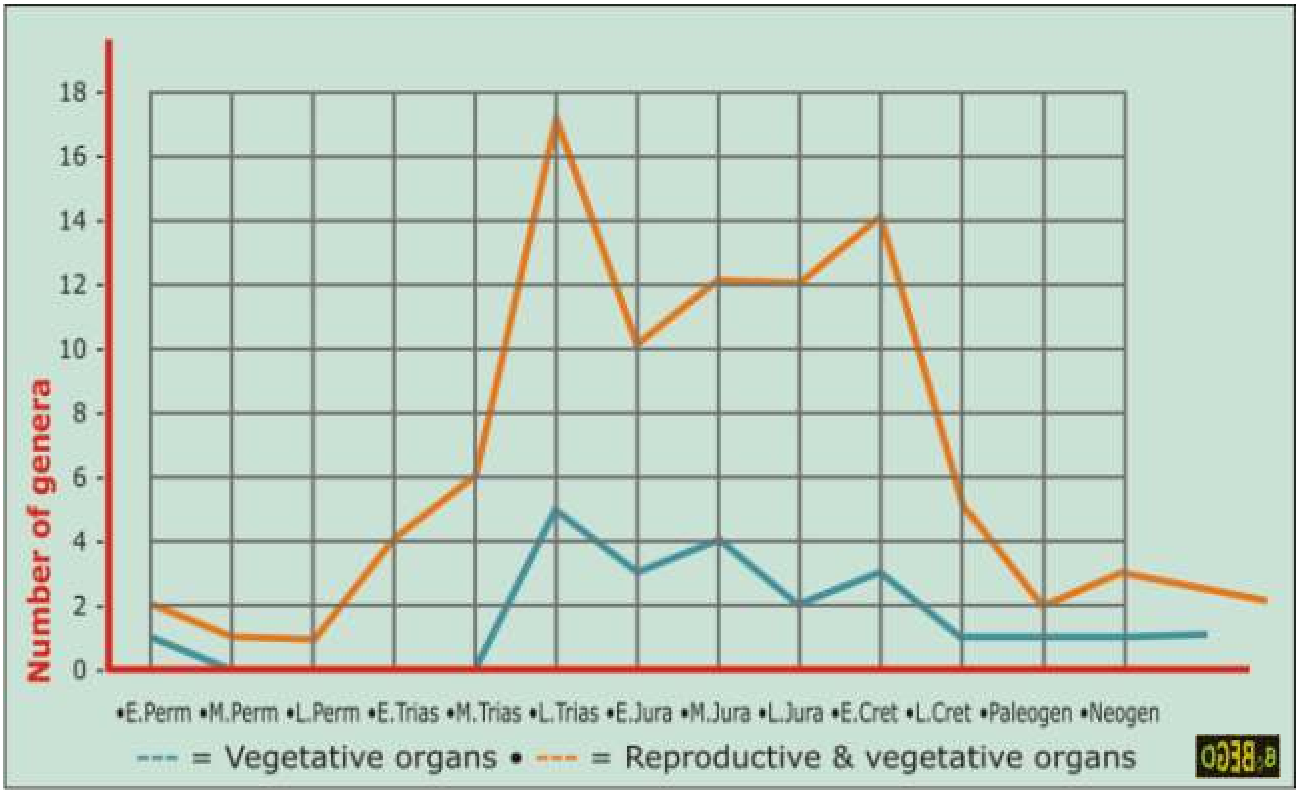


Table: the existence of genus *Ginkgo* (Permian > Neogen). (73)

ERA	PERIOD	Mill. years cca	Genus Ginkgo
Cenozoic	Quaternary		
	Holocene (Epoch)	0,01	
	Pleistocene (Epoch)	2	
	Terciare		
	Pliocene (Epoch)	5	
	Miocene (Epoch)	25	
	Oligocene (Epoch)	38	
	Eocene (Epoch)	55	
	Paleocene (Epoch)	65	
Mesozoic	Cretaceous	145	
	Jurassic	200	
	Triassic	250	
Paleozoic	Permian	250	
	▼	▼	



Pag. 69. Middle Mesozoic fossils of *Ginkgo*: A: *G. digitata* (Seward 1900), B: *Salisburia digitata* (Saporta 1884), C: *G. adiantoides* (Konstantov 1914), D: *G. Digitata*, Stanislavski 1957), E: *Salisburia digitata* (Saporta 1884), F: *G. digitata* (Stanislavski 1957), G-I: *G. digitata* (Harris 1948), J: *G. huttoni* (Bartholin 1892-1894), K: *G. digitata* (Kryshtofovitch 1927), L: *G. huttoni* (Krasser 1900), M: *G.huttoni* (Vakhrameev & Doludenko 1961), N-P: *G. digitata* incl.var.*huttoni* (Oishi 1940), Q-U: *G. huttoni* (Harris 1948). *Pag.75.* Upper Mesozoic fossils of *Ginkgo*: A: *G. adiantoides* (Vakhrameev 1958), C: *G. adiantoides* (Vasiljevskaja & Pavlov 1963), D: *G. adiantoides* (Vasiljevskaja & Pavlov 1963), E: *G. adiantoides* (Vasiljevskaja & Pavlov 1963), F: *G. adiantoides* (Vasiljevskaja & Pavlov 1963), G: *G. adiantoides* (Bell 1956), H: *G. pluripartita* (Bell 1956), I: *G. pluripartita* (Bell 1956), J: *G. dawsoni* (Bell 1957), K: *Baiera pluripartita* (Schenk 1871), L: *G. huttoni* (Ward 1905), M: *G. pseudoadiantoides* (Hollick 1930), N: *G. digitata* (Nathorst 1919), O: *G. digitata* (Nathorst 1919), P: *G. polaris* (Florin 1936), Q: *G. digitata* (Ward 1905), R: *G. huttoni* (Ward 1905). (341, p.69 and 75)

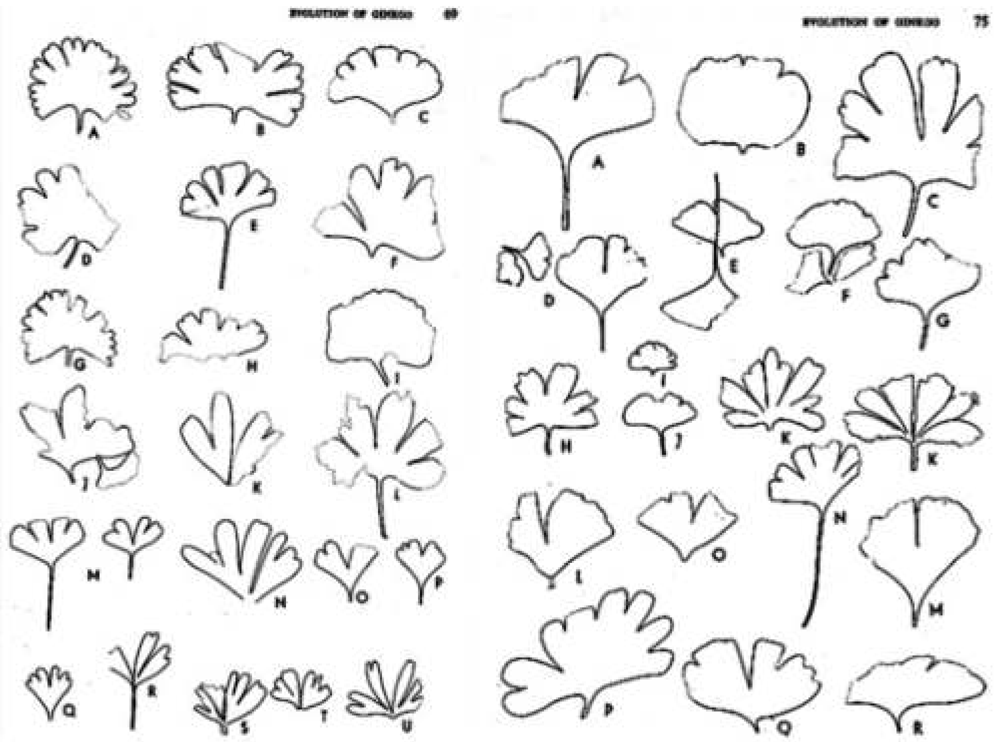
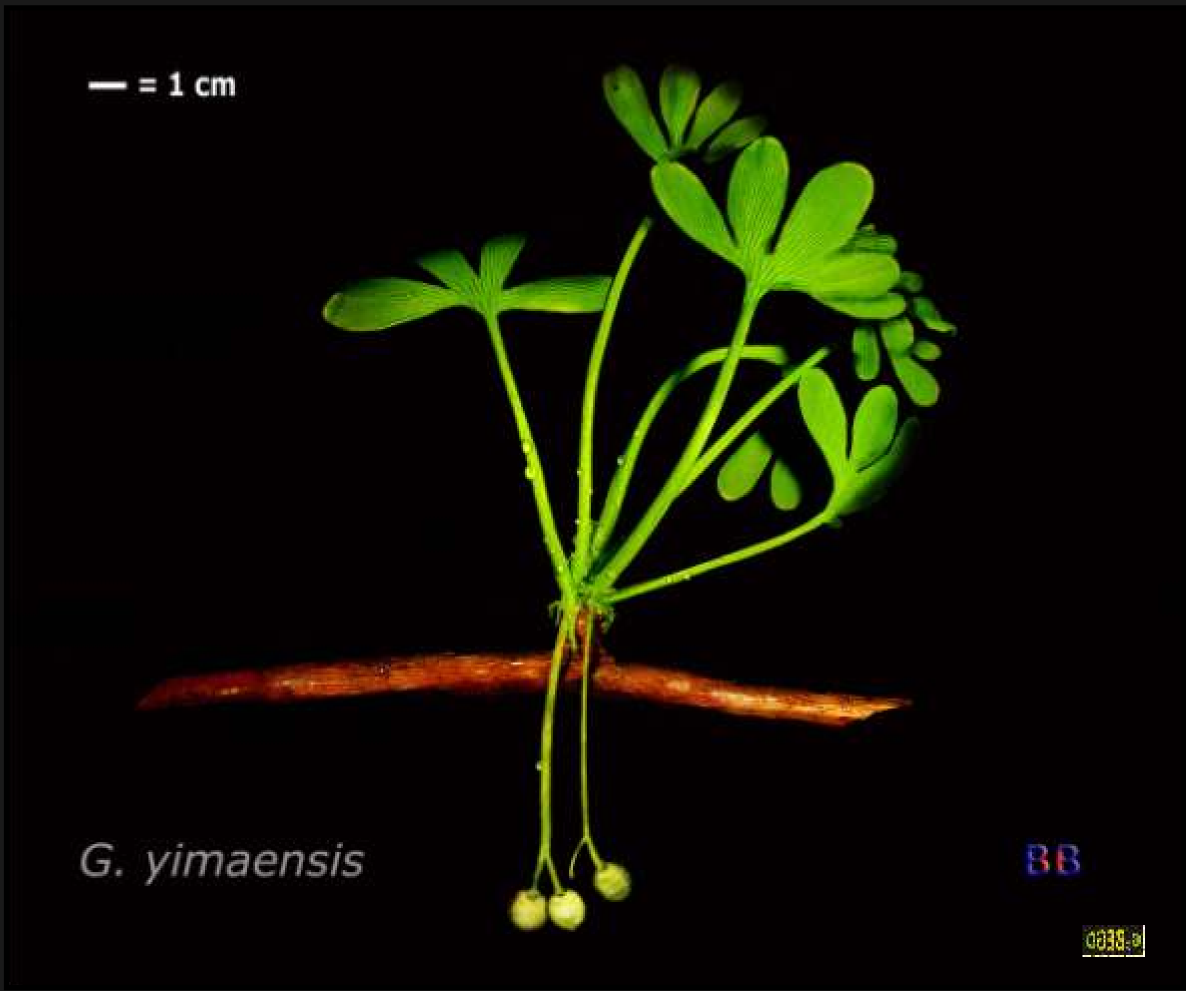


Fig. pages 60-61.

Evolution of *Ginkgo biloba*. Graphic (approximately) reconstruction *G. yimaensis*, *G. apodes*, *G. adiantoides* (*G. cranii*) and *G. biloba*.

Graphic design by Begovic, B. (2010) - based on Zhou and Zhang (1989) and Zhou and Zheng (2003).


— = 1 cm
G. yimaensis


— = 1 cm
G. apodes


— = 1 cm
G. adiantoides
New = G. cranii
BB

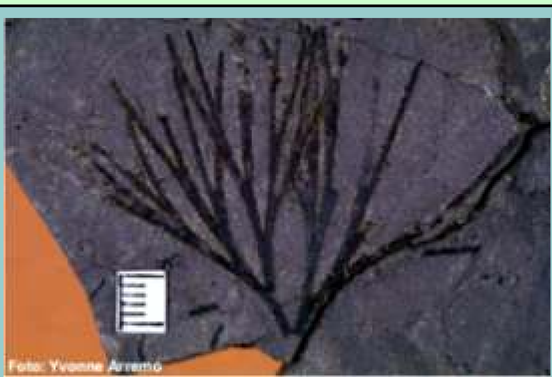

— = 1 cm
G. biloba
BB

Dichophillum (Kansas-USA, Carboniferous-Permian). (47)

Baiera digitata (Germany, Permian). Photo by Yvonne Arremo - Department of Palaeobotany, Swedish Museum of Natural History. (45)

Baiera (South Africa, Triassic). Photo by Yvonne Arremo - Department of Palaeobotany, Swedish Museum of Natural History.(30)

Sphenobaiera (Greenland, Triassic-Jurassic). (31)



Baiera furcata (England, Jurassic). Photo by Yvonne Arremo - Department of Palaeobotany, Swedish Museum of Natural History. (32)

Ginkgoites hermelinii (Sweden, Triassic). Photo by Yvonne Arremo - Department of Palaeobotany, Swedish Museum of Natural History.(33)

Ginkgoites australis (Australia, Cretaceous). (34)

Ginkgoites regnellii (Sweden, Jurassic). Photo by Yvonne Arremo - Department of Palaeobotany, Swedish Museum of Natural History.(29)

Ginkgoites australis (Australia, Cretaceous). (42)

Ginkgo huttoni (England, Jurassic). (35b)

Ginkgo digitata (Norway, Cretaceous). (37) See page 68.

Ginkgo cordilobata (Afghanistan, Jurassic). Photo by Yvonne Arremo - Department of Palaeobotany, Swedish Museum of Natural History. (29)

Ginkgo dissecta (Canada, Eocene). (39a)

Ginkgo sibirica (Siberia - Russia, Jurassic). (166)

Ginkgo huttoni (Yorkshire, United Kingdom, Jurassic). (39a)

Ginkgo huttoni (England, Jurassic). Photo by Michael Pop, USA. (40)

Ginkgo yimaensis (leaf, Jurassic). (110)

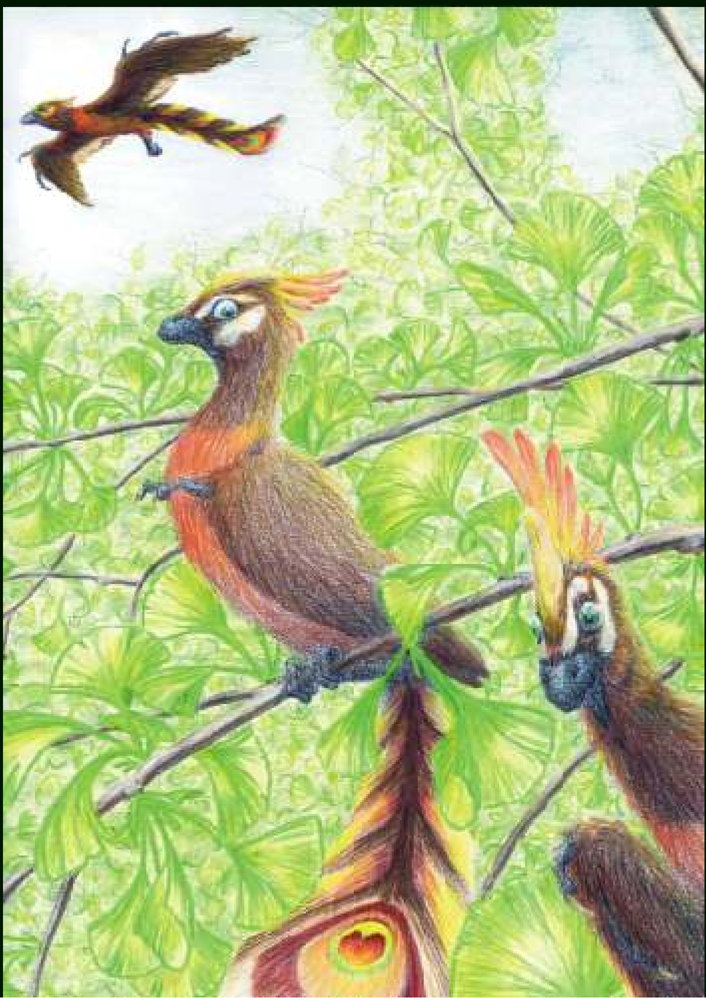
Ginkgo yimaensis (China, Jurassic). (36b)

Ginkgo yimaensis (China, Middle Jurassic). (5a)

Bird-reptile Archaeopteryx (the ancestor of birds) living at the same time as the ancestors of ginkgo. Archaeopteryx lived during the Late Jurassic Period around 150–148 million years ago, in what is now southern Germany during a time when Europe was an archipelago of islands in a shallow warm tropical sea, much closer to the equator than it is now. Reconstruction by Charles Swinford, USA (http://artcastic.files.wordpress.com/2011/02/archaeopteryx-and-ginko-web.jpg - Grupo de Etnologia e Arqueologia da Lourinhã, Portugal) 2009. Source: http://www.museulourinha.org/en/CIID/CIID_Image.htm?key=6-60-A

Ginkgo adiantoides (USA, Tertiary). (46)

Postage stamp with fossil *Ginkgophyta* (*Ginkgo koningensis*) from (18. Jan.) 1990.



Notes (A-B)

A) Table: overview of some fossils *Ginkgophyta*

Source: references this chapter. (+ 7, 341, etc.)

Species	Locality	Country	Age	Reference
Ginkgo matatiensis	Little Switzerland	South Africa	T Camian	Anderson & Anderson 1989
Ginkgo telemachus	Little Switzerland	South Africa	T Camian	Anderson & Anderson 1989
Ginkgo antarctica	Little Switzerland	South Africa	T Camian	Anderson & Anderson 1989
Ginkgo sp.	Neue Welt	Switzerland	T Camian	Kräusel 1923
Ginkgoites lunzensis	Lunz	Austria	T Camian	Kräusel 1943a
Ginkgo ferganensis	Yagnob	Uzbekistan	T Rhaetian	Khudaiberdeyev et al. 1971
Ginkgoites obovatus	Bjuv	Sweden	T Rhaetian	Florin 1937
Ginkgoites troedssonii	Billesholm	Sweden	T Rhaetian	Lundblad 1959
Ginkgoites troedssonii	NW Scania	Sweden	T Rhaetian	Beerlinger et al. 1998
Ginkgoites marginata	NW Scania	Sweden	T Rhaetian	Beerlinger et al. 1998
Ginkgoites obovatus	Jameson Land	Greenland	T Rhaetian	McElwain et al. 1999
Ginkgoites obovatus	Jameson Land	Greenland	T Rhaetian	McElwain et al. 1999
Ginkgoites acosmia	Jameson Land	Greenland	T Rhaetian	McElwain et al. 1999
Ginkgoites marginata	NW Scania	Sweden	J Hettangian	Beerlinger et al. 1998
Ginkgo taeniata	Bayreuth	Germany	J Hettangian	Collinson et al. 1998
Ginkgo huttoni	Yorkshire	England	J Aalenian	Beerlinger et al. 1998
Ginkgo sibirica	Schurab	Uzbekistan	J Bajocian-Bathonian	Khudaiberdeyev et al. 1971
Ginkgo huttoni	Schurab	Uzbekistan	J Bajocian-Bathonian	Khudaiberdeyev et al. 1971
Ginkgo suluktensis	Sulyakta	Uzbekistan	J Bathonian	Khudaiberdeyev et al. 1971

Species	Locality	Country	Age	Reference
Ginkgo asiatica	Angren	Uzbekistan	J Bathonian	Nosova 1998
Ginkgo huttoni	Helmsdale	Scotland	J Kimmer-idgian	Florin 1937, Tralau 1968
Ginkgo manchurica	Huoshiling	China	J Kimmeridgian-Tithonian	Oishi 1933; Zhao et al. 1993
Ginkgo manchurica	Xilutian	China	J Tithonian	Zhao et al. 1993
Ginkgo manchurica	Shahezi	China	C Berriasian	Oishi 1933; Zhao et al. 1993
Ginkgo pluripartita	Hannover	Germany	C Berriasian	Florin 1937, Tralau 1968
Ginkgoites dissectus	Adnikan	Primorie	C Berriasian	Krassilov 1972
Ginkgo coriaceae	Huolinhe	China	C Valanginian-Hauterivian	Sun 1993
Ginkgo coriaceae	Cape Stephen	Franz Joseph Land	C Barremian	Florin 1937, Tralau 1968
Ginkgo polaris	Cape Flora	Franz Joseph Land	C Barremian	Florin 1937, Tralau 1968
Ginkgoites tigrensis	Estancia Bajo Tigre	Argentina	C Aptian	Archangelsky 1965, Villar de S. 1997
Ginkgoites ticoensis	Ticó Amphi-theatre	Argentina	C Aptian	Archangelsky 1965
Ginkgoites australis	Eagle's Nest	Australia	C Aptian	Douglas 1969
Ginkgo paradiantoides	Zyrianka River	Russia	C Albian	Samylina 1967b
Ginkgo delicata	Zyrianka River	Russia	C Albian	Samylina 1967b
Ginkgo pilifera	Lindi River	Russia	C Cenomanian-Senonian	Samylina 1967a
Ginkgo pilifera	Sim River	Russia	C Turonian	Samylina 1967a
Ginkgo pilifera	Elistratova	Russia	C Turonian-Coniacian	Samylina 1967a
Ginkgo adiantoides	Dakota	U.S.A.	C Maastrichtian	Mösle et al. 1998

Species	Locality	Country	Age	Reference
Ginkgo tzagajanica	Bureya River	Primorie	C Maastrichtian	Samylina 1967a
Ginkgo wyomingensis	Wyoming	U.S.A.	P Paleocene	Manum 1966
Ginkgo adiantoides	Johnson Co.	Wyoming U.S.A.	P Paleocene	Collinson et al. 1998
Ginkgo spitsbergensis	Mt Basilika	Spitsbergen	P Paleocene	Manum 1966
Ginkgo gardneri	Ardtun	Isle of Mull	P Paleocene-Eocene	Florin 1937, Tralau 1968, Boulter 1989
Ginkgo tzagajanica	Noda	Japan	P Eocene	Horiuchi & Kimura 1986
Ginkgo orientalis	Tavrichanka	Primorie	P Eocene	Polyshchuk 1975
Ginkgo orientalis	Krilion	Sakhalin	P Eocene	Samylina 1967a
Ginkgoites samyliane	Zagorsk	Sakhalin	P Eocene	Medyalyanov 1969
Ginkgoites adiantoides	Kuzi	Japan	P Oligocene	Oishi 1938
Ginkgo occidentalis	Zakarnatskie	Russia	N Miocene	Samylina 1967a
Ginkgo adiantoides	Klaj	Poland	N Miocene	Lancucka-Środoniova 1966
Ginkgo adiantoides	Stare Gliwice	Poland	N Miocene	Szafer 1961
Ginkgo adiantoides	Klärbecken	Germany	N Pliocene	Florin 1937, Tralau 1968
Ginkgoites obovatus	Astarte River	Greenland	T Rhaetian	Harris 1935
Ginkgoites acosmia	Astarte River	Greenland	T Rhaetian	Harris 1935
Ginkgoites fimbriata	Astarte River	Greenland	T Rhaetian	Harris 1935
Ginkgoites marginata	Stabbarp	Sweden	T Rhaetian	Lundblad 1959
Ginkgoites taeniata	Bayreuth	Germany	J Hettangian	Harris 1935

Species	Locality	Country	Age	Reference
Ginkgoites hermelini	Vardekløft	Greenland	J Hettangian	Harris 1935
Ginkgo marginata	Anina	Romania	J Hettangian-Sinemurian	Czier 1998
Ginkgo skottsbergi	Anina	Romania	J Hettangian-Sinemurian	Czier 1998
Ginkgoites marginata	Hälsingborg	Sweden	J Pliensb.-Toarcian	Lundblad 1959
Ginkgo huttoni	Pennyholm	England	J Aalenian	Harris et al. 1974
Ginkgo whitbiensis	Whitby	England	J Aalenian	Harris et al. 1974
Ginkgo huttoni	Derwent River	England	J Aalenian	McElwain & Chaloner 1996
Ginkgo cordilobata	Ishpushta	Afganistan	J Bajocian-Bathonian	Schweitzer & Kirchner 1995
Ginkgo furcinervis	Schurab	Uzbekistan	J Bajocian-Bathonian	Khudaiberdyev et al. 1971
Ginkgo digitata	Cayton Bay	England	J Bajocian	Harris et al. 1974
Ginkgo longifolius	Cayton Bay	England	J Bajocian	Harris et al. 1974
Ginkgo kokinensis	Sulyakta	Uzbekistan	J Bathonian	Khudaiberdyev et al. 1971
Ginkgo gromykoi	Angren	Uzbekistan	J Bathonian	Nosova 1998
Ginkgo huttoni	White Nab	England	J Bathonian	Harris et al. 1974
Ginkgo huttoni	Scalby Ness	England	J Bathonian	Harris et al. 1974
Ginkgo digitata	Brora	Scotland	J Bathonian	Stopes 1907
Ginkgoites regnelli	Eriksdal	Sweden	J Bathonian	Tralau 1966
Ginkgo huttoni	Aldan River	Russia	J Tithonian	Samylina 1963
Ginkgoites sphenophyllus	Urgal	Primorie	C Berriasian	Krassilov 1972

Species	Locality	Country	Age	Reference
Ginkgoites longipilosus	Adnikan	Primorie	C Berriasian	Krassilov 1972
Ginkgoites jampolensis	Urgal	Primorie	C Valanginian	Krassilov 1972
Ginkgoites australis	Woolamai	Australia	C Aptian	Douglas 1969
Ginkgoites australis	Point Lydia	Australia	C Aptian	Douglas 1969
Ginkgoites australis	Trafalgar	Australia	C Aptian	Douglas 1969
Ginkgo altanensis	Altan	Russia	C Albian	Srebrodolaskaya & Samylina 1984
Ginkgo singularis	Zyrianka River	Russia	C Albian	Samylina 1967b
Ginkgo polaris	Zyrianka River	Russia	C Albian	Samylina 1967b
Ginkgo paradiantoides	Lepiska River	Russia	C Albian	Samylina 1967a
Ginkgo sibirica	Gryaznii	Russia	C Cenomanian	Samylina 1988
Ginkgoites antarctica	Atanekerdluk	Greenland	C Cenomanian	Florin 1937
Ginkgo tatjanae	Tal-Juryakh	Russia	C Cenomanian	Samylina 1988
Ginkgo diminuta	Tanitoge	Japan	C Turonian	Ohana % Kimura 1986
Ginkgo sp.	Kap Kon-glomeratovi	Russia	C Turonian-Coniacian	Samylina 1967a
Ginkgoites transsenonicus	Mgachi	Sakhalin	C Coniacian	Krassilov 1979
Ginkgo spitsbergensis	Darmakana	Primorie	P Paleocene	Krassilov 1979
Ginkgo kamschatica	Anadyr River	Kamchatka	P Paleocene	Budantsev 1983
Ginkgo tzagajanica	Hanzaki	Japan	P Eocene	Uemura 1997
Ginkgo tatjanae	Podkagern-aya River	Russia	P Eocene	Samylina & Chelebayeva 1986

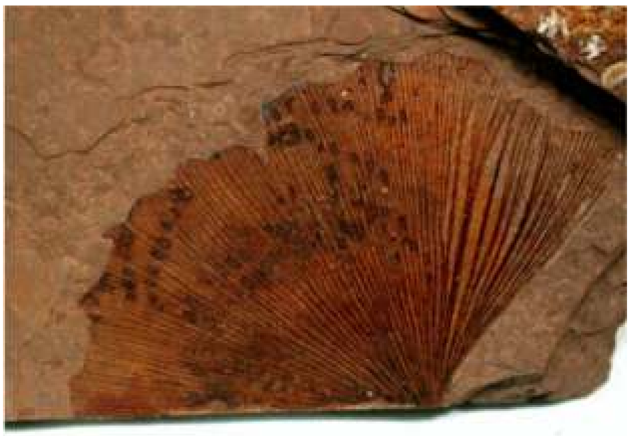
Species	Locality	Country	Age	Reference
Ginkgo digitata	Spitsbergen	Norway	C Cretaceous	http://nhm.uio.no
Ginkgo semirotunda	New South Wales	Australia	T Triassic	White 1986
Ginkgo manchurica	Hunan	China	J Jurassic	http://xs4all.nl
Ginkgo dissecta	Brit. Columbia	Canada	P Eocene	http://xs4all.nl
Ginkgo huttoni	Yorkshire	England	J Jurassic	http://141.20.244.90/mehr/paleo
Ginkgo huttoni	North Yorkshire	England	J Midle Jurassic	http://xs4all.nl
Ginkgo adiantoides	North Dakota	U.S.A.	P Paleocene	http://itc.gsw.edu
Ginkgo biloba	Longyearbyena	Norway	P Paleocene	http://nhm.uio.no
Ginkgoites marginatus	Komló	Hungary	J Sinemurian	Barbacka 2002
Ginkgoites minuta	Komló	Hungary	J Sinemurian	Barbacka 2002
Ginkgo obrutschewi	Xinjiang	China	J Sinemurian	Chen et al. 2001

Legend:

- T = Triassic
- J = Jurassic
- C = Cretaceous
- P = Paleogene
- N = Neogene

Species	Locality	Country	Age	Reference
Ginkgoites sp.	Zagorsk	Sakhalin	P Eocene	Medyulyanov 1969
Ginkgo adiantoides	Pit River	California U.S.A.	N Miocene	La Motte 1936
Ginkgo biloba	Pierzchow	Poland	N Miocene	Lancucka-Środoniova 1966
Ginkgo biloba	Gotse Delchev	Bulgaria	N Pliocene	Jordanov & Kitanov 1963
Ginkgo biloba	Hoshiwara	Japan	N Pliocene	Iwao 1978
Ginkgo biloba	Daiwa	Japan	N Pliocene	Uemura 1997
Ginkgo adiantoides	Kudia River	Russia	N Tertiary	http://cumuseum.colorado.edu
Ginkgo adiantoides	Almont	U.S.A.	P Paleocene	Zhou 2009
Ginkgo apodes	Liaoning	China	C Early Cretaceous	Zhou 2009
Ginkgo ginkgoidea	Scania	Sweden	J Middle Jurassic	Zhou 2009
Ginkgo liaoningensis	Liaoning	China	C Early Cretaceous	Zhou 2009
Ginkgo manchurica	Liaoning	China	C Early Cretaceous	Zhou 2009
Ginkgo rajmahelansis	Rajmahal Hills	India	J Jurassic	Zhou 2009
Ginkgo sibirica	Bureja	Russia	J Middle Jurassic	Zhou 2009
Ginkgo yimaensis	Henan	China	J Middle Jurassic	Zhou 2009
Ginkgoites matatiensis	El Puquén	Chile	T Late Triassic	Troncoso & Herbst 1999
Ginkgoites waldeckensis	La Ternera	Chile	T Late Triassic	Troncoso & Herbst 1999
Ginkgoites covacevicii	La Ternera	Chile	T Late Triassic	Troncoso & Herbst 1999
Ginkgoites antarctica	La Ternera	Chile	T Late Triassic	Troncoso & Herbst 1999

B) Year 2003 discovered the link in the evolution of Ginkgo: *Ginkgo apodes* (Nature, Vol 423, 19 June 2003, p. 821-822.)



Often exposed fossil *G. adiantoides*: Eocene fossil leaf from the Tranquille Shale of British Columbia, Canada. (11)

The missing link in Ginkgo evolution

The modern maidenhair tree has barely changed since the days of the dinosaurs.

The maidenhair tree, or *Ginkgo*, is a gymnosperm that has been described as a 'living fossil' because it is known to have existed early in the Jurassic period 170 million years (Myr) ago, but a full understanding of its evolution has been impeded by a gap in the fossil record of more than 100 Myr — a crucial period during which the modern ovulate organs evolved from the Jurassic type[1]. Here we describe a new *Ginkgo* fossil that was collected from the Lower Cretaceous fossil Lagerstätte (the Yixian Formation[2], which is over 121 Myr old[3]) in China and which fills this gap. This missing link reveals that *Ginkgo*'s reproductive structures at that time were more like those of the present-day *Ginkgo biloba* than those of the primitive Jurassic type, indicating that their morphology has changed little for over 100 Myr.

The fossil was found on the southern slope of the Yinwoshan Mountain in Toudaohezi village (41° 46´ N, 121° 40´ E) of Yixian County in Liaoning Province. The ovulate organs consist of clusters of collared ovules and a common stalk (peduncle) (Fig. 1a, c, d) that is 32–42 mm long and 1–3 mm wide. Only one to three large, probably mature ovules are still attached (Fig. 1c, d), but judging by the number of collars, the organs originally had more (up to six) ovules. Each ovule is borne at the end of an individual stalk (pedicel) (Fig. 1a) that is about 2–3 mm in length and 2 mm in width in juvenile organs. In mature organs, the individual stalk is hardly visible below the collar (Fig. 1c, d). Well-developed ovules (seeds) are roughly circular in outline (7.3–8.8 mm long and 6–8 mm wide). The surface of the ovule is smooth.

The associated leaves (Fig. 1b, and see supplementary information) are small, consisting of a petiole and a flabellate-tosemicircular lamina that are dichotomously divided several times. The ultimate segments are wedge-shaped to oblanceolate, with an obtusely rounded or truncated apex and three to six veins that converge slightly towards the apex.

No record existed of well-preserved *Ginkgo* ovulate organs from between the Middle Jurassic and the Early Tertiary epoch[4] (see supplementary information). The new Cretaceous *Ginkgo* is unlike the oldest known (Middle Jurassic) species *G. yimaensis*[1] (Fig. 1e), which has ovulate organs with three or four mature ovules, each terminating in a long individual stalk. It also differs from the Early Tertiary (about 56 Myr ago) *G. adiantoides*[5] and the living species *G. biloba*. The ovulate organs of both have only a single, developed ovule and an aborted one attached to the common stalk (Fig. 1e; for a comparison of the ovulate organs of living and fossil *Ginkgo* species, see supplementary information). Two or more ovules, each with an individual stalk, can occur in juvenile or aberrant organs of *G. biloba*[6,7], but these organs are usually shed in the early stages of development.

The associated leaves are not divided to the same extent as those of Jurassic species such as *G. yimaensis*[1] and *G. huttonii* (Sternberg) Heer[8], but are more divided than leaves of the Early Tertiary and modern species (although leaves from new long shoots or seedlings of *G. biloba* are also deeply divided[9]) (Fig. 1e).

The new *Ginkgo* is morphologically intermediate between the Jurassic species and the Early Tertiary and modern species, and is closer to the latter types. The new finding extends the geological range of the modern form and is evidence of a roughly 120-Myr morphological stasis in ovulate organs of *Ginkgo* (Fig. 1e). It also suggests that ovulate organs of the *G. biloba* type could have originated by heterochrony (peramorphosis)[10] from the Jurassic *G. yimaensis* type[7].

Zhiyan Zhou*, Shaolin Zheng†
**Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China*
e-mail: zyzhou@nigpas.ac.cn
†Shenyang Institute of Geology and Mineral Resources, Ministry of National Land and Resources, Shenyang 110032, China

1. Zhou, Z.-Y. & Zhang, B.-L. *Palaeontographica B* **211,** 113–133 (1989).
2. Chang, M.-M., Chen, P.-J., Wang, Y.-Q. & Wang, Y. (eds) *The Jehol Biota* (Shanghai Science & Technology, Shanghai, 2001).
3. Swisher, C. C. III *et al. Chinese Sci. Bull.* **47,** 135–138 (2002).
4. Rothwell, G. W. & Holt, B. in *Ginkgo biloba— A Global Treasure from Biology to Medicine* (eds Hori, T. *et al.*) 223–230 (Springer, Tokyo, 1997).
5. Crane, P. R., Manchester, S. R. & Dilcher, D. L. *Fieldiana (Geol.) N. Ser.* **20,** 1–63 (1990).
6. Fuji, K. *Bot. Mag. (Tokyo)* **10,** 104–110 (1896).
7. Zhou, Z.-Y. *Acta Palaeontol. Sin*. **33,** 131–139 (1994).
8. Harris, T. M., Millington, W. & Miller, J. *The Yorkshire Jurassic Flora IV: Ginkgoales and Czekanowskiales* (Br. Mus. Nat. Hist., London, 1974).
9. Seward, A. C. *Fossil Plants* Vol. 4 (Cambridge Univ. Press, Cambridge, 1919).
10. Alberch, P., Gould, S. J., Oster, G. F. & Wade, D. B. *Paleobiology* **5**, 296–317 (1979).

Supplementary information accompanies this communication on *Nature*'s website.
Competing financial interests: declared none.

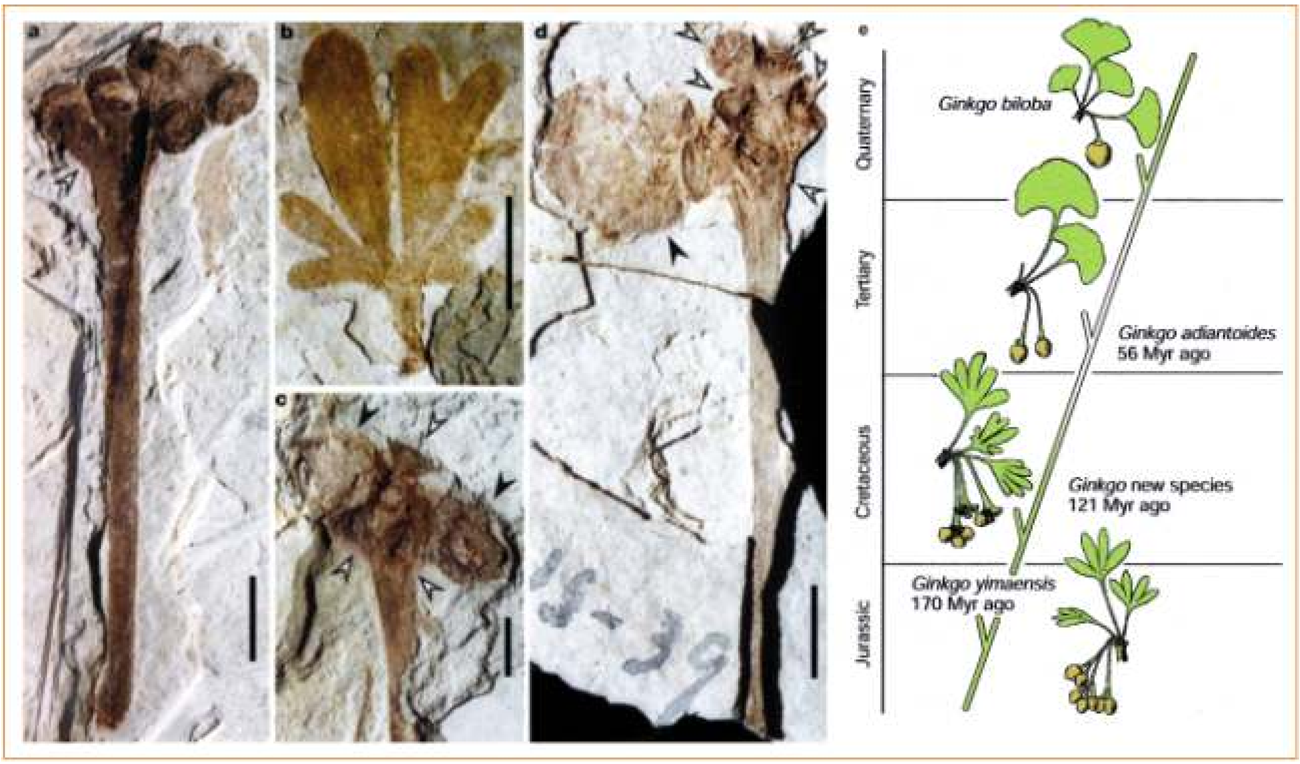


Figure 1 Newly discovered Ginkgo species from the Lower Cretaceous Zhuanchengzhi Bed of the Yixian Formation, China. a, Juvenile ovulate organ with six collars and very short individual stalks (arrowed) (specimen YWS139, PB19880). b, An associated leaf (specimen YWS129, PB19881). c, Ovulate organ bearing two developed ovules (black arrows) and three empty collars (white arrows) (specimen YWS42, PB19883). d, A mature ovulate organ without individual stalks, bearing one developed ovule (black arrow) and five empty collars (white arrows) on the common stalk (specimen YWS139, Pb19884). Scale bars, 5 mm. e, Evolution of the Ginkgo genus in geological history, showing a reduction of individual stalks and a decrease in the number of ovules, and an increase in the size of the ovules and in the width of leaf segments. These evolutionary trends are roughly consistent with the ontogenetic sequence of the living species and are probably caused by peramorphosis[7,10]. Note that the modern type of ovulate organ, the ovule of which has no individual stalk when mature, appeared early in the Lower Cretaceous epoch.

Up left: *Ginkgo digitata* (leaf). Jurassic, Spitsbergen, Norway. Photo by Michael Pop, USA. In Smithsonian National Museum of Natural History, USA.

Fossil *Ginkgo digitata* (leaf) from the Cretaceous of Bohemanneset (Spitsberge, Svalbard, Arctic Norway). Natural History Museum, University of Oslo, Norway.

Ginkgo dissecta (leaf) from Early Middle Eocene (McAbee Fossil Beds, Tranquille Shale, Cache Creek, British Columbia, Canada). The photo was published good deed Virtual Fossil Museum http://www.fossilmuseum.net/

Lecturing: introducing the young generation of scientists with Ginkgo fossils and fossils of other plants from the Jurassic and the other time periods. By Yong Yi Zhen. Australian Museum, Sydney, Australia.

References

(correction approach to web sites 2011/01/17)

1. http://xs4all.nl/~kwanten (The Ginkgo Pages by Cor Kwant)
2. http://www.equisetites.de/palbot/science_history/palaeobotanists.html
3. http://palaeobotany.blogspot.com/search/label/Ginkgophyta
4. http://www.equisetites.de/palbot/organisations/palbotcollection.html
5. (a) http://www.palaeobotany.org/page/living-fossils/gingko-biloba/, (b) http://www.ymgfgs.com/?action=newshow|admin|648|cn|2500,641|44
6. http://www.zipcodezoo.com/Plants/G/Ginkgo_biloba/
7. http://www.nature.com/nature/journal/v411/n6835/extref/411287aa.html, http://www.nature.com/hdy/journal/v94/n4/full/6800616a.html
8. http://campus.fct.unl.pt/prmpedra/fotos/ph23.htm
9. http://maps.thefullwiki.org/Oswald_Heer
10. http://www.nrm.se/en/menu/visitthemuseum.24_en.html
11. http://en.academic.ru/dic.nsf/enwiki/9397716
12. http://www.fossilmuseum.net/plantfossils/Plant-Fossils.htm
13. http://cumuseum.colorado.edu/Research/Objects/feb08_ginkgo.html
14. http://australianmuseum.net.au/image/Talbragar-Jurassic-fossil-site-01
15. http://www.yukon-news.com/news/11990
16. http://fossilspictures.wordpress.com/2009/03/05/gingko-huttoni-jurassic-uk/
17. http://green-woodtrees.blogspot.com/2009/11/ginkgo.html
18. http://www.ginko-spg.org/
19. http://www.agardenersforum.com/forum/ubbthreads.php?ubb=showflat&Number=303931
20. http://www.harunyahya.com/index.php
21. http://www2.nrm.se/pb/data/scania/sp_g.html
22. http://www.ginkgomusic.com/blog/2008/09/01/ginkgo-music-visit-scotland/
23. http://www.historylink.org/index.cfm?DisplayPage=output.cfm&file_id=7396
24. http://www.waymarking.com/gallery/default.aspx?f=1&guid=b787f97e-94e4-4f6c-8258-f157c9516beb&gid=2
25. http://www.creationresearch.net/research/Jurassic-Ark-Project1.htm
26. http://sourcedb.cas.cn/sourcedb_nigpas_cas/en/ywrck/200907/t20090728_2280938.html
27. http://en.wikipedia.org/wiki/Geologic_time_scale
28. http://lounge.shade-online.jp/modules/myalbum/photo.php?lid=4215
29. http://www.nrm.se/sv/meny/forskningochsamlingar/enheter/paleobotanik/virtuellautstallningar/bildgalleri/ginkgoitesregnellii.1172.html, http://www.nrm.se/images/18.68e25d82120c414fd6f80002959/JE-Sch1542+a+part+a+fine+fossil.JPG
30. http://www.nrm.se/sv/meny/forskningochsamlingar/enheter/paleobotanik/virtuellautstallningar/bildgalleri/baierasp.1169.html
31. http://www.ucd.ie/research/newsevents/newsarchive/newsarchive2007/mainbody,6710,en.html
32. http://www.nrm.se/sv/meny/forskningochsamlingar/enheter/paleobotanik/virtuellautstallningar/bildgalleri/baierafurcata.1160.html
33. http://www.nrm.se/sv/meny/forskningochsamlingar/enheter/paleobotanik/virtuellautstallningar/bildgalleri/ginkgoiteshermelinii.1152.html
34. http://www.fossilmuseum.net/plantfossils/ginkofossils.htm
35. a) http://141.20.244.90/mehr/palaeo/edu/lebfoss/ausstellung/poster/farnginkgobj.html, b) http://item.rakuten.co.jp/mineru/ki664a/
36. a) http://terebess.hu/keletkultinfo/ginko.html, b) http://www.chinabaike.com/article/316/tour/2007/20071024609527.html
37. http://www.nhm.uio.no/besokende/faste-utstillinger/fossiler/galleri/montre/english/a31709.htm
38. http://www.xs4all.nl/~kwanten/fossils.htm, http://www.ggwinter.de/stamps/pfl.htm
39. a) http://www.fossilmuseum.net, b) http://animals.howstuffworks.com/dinosaurs/archaepteryx.htm
40. http://louisvillefossils.blogspot.com (e-mail (11/06/2011 from Michael Pop, USA)
41. http://www.nhm.uio.no/?vrtx=search&query=ginkgo&page=1
42. http://australianmuseum.net.au/image/Fossil-Ginkgo-tree-Ginkgoites-australis/
43. http://museumvictoria.com.au/prehistoric/image_html/mr007227.html
44. http://newpaleobotanikabeta.blogspot.com/2009/02/ginkgo.html
45. http://ginkgoworld.blogspot.com, http://www.nrm.se/images
46. http://141.20.244.90/mehr/palaeo/edu/lebfoss/gingko/blatttertiaer.jpg
47. http://taggart.glg.msu.edu/isb200/ginkgo.htm, http://www.ggwinter.de/stamps/tra18.htm
48. http://sourcedb.cas.cn/sourcedb_nigpas_cas/en/ywrck/200907/t20090728_2280938.html
49. Notes from Prof. Zhiyan Zhou 06/08/2010. and 28/09/2010. > ginkgo.begovic@gmail.com (China).
50. Anderson, J.M., Anderson, H.M., 1985. Paleoflora of Southern Africa, Prodromus of South Africa Megafloras. Devonian to Lower Cretaceous. A.A.Balkema, Rotterdam, 423.
51. Anderson, J.M., Anderson, H.M., 1989. Paleoflora of Southern Africa, MoltenoFormation (Triassic). 2. Gymnosperms (excluding Dicroidium). A.A.Balkema, Rotterdam, 567.
52. Anderson, J.M., Anderson, H.M., 2003. Heyday of the gymnosperms: systematics and biodiversity of the Late Triassic Molteno fructifications. Strelitzia 15, 1–398.
53. Anderson, J.M., Anderson, H.M., Cleal, C.J., 2007. Brief history of the gymnosperms: classification, biodiversity, phytogeography and ecology. Strelitzia 20, 1–280.
54. Andreánszky, G., 1952. Der versteinerteWald von Mikófalva und einige andere verkieselte Baumstämme aus Ungarn. Ann. Biol. Univ. Hungariae 1, 15–24.
55. Archangelsky, S., 1965. Fossil Ginkgoales from the Ticò flora, Santa Cruz Province, Argentina. Bull. Br. Mus. (Nat. Hist.) Geol. 10, 121–137.
56. Archangelsky, S., Cúneo, R., 1990. Polyspermophyllum, a new Permian gymnosperm from Argentina, with

consideration about the Dicranophyllales. Rev. Palaeobot. Palynol. 63, 117–135.
57. Archangelsky, S., Taylor, T.N., 1986. Ultrastructural studies of fossil plant cuticles II, Tarphyderma gen. n., a Cretaceous conifer from Argentina. Am. J. Bot. 73 (11), 1577–1587.
58. Arnold, C.A., 1947. An Introduction to Paleobotany. McGraw-Hill, New York/London, 433.
59. Artabe, A.E., Archangelsky, S., 1992. Las Cycadales Mesodescolea Archangelsky emend. Archangelsky y Petriella 1971 (Cretácico) y Stangeria Moore (actuel). Ameghiniana 29 (2), 115–123.
60. Audran, J.C., 1987. Comparison des ultrastructures exiniques et des modalités de l'ontogenèse pollinique chez les Cycadales et Ginkgoales actuelles (Prespermaphytes). Bull. Soc. Bot. France 134, Actual. Bot. 2, 9–18.
61. Audran, J.C., Masure, E., 1978. La sculpture et l'infrastructure du sporoderme de Ginkgo biloba comparées a celle des envelopes polliniques des Cycadales. Rev. Palaeobot. Palynol. 26, 363–387.
62. Bajpai, U., 1991. On Ginkgoites leaves from the early Permian of Rajmahal Hills, Bihar, India. Amegheniana 28, 145–148.
63. Bamford, M.K., Philippe, M., 2001. Jurassic-Early Cretaceous Gondwanan homoxylous woods: a nomenclatural revision of the genera with taxonomic notes. Rev. Paleobot. Palynol. 113, 287–297.
64. Banerji, J., Jana, B.N., 2000. Early Cretaceous megaflora from Bartala Hill, Rajnahal Basin, India. Palaeobotanist 49 (1), 51–56.
65. Barale, G., 1972a. Rhaphidopteris nouveau nom de genre de feuillage filicoïde mesozoique. C. R. Acad. Sci. Sér. D 274, 1011–1014.
66. Barale, G., 1972b. Sur la presence de genre Rhaphidopteris Barale dans le jurassique supérieur de France. C. R. Acad. Sci. Sér. D 275, 2467–2470.
67. Barale, G., 1981. Eretmoglossa nouveau genre de ginkgophytes dans les calcaires lithographiques du Crètacè infèrieur de la Serra du Montsech (Espagne). Ilerda 42, 51–61.
68. Barale, G., Baldoni, A., 1993. L'ultrastructure de la cuticle de quelques Bennettitales du Crétacé inférieur d'Argentine. C. R. Acad. Sci. Paris, Sér. 2 (316), 1171–1177.
69. Barbacka, M., 2002. The Jurassic Ginkgoales from the Mecsek Mountains, Hungary. Rev. Paleobiol. 21, 697–715.
70. Bardola, T. P. et al., 2009. Lenhos de Ginkgophyta em florestas petrificadas no Triássico superior Sul-rio-grandense, Brasil. Rev. bras. paleontol. 12(2):139-148.
71. Beck, G.F., 1945. Tertiary coniferous woods of western North America. Northwest.Sci. 19, 67–102.
72. Beerling, D.J., McElwain, J.C. & Osborne, C.P., 1998. Stomatal responses of the "living fossil" Ginkgo biloba L. to changes in atmospheric CO2 concentrations. Journal of Experimental Botany 49:1603-1607.
73. Begović, B., 2009. Svijet ginka, Croatia (manuscript) 1- 238.
74. Bell, W. A., 1957. Flora of the Upper Cretaceous Nanaimo Group of Vancouver Island. British Columbia: Geological Survey of Canada Memoir.
75. Bell, P. R. & Hemsley, A. R., 2000. Green Plants. Their Origin and Diversity. Sec. Ed. Cambridge, 241-245.
76. Berry, E.W., 1930. Fossil plants from the Cypress Hills of Alberta and Saskatchewan. Can. Nat. Mus. Bull. 63, 15–28.
77. Berry, E.W., 1935. A preliminary contribution to the floras of the Whitemud and Ravenscrag formations. Can. Geol. Surv. Mem. 182, 1–107.
78. Berry, E.W., 1938. Tertiary flora from the Rio Pichileufu, Argentina. Geol. Soc. Am. Spec. Pap. 12, 1–149.
79. Berthelin, M.,Voznin-Serra, C., Broutin, J., 2004. Phytogeographic and climatic implications of Permian woods discovered in Omen (Arabian Peninsula). Palaeontographica B 268, 93–112.
80. Biradar, N.V., Mahabale, T.S., 1978. Occurrence of Ginkgo-like wood in east Gondwanas of India. Rec. Res. Geol. 5, 146–153.
81. Black, M., 1929. Drifted plant-beds of the Upper Estuarine Series of Yorkshire. Q. J. Geol. Soc. Lond. 85, 389–437.
82. Bose, M.N., Banerjee, J., 1984. The fossil floras of Kachchh I. Mesozoic megafossils. Palaeobotanist 33, 1–189.
83. Bose, M.N., Dev, S., 1958. Studies on the fossil flora of the Jabalpur Series from the South Rewa Gondwana Basin. 1. Cycadopteris, Nipanophyllum and Ginkgoites. Palaeobotanist 7, 143–154.
84. Braun, C.F.W., 1843. Beiträge zur Urgeschischte der Pflanzen. In: Münster, G.G. (Ed.), Beiträge zur Petrefactenkunde 6. F.C. Birmer, Beyreuth, 25.
85. Budantsev, L.Y., 1983. Istoriya Arkticheskoi flori epoki rannego kainofita (History of the Arctic flora in the epochs of the early Cenozoic). Akademia Nauk SSSR, Botanicheskii Institut V.L. Komarova, Leningrad, 156.
86. Burleigh, J.G., Mathews, S., 2004. Phylogenetic signal in nucleotide data from seed plants: implications for resolving the seed plant tree of life. Am. J. Bot. 91, 1599–1613.
87. Cao, F.L. (Ed.), 2007. A Monograph of Chinese Ginkgos. China Forestry Publishing House, Beijing, 300 pp. (in Chinese).
88. Cao, Z.Y., 1992. Fossil ginkgophytes from Chengzihe Formation in Shuangyashan-Suibin region of eastern Heilongjiang. Acta Palaeont. Sin. 31 (2), 232–248 (in Chinese, with English summary).
89. Chamberlain, C.J., 1934. Gymnosperms—Structure and Evolution. Johnson Reprint Corporation Reprinted 1957, New York, 484.
90. Chamberlain, J.C., 1935. Gymnosperms. Structure and Evolution. Univ. Of Chicago Press. Chicago – Illinois.
91. Chase, M.W., Soltis, D.E., Olmstead, R.G., Morgan, D., Les, D.H., Mishler, B.D., Duvall, M.R., Price, R.A., Hills, H.G., Qiu, Y.L., Kron, K.A., Rettig, J.H., Conti, E., Palmer, J.D., Manhart, J.R., Sytsma, K.J., Michaels, H.J., Kress,W.J., Karol, K.G., Clark,W.D., Hedr, N.M., Gaut, B.S., Jansen, R.K., Kim, K.J., Wimpee, C.F., Smith, J.F., Furnier, G.R., Strauss, S.H., Xiang, Q.Y., Plunkett, G.M., Soltis, P.S., Swensen, S.M., Williams, S.E., Gadek, P.A., Quinn, C.J., Eguiarte, L.E., Golenberg, E., Learn, G.H., Graham, S.W., Barrett, S.C.H., Dayanandan, S., Albert, V.A., 1993. Phylogenetics of seed plants: an analysis of nucleotide sequences from the plastid gene rbcL. Ann. MO Bot. Gard. 80, 528–580.
92. Chaw, S.M., Zharkikh, A., Sung, H.M., Li,W.H., 1997. Molecular phylogeney of extent gymnosperms and seed plant evolution: analyses of nuclear 18SrRNA sequences. Mol. Biol. Evol. 14, 56–68.
93. Chen, F., Meng, X.Y., Ren, S.Q., Wu, C.L., 1988. The Early Cretaceous Flora of Fuxin Basin and Tiefa Basin, Liaoning Province. Geological Publishing House, Beijing, 180. (in Chinese).
94. Chen, L.Q., Li, C.S., Chaloner, W.G., Beerling, D.A., Sun, Q.G., Collinson, M.C., 2001. Assessing the potential for the stomatal characters of extent and fossil Ginkgo leaves to signal atomosphere CO2 change. Am. J. Bot. 88, 1309–1315.

95. Chudajberdyev, R., 1962.Wood of Ginkgo from the Upper Cretaceous of southwest Kyzulkum. Dokl. Akad. Nauk SSSR 145, 422–425 (in Russian).
96. Chudajberdyev, R., 1971. The woody fossil Ginkgoales. In: Sixtel, T.A., Kuzichkina, Y.M., Savitskaya, L.I., Chudajberdyev, R., Shetsova, E.M. (Eds.), History of Development of Ginkgoales in Middle Asia, vol. 2. Paleobot, Uzbekistan, pp. 98–104 (in Russian).
97. Collinson, M.E., Mösle, B., Pinch, P., Scot, A.C.,Wilson, R., 1998. The preservation of plant cuticle in the fossil record: a chemical and microscopical investigation. Ancient Biomol. 2, 251–265.
98. Crane, P.R., 1985. Phylogenetic analyses of seed plants and the origin of angiosperms. Ann. MO Bot. Gard. 72, 716–793.
99. Crane, P.R., 1987. Vegetational consequences of angiosperm diversification. In: Friis, E.M., Chaloner,W.G., Crane, P.R. (Eds.), The Origin of Angiosperms and their Biological Consequences. Cambridge University Press, Cambridge, 107–144.
100. Crane, P.R., Manchester, S.R., Dilcher, D.L., 1990. A preliminary survey of fossil leaves and well-preserved reproductive structures from the Sentinel Butte formation (Paleocene) near Almont, North Dakota, Fieldiana. Geol. New Ser. 20, 1–63.
101. Crawley, M., 2001. Angiosperm woods from British lower cretaceous and paleogene deposits. Palaeont. Spec. Pap. 66, 1–100.
102. Crisafulli, A.M., 2003. Nuevos registros para la xilotafoflora de la Formación Yaguarí, Pérmico Superior de Uruguay. Rev. Mus. Argentino Cienc. Nat., n. s 5 (2), 169–180.
103. Cúneo, R., 1987. Sobre la presencia de probables Ginkgoales en el Pérmico inferior de Chubut, Argentina. Actas VII Simposio Argentino Paleobot. Palynol. (Buenos Aires) 13–15 April, 1987, pp. 47–49.
104. Czier, Z., 1998. Ginkgo foliage from the Jurassic of the Carpathian Basin. Palaeontology 41, 349–81.
105. Darwin, C., 1859. On the Origin of Species by Means of Natural Selection, or, The Preservation of Favoured Races in the Struggle for Life Ch. 14 (J. Murray, 1859).
106. De Franceschi, D., Vozenin-Serra, C., 2000. Origine du Ginkgo biloba L. Approche phylogénétique. C. R. Acad. Sci. (Sci. de la Vie) 323, 583–592.
107. Del Fueyo, G.M., Archangelsky, S., 2001. New studies on Karkenia incurva Archang. from the Early Cretaceous of Argentina. Evolution of the seed cone in Ginkgoales. Palaeontographica B 256, 111–121.
108. Del Fuyuo, G.M., Villar de Seoane, L., Archangelsky, S., Guignard, G., 2006. Estudios cuticulares de Ginkgoites Seward del Cretácico Inferior de Patagonia. Rev. Mus. Argentino Cienc. Nat., n. s 8 (2), 143–149.
109. Del Tredici, P., 1989. Ginkgos and multituberculates: evolutionary interpretations in the Tertiary. Biosystems 22, 327–339.
110. Del Tredici, P., 2007. The phenology of sexual reproduction in Ginkgo biloba: ecological and evolutionary implications. Bot. Rev. 73 (4), 267–278.
111. Del Tredici, P., Ling, H., Guang, Y., 1992. The Ginkgos of Tian Mu Shan. Conserv. Biol. 6, 202–210.
112. Deng, S.H., Yang, X.J., Zhou, Z.Y., 2004. An Early Cretaceous Ginkgo ovulebearing organ fossil from Liaoning, Northeast China and its evolutionary implications. Chin. Sci. Bull. 49 (16), 1774–1776.
113. Dijkstra, S.J., 1973. Fossilium Catalogus. II. Plantae, pars 82. Uitgeverij Dr.W. Junk N.V.'s-Gravenhage.
114. Doludenko, M.P., Rasskazova, E.S., 1972. Mesozoic Plants (Ginkgoales and Czekanowskiales) of East Siberia. Trud. Geol. Inst. Acad. Nauk SSSR 230, 7–43 (in Russian).
115. Dobruskina, I.A., 1980. Stratigraphic position of Triassic plant-bearing beds of Eurasia. Trud. Geol. Int. AN SSSR 345, 1–163.
116. Dorf, E., 1958. The geographical distribution of the Ginkgo family. Bull.Wagner Free Inst. Sci. 33, 1–10.
117. Doubinger, J., 1956. Contribution a l'etude des flores Autuno—Stéphaniennes. Mém. Soc. Geol. France 75, 1–189.
118. Douglas, J.G., 1969. The Mesozoic flora of Victoria 1–2. Geol. Surv. Victoria Mem. 28, 1–310.
119. Doweld, A.B., 2001. Prosyllabus Tracheophytorum. Tentamen Systematis Plantarum Vascularium (Tracheophyta). Geos, Moscow, 110.
120. Doyle, J.A., 2006. Seed ferns and the origin of angiosperms. J. Torrey Bot. Soc.133, 169–209.
121. Doyle, J.A., Donoghue, M.J., 1986. Seed plant phylogeny and the origin of angiosperms: an experimental cladistic approach. Bot. Rev. 52, 321–431.
122. Doyle, J.A., Donoghue, M.J., 1987a. The importance of fossils in elucidating seed plant phylogeny and macroevolution. Rev. Palaeobot. Palynol. 50, 63–95.
123. Doyle, J.A., Donoghue, M.J., 1987b. The origin of angiosperms: a cladistic approach. In: Friis, E.M., Chaloner, W.C., Crane, P.C. (Eds.), The Origin of Angiosperms and their Biological Consequences. Cambridge University Press, Cambridge, 17–49.
124. Doyle, J.A., Donoghue, M.J., Zimmer, E.A., 1994. Integration of morphological and ribosomal RNA data on the origin of angiosperms. Ann. MO Bot. Gard. 81, 419–450.
125. Drinnan, A.N., Chambers, T.C., 1986. Flora of the Lower Cretaceous Koonwarra Fossil Bed (Korumburra Group), South Gippsland, Victoria. In: Jell, P.A., Roberts, J. (Eds.), Plants and Invertebrates from the Lower Cretaceous Koonwarra Fossil Bed, South Gippsland, Victoria, vol. 3. Memoirs of the Association of Australasian Palaeontologists, 1–75.
126. Duan, S.Y., 1987. The Jurassic flora of Zhai Tang,Western Hills of Beijing. Dept. Geol., Univ. Stockholm, Dept. Palaeobot., Swed. Mus. Nat. Hist, Stockholm, 95.
127. Emberger, L., 1954. Sur les Ginkgoales et quelques rapprochements avec d'autres groupes systématiques. Svensk Bot. Tidskr. 48, 361–367.
128. Engelhardt, H., Kinkelin, F., 1908. Oberpliocene Flora und Fauna des UnterMainstales, insbesondere des Frankfurter Klärbeckens. Abh. Senck. Naturforsch. Ges. 250, 1–156.
129. Falcon-Lang, H.J., 2004.Anewanatomically preserved ginkgoalean genus from the Upper Cretaceous (Cenomanian) of the Czech Republic. Palaeontology 47, 349–366.
130. Fan, X.X., Shen, L., Zhang, X., Chen, X.Y., Fu, C.X., 2004. Assessing genetic diversity of Ginkgo biloba L. (Ginkgoaceae) populations from China by RAPD markers. Biochem. Genet. 42, 269–278.
131. Feistmental, O., 1881. Fossil flora of the Gondwana system. The flora of the Damuda and Panchet divisions. Mem. Geol. Surv. India, Palaeont. Indica (Ser. 2) 3 (2), 1–149.
132. Feng, S.N., Chen, G.X., Xi, Y.H., Zhang, C.F., 1977. Plants. In: Hupei Institute of Geological Sciences, et al. (Eds.), Fossil Atlas of Middle-South China II. Geological Publishing House, Beijing, pp. 230–253 (in Chinese).

133. Florin, R., 1936. Die fossilen Ginkgophyten von Franz-Joseph-Land nebst Erörterungen über vermeintliche Cordaitales mesozoischen Alters I, II. Palaeontographica B 81, 71–173, 82, 1–72.
134. Florin, R., 1937. Die fossile Ginkgophyten von Franz-Joseph-Land, nebst Erörterunger über vermeintliche Cordaitales mesozoischen Alters. Part 2. Allgemeiner Teil. Palaeontographica B82:1-72.
135. Florin, R., 1949. The morphology of Trichopitys heteromorpha Saporta, a seed plant of Palaeozoic age, and the evolution of female flowers in the Ginkgoinae. Acta Hort. Berg. 15 (5), 158–182.
136. Foto: Jim Frazier., 1986. dr. Mary E. White: «The Greening of Gondwana», Australia, Frenchs Forest, N.S.W. – 256.
137. Fu, D.Z., Yang, Q.E., 1993. A new morphological interpretation of the female reproductive organs in Ginkgo biloba L., with a phylogenetic consideration on gymnosperms. Acta Phytotaxon. Sin. 31 (3), 294–296.
138. Fujii, K., 1896. On the different views hitherto proposed regarding the morphology of the flower of Ginkgo biloba L. Bot. Mag. Tokyo 10 (15), 104–110.
139. Ganju, P.N., 1943. On a new species of Psygmophyllum (P. sahnii sp. nov.) from the Lower Gondwana beds of Kashmir. J. Ind. Bot. Soc. 22, 201–207.
140. Gardner, J.S., 1883. A monograph of the British Eocene flora, 2(2) Gymnospermae. Palaeont. Soc. London, 159.
141. Ge, Y.Q., Qiu, Y.Q., Ding, B.Y., 2003. An ISSR analysis on popolation genetic diversity of the relict plant Ginkgo biloba. Biodiversity 11, 276–287 (in Chinese, with English abstract).
142. Giraud, B., Hankel, O., 1986. Nouveaux bois fossiles de Gymnospermes des dépôts du Karoo du Bassin du Luwegu (Tanzanie méridionale). Ann. Paléontol. 72, 1–27.
143. Goeppert, H.R., 1850. Monographie der fossilen Coniferen. Arnz, Leiden, 286.
144. Gomankov, A.V.,Meyen, S.V., 1986.Tatarina flora (composition and distribution in the Late Permian of Eurasia). Trud. Geol. Inst. Akad. Nauk SSSR 401, 1–140 (in Russian).
145. Gomez, B., Martín-Closas, C., Barale, G., Thévenard, F., 2000.Anewspecies of Nehvizdya (Ginkgoales) from the Lower Cretaceous of the Iberian Ranges (Spain). Rev. Palaeobot. Palynol. 111, 49–70.
146. Gong,W., Chen, C., Dobes, C., Fu, C.X.,Koch, M.A., 2008. Phylogeography of a living fossil: Pleistocene glaciations forced Ginkgo biloba L. (Ginkgoaceae) into two refuge areas in China with limited subsequent postglacial expansion. Mol. Phylogenet. Evol. 48 (3), 1094–1105.
147. Gong, W., Qui, Y.X., Chen, C., Ye, Q., Fu, C.X., 2007. Glacial refugia of Ginkgo biloba L. and human impact on its genetic diversity: evidence from chloroplast DNA. J. Integr. Pl. Biol. 50 (3), 368–374.
148. Grauvogel-Stamm, L., 1978. La flore du gres a Votzia (Buntsandstein supérieur) des Vosges du Nord (France). Mém. Sci. Géol. 50, 1–225.
149. Greguss, P., 1961. Permische fossile Hölzer aus Ungarn. Palaeontographica B. 109, 131–146.
150. Gu, Zhi, 1974. (“Palaeozoic Plants from China” writing group of Nanjing Institute of Geology and Palaeontology Institute of Botany, Academia Sinica). Palaeozoic Plants from China. Science Press, Beijing, 168. (in Chinese).
151. Guignard, G., Zhou, Z.Y., 2005. Comparative studies of leaf cuticle ultrastructure between living and the oldest fossil ginkgos in China. Int. J. Plant Sci. 166 (1), 145–156.
152. Guignard, G., Boka, K., Barbaka, M., 2001. Sun and shad leaves? Cuticle ultrastructure of Jurassic Komlopteris nordenskioeldii (Nathorst) Barbaka. Rev. Palaeobot. Palynol. 114, 191–208.
153. Halle, T.G., 1927. Palaeozoic plants from Central Shansi. Palaeontol. Sinica A 1 (2), 1–316.
154. Harris, T.M., 1932. The Yorkshire flora of Scoresby Sound, East Greenland, 2. Medd. Grønl. 85 (3), 1–112.
155. Harris, T.M., 1935. The fossil flora of Scoresby Sound, East Greenland, 4. Medd. Grønl. 112 (1), 1–176.
156. Harris, T.M., 1937. The fossil flora of Scoresby Sound, East Greenland, 5. Medd. Grønl. 112 (2), 1–114.
157. Harris, T.M., 1951. The fructification of Czekanowskia and its allies. Philos. Trans. R. Soc. Lond. B 235, 483–508.
158. Harris, T.M., 1961. The Yorkshire Jurassic Flora I. British Museum (Natural History), London, 212.
159. Harris, T.M., 1964. The Yorkshire Jurassic Flora II. British Museum (Natural History), London, 191.
160. Harris, T.M., 1969. The Yorkshire Jurassic Flora III. British Museum (Natural History), London, 186.
161. Harris, T.M., Millington, W., Miller, J., 1974. The Yorkshire Jurassic Flora IV. British Museum (Natural History), London, 150.
162. Haseba, M., 1997. Molecular phylogeny of Ginkgo biloba: close relation between Ginkgo biloba and cycads. In: Hori, T., Ridge, R.W., Tulecke, W., Del Tredici, P., Trémouillaux-Guiller, J., Tobe, H. (Eds.), Ginkgo biloba—A
163. Global Treasure from Biology to Medicine. Springer Verlag, Tokyo, 173–181.
164. He, S.A., Gu, Y., Pang, Z.J., 1997. Resources and prospects of Ginkgo biloba in China. In: Hori, T., Ridge, R.W., Tulecke,W., Del Tredici, P., Trémouillaux-Guiller, J., Tobe, H. (Eds.), Ginkgo biloba—A Global Treasure from Biology to Medicine. Springer Verlag, Tokyo, 373–383.
165. Heer, O., 1870. Die Miocene flora und fauna Spetzbergens. K. Sven. Vet. Akad. Handl. 8 (7), 1–98.
166. Heer, O., 1876. Beiträge zur Jura-Flora Ostsibiriens and Amurlandes. Mém. Acad. Imp. Sci. St. Pétersb. Ser. 7 25 (6), 1–122.
167. Hill, R.S., Carpenter, R.J., 1999. Ginkgo leaves from Palaeogene sediments in Tasmania. Aust. J. Bot. 47, 717–724.
168. Hilton, J., Bateman, R.M., 2006. Pteridosperms are the backbone of seed-plant phylogeny. J. Torrey Bot. Soc. 133, 119–168.
169. Hluˇstik, A., 1977. The nature of Podozamites obtusus Velenovsky. Sbor. Narod. Muz. Praze. Ser. B 30 (4/5), 173–186.
170. Høeg, O.A., 1942. The Downtonian and Devonian flora of Spitzbergen. Norges Svalbard Ishavs – Unders. Skr. 83, 1–228.
171. Høeg, O.A., 1967. Ordre incertae sedis des Palaeophyllales. In: Boureau, E. (Ed.), Traité de Paléobotanique II. Masson et Cie, Paris, 362–399.
172. Høeg, O.A., Bose, M.N., 1960. The Glossopteris flora of the Belgian Congo. Ann. Mus. R. Congo Belg. Sci. Geol. 32, 1–106.
173. Holmes, W.B.K., Anderson, H.M., 2007. The Middle Triassic megafossil flora of the Basin Creek Formation, Nymboida Coal Measures, New South Wales, Australia. Ginkgophyta. Proc. Linn. Soc. N.S.W 128 (Pt. 6), 155–200.
174. Holt, B.F., Rothwell, G.W., 1995. Phenology and germination history of Ginkgo biloba. Am. J. Bot. 82, 20.
175. Holt, B.F., Rothwell, G.W., 1997. Is Ginkgo biloba (Ginkgoaceae) an oviparous plant? Am. J. Bot. 84 (6),

870–872.
176. Hori, T., Miyamura, S., 1997. Contribution to the knowledge of fertilization of gymnosperms with flagellated sperm cells: Ginkgo biloba and Cycas revoluta. In: Hori, T., Ridge, R.W., Tulecke, W., Del Tredici, P., Trémouillaux-Guiller, J., Tobe, H. (Eds.), Ginkgo biloba—A Global Treasure from Biology to Medicine. Springer Verlag, Tokyo, 67–84.
177. Horiuchi, J., Kimura, T., 1986. Ginkgo tzagajanica Samylina from the Paleogene Noda Group, northeast Japan, with special reference to its external morphology and cuticular features. Trans. Palaeont. Soc. Jpn. 12, 341–353.
178. Iwao, Y., 1978. Late Cenozoic Ginkgo biloba L. from the Hoshiwara formation in Kumamoto Prefecture, Kyushu, Japan. Reports of the Faculty of Science and Engineering Saga University 6:45-49.
179. Jain, R.K., Delevoryas, T., 1967. A middle Triassic flora from the Cackeuta Formation, Minas de Petroleo, Argentina. Paleont 10, 557–589.
180. Jiang, M.X., Jin, Y.X., Zhang, Q.F., 1990. A preliminary study on Ginkgo biloba in Dahongshan, Hubei. J. Wuhan Bot. Res. 8, 191–193 (in Chinese).
181. Jordanov, D. & Kitanov, B., 1963. Nyalkolko interesni fosilni rasteniya ot plioshena Goshedelchevsko (Some interesting fossil plants from the neighbourhood of Gotse Delchev). Godischnik na Sofiiskiya Universitet Biologo-Geologo-Geografski Facultet Series 1-Biologie 56:25-36.
182. Kahlert, E., Schultka, S., Süss, H., 1999. Die mesophytische Flora der Saurierlagerstätte am Tendaguru (Tansania). Erste Ergebnisse. Mitt. Mus. Nat. kd. Berl., Geowiss. R 2, 185–199.
183. Kamada,Y., Iwao,Y., Miyaki, M., Okazawa, A., 1981. On the Hiradoguchi plant bed discovered from Tabira-machi, Kitamatsuura-gun, Nagasaki Prefecture. Nagasaki-ken Chigaku Kaishi 33–34, 11–28.
184. Kawasaki, S., Kon'no, E., 1932. The flora of the Heian System, Pt. 3. Bull. Geol. Surv. Chosen 6 (3), 32–44.
185. Khudaiberdyev, R., Gomolitsky, N.P. & Lobanova, A.V., 1971. Materiali k yurskoi flora yuzhnoi Fergani (Specimens from the Jurassic flora of southern Fergana). In T.A. Sixtel (ed.) Paleobotanika Uzbekistana (Paleobotany of Uzbekistan). Akademia Nauk Uzbekskoe SSSR, Tashkent, 3-57.
186. Kim, Y.S., Lee, J.K. & Chung, G.C., 1997. Tolerance and susceptibility of Ginkgo to air pollution. In T. Hori, R.W. Ridge, W. Tulecke, P. Del Tredici, J. Trémouillaux-Guiller, & H. Tobe (eds.) Ginkgo biloba: a global treasure from biology to medicine. Springer, Tokyo, 233-242.
187. Kimura, T., Sekido, S., 1965. Some interesting Ginkgoalean leaves from the Itoshiro-Subgroup, the Tetori Group, Central Honshu, Japan. Mem. Mejiro Gakuen Women's Coll. 2, 1–4.
188. Kimura, T., Tsujii, M., 1984. Early Jurassic plants in Japan, 6. Trans. Proc. Palaeont. Soc. Jpn. N.S. 133, 265–287.
189. Kirchner,M., 1992. Untersuchungen an einigen Gymnospermen der fränkischen Rhät-Lias-Grenzschichten. Palaeontographica B 224, 17–61.
190. Kirchner, M., Van Konijnenburg-van Cittert, J.H.A., 1994. Schmeissneria microstachys (Presl, 1833) Kirchner et Van Konijnenburg-van Cittert, gen. et sp. nov., plants with ginkgoalean affinities of Germany. Rev. Palaeobot. Palynol. 83, 199–215.
191. Kiritchkova, A.I., Samylina, V.A., 1979. On the peculiarities of leaves of some Mesozoic Ginkgoales and Czekanowskiales. Bot. Zhurn. 64, 1529–1538 (in Russian).
192. Knowlton, F.H., 1930. The flora of the Denver and associated formations of Colorado. U.S. Geol. Surv. Prof. Pap. 155, 1–247.
193. Kovar-Eder, J., Givulescu, R., Hably, L.,Kvacek, Z., Mihajlovic, D.,Teslenko, J., Walther, H., Zastawniak, E., 1994. Floristic changes in the areas surrounding the Paratethys during Neogene time. In: Boulter, M.C., Fisher, H.C. (Eds.), Cenozoic Plants and Climate of the Arctic. Springer Verlag, Berlin, 347–369.
194. Krassilov,V.A., 1970. Anapproach to the classification of Mesozoic ginkgoalean plants from Siberia. Palaeobotanist 18, 12–19.
195. Krassilov, V.A., 1972. Mesozoic Flora from the Bureja River (Ginkgoales and Czekanowskiales). Nauka, Moscow, 115 pp. (in Russian).
196. Krassilov, V.A., 1976. Tsagayanskaya flora Amurskoi oblasti (Tsaganyansk flora of the Amur region). Akademia Nauk SSSR Dalinevostochnoii Nauchnii Shentr Biologo-Pochvennii Institut, Izdatelistvo Nauka, Vladivostok, 92.
197. Krassilov, V.A., 1982. Early Cretaceous flora of Mongolia. Palaeontographica B 181, 1–43.
198. Krassilov, V.A., 1990. Fossil links reconsidered. Proceedings of the 3rd IOP Conference, August 24–26, 1988, Melbourne, 11–15.
199. Kräusel, R., 1923. Paläobotanische Notizen VII Über Papillenbildung an den Spaltöffnungen einiger fossiler Gymnospermen. Senckenbergiana 5(3/4):81-96.
200. Kräusel, R., 1943a. Die Ginkgophyten der Trias von Lunz in Neider Osterreich und von Neuewelt bei Basel. Palaeontographica B 87, 59–93.
201. Kräusel, R., 1943b. Furcifolium longifolium (Seward) n. comb., eine Ginkgophyte aus dem Solenhofener Jura. Senkenbergiana 26, 426–433.
202. Kräusel, R., Schaarschmidt, F., 1966. Die Keuperflora von Neuewelt bei Basel IV. Pterophyllen und Taeniopteriden, Schweiz. Paläontol. Abh. 84, 1–64.
203. Kvaček, J., Falcon-Lang, L., Dašková, J., 2005. A new late Cretaceous ginkgoalean reproductive structure Nehvizdyella gen. nov. from the Czech Republic and its whole-plant reconstruction. Am. J. Bot. 92, 1958–1969.
204. Lam, H.J., 1950. Stachyospory and phyllospory as factors in the natural system of the Cormophyta. Svensk Bot. Tidskr. 44, 517–534.
205. La Motte, R.S., 1936. The Upper Cedarville flora of northwestern Nevada and adjacent California. In Contributions to Paleontology: Middle Cenozoic floras of western North America. Carnegie Insitution of Washington Publications 455:59-142.
206. La Motte, R.S., 1952. Catalogue of the Cenozoic plants of North America through 1950. Mem. Geol. Soc. Am. 51, 1–281.
207. Lancucka-Środoniova, M., 1966. Tortonian flora from the "Gdów Bay" in the south of Poland. Acta Palaeobotanica 7(1):135.
208. Lee, P.C., Tsao, C.Y., Wu, S.Q., 1976. Mesozoic plants from Yunnan. In: Nanjing Institute of Geology and Palaeontology Academia Sinica (Ed.), Mesozoic Fossils from Yunnan, vol. 1. Science Press, Beijing, pp. 87–150 (in Chinese).

209. Lele, K.M., 1962. Studies in the Indian Middle Gondwana flora. II. Plant fossils from the South Rewa Gondwana Basin. Palaeobotanist 10 (1/2), 69–83.
210. Leuthardt, F., 1903. Die Keuperflora von Neuewelt bei Basel. I. Phanerogamen. Abh. Schweiz. Pal. Ges. 30, 1–23.
211. Li, H.L., 1956. A horticultural and botanical history of Ginkgo. Bull. Morris Arboretum 7, 3–12.
212. Li, J.W., Liu, Z.Y., Tan, Y.M., Ren, M.B., 1999. Studies on the Ginkgo at Jinfoshan Mountain. Forest Res. 12 (2), 197–201 (in Chinese, with English abstract).
213. Li, P.J., He,Y.L.,Wu, X.W., Mei, S.W., Li, B.Y., 1988. Early and Middle Jurassic Strata and their Floras from Northeastern Border of Qaidam Basin, Qinghai. Nanjing University Press, Nanjing, 231 pp. (in Chinese, with English summary).
214. Li, X.X. (Ed.), 1995. Fossil Flora of China Through the Geological Ages. Guangdong Science and Technology Press, Guangzhou, 542.
215. Lin, X., Zhang, D.H., 2004. Analysis for the origin of Ginkgo population in Tianmu Mountains. Scient. Silv. Sin. 40 (2), 28–31 (in Chinese, with English abstract).
216. Lin, X., 2007. Natural populations and plantation areas of Ginkgo biloba. In: Cao, F.L. (Ed.), A Monograph of Chinese Ginkgos. China Forestry Publishing House, Beijing, pp. 37–52 (Chapter 4, in Chinese).
217. Liu, X.Q., Li, C.S.,Wang,Y.F., 2006. The pollen cones of Ginkgo from the Early Cretaceous of China, and their bearing on the evolutionary significance. Bot. J. Linn. Soc. 152, 133–144.
218. Liu, X.Q., Hueber, F.M., Li, C.S.,Wang, Y.F., 2005. Emendation of Sorosaccus gracilis Harris 1935, a gymnospermous pollen cone. Acta Phytotaxon. Sin. 43, 182–190.
219. Lundblad, B., 1959. Studies in the Rhaeto-Liassic floras of Sweden, II, 1. Ginkgophyta from the mining district of N.W. Scania. K. Svensk. Vetensk Akad. Handl. Ser. 4, 6 (2), 1–38.
220. Mahabale, T.S., Satyanarayana, T., 1978. Petrified Ginkgo wood from Pangidi in Andhra Pradesh, India. Rec. Res. Geol. 4, 462–469.
221. Maheshwari, H.K., Banerji, J., 1978. On a ginkgoalean leaf from Triassic of Madhya Pradesh. Palaeobotanist 25, 153–249.
222. Maheshwari, H.K., Bajpai, U., 1992. Ginkgophyte leaves from the Permian Gondwana of the Rajmahal Basin, India. Palaeontographica B 224, 131–149.
223. Manum, S., 1966. Ginkgo spitsbergensis n.sp. from the Paleocene of Spitsbergen and a discussion of certain Tertiary species of Ginkgo from Europe and North America. Norsk Polarinstitut Årbok 1965:49-58.
224. Manum, S.B., Bose, M.N., Vigran, J.O., 1991. The Jurassic flora of Andoya, northern Norway. Rev. Paleobot. Palynol. 68, 233–256.
225. McElwain, J.C., Chaloner, W.G., 1995. Stomatal density and index of fossil plants track atmosphere carbon dioxide in the Palaeozoic. Ann. Bot. 76, 389–395.
226. McElwain, J.C., Chaloner, W.G., 1996. The fossil cuticle as a skelectal record of environmental change. Palaios 11, 376–388.
227. McElwain, J.C., Beerling, D.J. & Woodward, F.I., 1999. Fossil plants and global warming at the Triassic-Jurassic boundary. Science 285:1386-1390.
228. Medyulyanov, V.A., 1969. Ginkgoites ex. gr. adiantoides iz nizhnego paleogena yuzhnogo Sakhalina (Ginkgo ex. gr. adiantoides from the lower Paleogene of southern Sakhalin). In M.N. Gramm & V.A. Krassilov (eds.) Iskopaemaya fauna i flora Dalnego Vostoka (Fossil fauna and flora of the Far East). Akademiya Nauk SSSR, Vladivostok, v. 1., p. 139-152.
229. Medwell, L.M., 1954. A review and revision of the flora of the Victoria Lower Jurassic. Proc. R. Soc. Vict. 65, 63–111.
230. Mehlqvist, K. et al., 2009. A Jurassic (Pliensbachian) flora from Bornholm, Denmark - a study of a historic plant-fossil collection at Lund University, Sweden. GFF, 131: 1, 137 – 146.
231. Meng, F.S., 1992. New genus and species of fossil plants from Jiuligang Formation in W. Hupei. Acta Palaeont. Sin. 31 (6), 703–707 (in Chinese, with English summary).
232. Meyen, S.V., 1982. Ginkgo as a possible living pteridosperm. In: Nautiyal, D.D. (Ed.), Studies on Living and Fossil Plants. D.D. Pant Commemoration Volume. Society of Plant Taxomists, Allahabad, India, 163–172.
233. Meyen, S.V., 1984. Basic features of gymnosperm systematics and phylogeney as shown by the fossil record. Bot. Rev. 50, 1–111.
234. Meyen, S.V., 1987. Fundamentals of Palaeobotany. Chapman & Hall, London/New York, 432.
235. Meyen, S.V., 1988. Gymnosperms of the Angara flora. In: Beck, C.B. (Ed.), Origin and Evolution of Gymnosperms. Columbia University Press, New York, 338–381.
236. Mösle, B., Collinson, M.E., Pinch, P., Scott, A.C., 1997. Comparison of modern and fossil plant cuticles by selective chemical extraction monitored by flash pyrolysis-gas chromatography-mass spectrometry and electron microscopy. J. Anal. Appl. Pyrol. 40–41, 585–597.
237. Mösle, B., Collinson, M.E., Finch, P., Stankiewicz, B.A., Scott, A.C., & Wilson, R., 1998. Factors influencing the preservation of plant cuticles: a comparison of morphology and chemical composition of modern and fossil examples. In B. Harsfield, M. Rohde, R.G. Schaefer & H. Wilkes (eds.), Advances in organic geochemistry 1997. Eighteenth International Meeting of Organic Geochemistry Proceedings Part II Biogeochemistry. Organic Geochemistry 29(5-7):1369-1380.
238. Mustoe, G.E., 2002. Eocene Ginkgo leaf fossils from the Pacific Northwest. Can. J. Bot. 80, 1078–1087.
239. Nathorst, A.G., 1878–1886. Om floran i Skånes kolförande bildningar-I. Floran vid Bjuf. Sveriges Geologiska Undersökning. Serie C 27, 33, 85, 1–126.
240. Nathorst, A.G., 1899. Fossil plants from Franz Josef Land. In: Nansen, F.M. (Ed.), The Norwegian North Polar Expedition 1893–96, Scientific Results, III. Christianaia, London, 1–26.
241. Naugolnykh, S.V., 1995.Anewgenus of Ginkgo-like leaves from theKungurian of the Urals Region. Paleontol. Zh. 3, 106–116 (in Russian).
242. Naugolnykh, S.V., 2001. Paleobotany of the Upper Carboniferous/Lower Permian of the southern Urals. Part 3. Generative organs of gymnosperms. Permophiles 39, 19–23.
243. Naugolnykh, S.V., 2007. Foliar seed-bearing organs of Paleozoic and the early evolution of the Ginkgoales. Paleont. J. 41 (8), 815–859.
244. Nguyen Tu, T.T., Derenne, S., Largeau, C., Mariotti, A., Bocherens, H., 2003. Comparison of leaf lipids from a an plant and its extant counterpart at two degradation stages: diagenetic and chemotaxonomic implications.

Rev. Palaeobot. Palynol. 124, 63–78.
245. Nixon, K.C., Crepet, W.L., Stevenson, D., Friis, E.M., 1994. A reevaluation of seed plant phylogeny. Ann. MO Bot. Gard. 81 (3), 484–533.
246. Norstog, K.J., Gifford, E.M., Stevenson, D.W., 2004. Comparative development of the spermatozoids of cycads and Ginkgo biloba. Bot. Rev. 70, 5–15.
247. Nosova, N.V. 1998 The Jurassic flora of Angren (Uzbekistan). Paleontological Journal 32(6):624-632.
248. Ohana, T. & Kimura, T., 1986. Ginkgo diminuta sp. nov. from the Upper Cretaceous Omichidani Formation in the Inner Zone of Japan. Proceedings of the Japan Academy Series B Physical and Biological Sciences 62(9):345-348.
249. Ôishi, S., 1938. On the cuticles of Tertiary Ginkgoites leaves from Kuzi, Iwate Pref. Journal of the Faculty of Science Hokkaido Imperial University 4(1,2):103-106.
250. Ôishi, S., 1940. The Mesozoic floras of Japan. J. Fac. Sci. Hokkaido Univ. Ser. 4 (5), 123–480.
251. P'an, C.H., 1936–1937. Notes on Kawasaki and Kon'no's Rhipidopsis brevicaulis and Ps. baieroides of Korea with description of similar form from Yuhsien, Honan. Bull. Geol. Soc. Chin. 16, 261–280.
252. Pettitt, J.M., 1977. The megaspore wall in gymnosperms: ultrastructure in some zooidogamous forms. Proc. R. Soc. Lond. B 195, 497–515.
253. Philippe, M., 1993. Nomenclature générique des trachéidoxyles mésozoïques à champs araucarioïdes. Taxon 42, 74–80.
254. Philippe, M., 1995. Bois fossiles du Jurassique de Franche-Comté (nord-est de la France): systematique et biogeography. Palaeontographica B 236, 45–103.
255. Philippe, M., Bamford, M., 2008. A key to morphogenera used for Mesozoic conifer-like woods. Rev. Palaeobot. Palynol. 148, 184–207.
256. Philippe, M., Bamford, M., McLoughlin, S., Alves, L.S.R., Falcon-Lang, H.J., Gnaedinger, S., Ottoneg, E.G., Poleh, M., Rajanikanthi, A., Shoemakerj, R.E., Torresk, T., Zamuner, A., 2004. Biogeographic analysis of Jurassic-Early Cretaceous wood assemblages from Gondwana. Rev. Palaeobot. Palynol. 141, 141–173.
257. Philippe, M., Barbacka, M., Gradinaru, E., Iamandei, E., Iamandei, S., Kázmér, M., Popa, M., Szakmány, G., Tchoumatchenco, P., Zato´n, M., 2006. Fossil wood and Mid-Eastern Europe terrestrial palaeobiogeography during the Jurassic-Early Cretaceous interval. Rev. Palaeobot. Palynol. 142, 15–32.
258. Plumstead, E.P., 1961. The Permo-Carboniferous coal measures of the Transvaal, South Africa—an example of the contrasting stratigraphy in the Southern and Northern Hemispheres. 4ème Congr. Gèol. et Stratigr. Carbonif. 2, 545–550.
259. Polyshchuk, L.V., 1975. Izhmenchivosti epidermalinikh prizmakov listov Ginkgo iz paleogena i neogena Primorie v svayzi s ismeneniyami klimata (Variation of epidermal characters of Ginkgo from the Paleogene and Neogene of Primorie in respect to climatic changes). In V.A. Krassilov (ed.) Iskopaemiya flora Dalnego Vostoka (Fossil floras of the Far East). Akademiya Nauk SSSR, Vladivostok, 76-83.
260. Pons, A., 1955. Quelques techniques modernes de la Paléobotanique appliquée au matériel du sud-estde la France. Rec. Trav. Lab. Bot. Géol. Zool. Fac. Sci. Montpellier, sér. Bot. 7, 89–97.
261. Pons, D., Vozenin-Serra, C., 1992. Wood of Ginkgoales in the Cenomanian of Anjou, France. Cour. Forschungsinst. Senckenberg 147, 199–213.
262. Potonie, R., 1933. Über einige Pflanzenreste aus dem Jura Persiens. Arbeit. Inst. Paläobot. Petrogr. Brennstein 3, 247–250.
263. Prakash, N., Kumar, M., 2004. Occurrence of Ginkgo Linn. in Early Cretaceous deposits of South Rewa Basin, Madhya Pradesh. Cur. Sci. 87, 1512–1515.
264. Prakash, U., Barghoorn, E.S., 1961. Miocene fossil wood from the Columbia basalts of central Washington. J. Arnold Arb. 42, 165–195.
265. Prasad, M.N.V., 1982. An annotated synopsis of India Palaeozoic gymnospermous woods. Rev. Palaeobot. Palynol. 38, 119–156.
266. Prasad, M.N.V., Lele, K.M., 1984. Triassic ginkgoalean wood from the South Rewa Gondwana Basin, India. Rev. Palaeobot. Palynol. 40, 387–397.
267. Prynada, V.D., 1962. Mesozoic flora of Eastern Siberia and Transbaikalia. Gosgeolltekhizdat, Moscow, 368.
268. Prynada, V.D., 1970. Fossil flora of the Corvunchansk Suite, Lower Tunguska River Basin. Nauka, Moscow, 80 pp. (in Russian).
269. Raciborski, M., 1892. Przyczynek do flory retyckiej Polski. Rozpr. Wydz. Mat. -Przyr. Akad. Um. Krakow 22, 345–360.
270. Raubeson, I.A., Jansen, R.K., 1992. Chloroplast DNA evidence on the ancient evolutionary split in vascular land plants. Science 255, 1697–1699.
271. Retallack, G.J., 2001. A 300-million-year record of atmospheric carbon dioxide from fossil plant cuticles. Nature 411, 287–290.
272. Rohr, R., 1977. Etude Comparrée de la formation de l'exine du cours de la microsporogense chez une gymnosperme (Taxus baccata) et une Préphanérogame (Ginkgo biloba). Cytologie 42, 157–167.
273. Rothwell, G.W., Holt, B.F., 1997. Fossils and phenology in the evolution of Ginkgo biloba. In: Hori, T., Ridge, R.W., Tulecke, W., Del Tredici, P., Trémouillaux-Guiller, J., Tobe, H. (Eds.), Ginkgo biloba—A Global Treasure from Biology to Medicine. Springer Verlag, Tokyo, 223–230.
274. Rothwell, G.W., Serbet, R., 1994. Lignophyte phylogeney and the evolution of spermatophytes: a numerical cladistic analysis. Syst. Bot. 19, 443–482.
275. Royer, D.L., Hickey, L.J., Wing, S.L., 2003. Ecological conservatism in the „living fossil“ Ginkgo. Paleobiology 29, 84–104.
276. Sah, S.C.D., Jain, K.P., 1965. Ginkgoites rajmahalensis sp. nov. from the Rajmahal Hills, Bihar. India. Palaeobotanist 13 (2), 155–157.
277. Sakisaka, M., 1927. On the morphological significance of seed-bearing leaves of Ginkgo biloba. Bot. Mag. 41, 273–278.
278. Sakisaka, M., 1929. On the seed-bearing leaves of Ginkgo. J. Jap. Bot. 4, 219–235.
279. Samylina, V.A., 1963. The Mesozoic flora of the Lower course of the Aldan River. Paleobotanica IV, 59–139 (in Russian, with English summary).
280. Samylina, V.A., 1964. The Mesozoic flora of the area to the west of the Kolyma River (the Zyrianka Coal-basin) V, 39–80 (in Russian, with English summary). I. Paleobotanica V, 39–80 (in Russian, with English summary).

281. Samylina, V.A., 1967. The Mesozoic flora of the area to the west of the Kolyma River (the Zyrianka Coal-basin) II. Paleobotanica V, 135–175 (in Russian, with English summary).
282. Samylina, V.A., 1967. On the final stage of the history of the genus Ginkgo L. in Eurasia. Bot. Zh. 52, 303–316 (in Russian).
283. Samylina, V.A., 1967a. O zaklyuchitelinikh etapakh istorii roda Ginkgo L. v Evrazii (On the final stages of the history of the genus Ginkgo in Eurasia). Botanicheskii Zhurnal 52(3):303-316.
284. Samylina, V.A., 1967b. Mesozoiskaya flora levobereschiya r.Kolymi II Ginkgovie, Khvoine, obschie glavy (The Mesozoic flora of the left bank of the Kolyma River II Gingkos, conifers, general principles). Trudy VIN'a, Paleobotanika 6:133-175.
285. Samylina, V.A., 1990. Grenana—a new genus of seed ferns from the Jurassic deposits of Middle Asia. Bot. Zh. 75, 846–850 (in Russian).
286. Samylina, V.A., Chelebayeva, A.I., 1986. New data on the Tertiary species of Ginkgo in Soviet eastern Asia. Palaeont. J. 20, 91–96.
287. Samylina, V.A., Markovich, E.M., 1991. On the Jurassic flora of Nazaravsk coalfield (Western Siberia). Bot. Zh. 76, 322–333 (in Russian).
288. Saporta, Gaston de., 1873. Plantes jurassiques, Paris.
289. Saporta, G.de., 1875. Sue la decouverte de deux types nouveaux de Coniferes dans les schistes permiens de Lodeve (Herault). C. R. Acad. Sci. Paris 80, 1017–1022.
290. Saporta, G.de., 1878. Observations sur la nature des végétaux réunis dans le groupe des Noeggerathia. C. R. Acad. Sci. Paris 86, 746–873.
291. Saporta, G.de., 1884. Paléontologie franc¸aise, plantes jurassique 2. Masson, Paris, 672.
292. Savidge, R.A., 2006. Xylotomic evidence for two new conifers and a ginkgo within the Late Triassic Chinle Formation of Petrified Forest National Park, Arizona, USA. In: Parker,W.G., Ash, S.R., Irmis, R.B. (Eds.), A Century of Research at Petrified Forest National Park: Geology and Paleontology.Mus. North. Arizona Bull. 62, 147–149.
293. Schenk, A., 1867. Die fossile Flora der Grenzschichten des Keuper and Lias Frankens. Wiesbaden, 232.
294. Schimper, W.P., 1870 (1870–1873). Traité de paléontology végétale, 2. J.B. Bailliére et fils, Paris, 968.
295. Schmalhausen, J., 1879. Ein ferner Beiträge zur Kenntnis der Ursastufe Ost-Sibiriens. Bull. Acad. Imp. Sci. St. Pétersb. 25, 1–17.
296. Schultze-Motel, J., 1966. Gymnospermenhölzer aus den oberkretazischen Umzamba-Schichten von Ost-Pondoland (S-Afrika). Senck. Leth. 47, 279–337.
297. Schweitzer, H.J., Kirchner, M., 1995. Die Rhäto-Jurassischen Floren des Iran und Afghanistans. 8. Ginkgophyta. Palaeontographica B 237, 1–58.
298. Scott, R.A., Barghoorn, E.S., Prakash, U., 1962.Wood of Ginkgo in the tertiary of western North America. Am. J. Bot. 49, 1095–1101.
299. Serbet, R., 1996. Adiverse assemblage of morphologically and anatomically preserved fossil plants from the Upper Cretaceous (Maastrichtian) of Alberta, Canada. IOP Conference V, Abstracts, Santa Barbara, CA, p. 89.
300. Serra, C., 1966a. Etude anatomique et paléogéographique de quelques espèces homoxylées du Sud-Vietnam et du Cambodge. Arch. Géol. Viêt-Nam 8, 59–131.
301. Serra, C., 1966b. Nouvelle contribution à l'étude paléoxylologique du Cambodge, du Laos et du Viet-nam. Arch. Géol. Viêt-Nam 9, 17–40.
302. Serra, C., 1967. Sur un nouveau bois de Ginkgoales récolté dans le Ho Gia (province de Quang-Nam). Arch. Géol. Viêt-Nam 10, 93–103.
303. Seward, A.C. and Gowan, J. 1900. The maidenhair tree. (Ginkgo biloba L.). Annal Botany 14, 109-154.
304. Seward, A.C., 1903. Fossil flora of Cape Colony. Ann. S. Afr. Mus. 4, 1–122.
305. Seward, A.C., 1904. On a collection of Jurassic plants from Victoria. Rec. Geol. Surv. Vic. 1, 155–211.
306. Seward, A.C., 1907. Permo-Carboniferous plants from Kashmir. Rec. Geol. Surv. India 36, 57–61.
307. Seward, A.C., 1908. On a collection of fossil plants from South Africa. Q. J. Geol. Soc. Lond. 64, 83–108.
308. Seward, A.C., 1919: Fossil plants. Volume IV: Ginkgoales, Coniferales, Gnetales. Cambridge University Press, Cambridge. xvi + 543, London.
309. Seward, A.C., Sahni, B., 1920. Indian Gondwana plants: a revision. Mem. Geol. Surv. India, Palaeont. Indica New Ser. 7 (1), 1–41.
310. Shen, L., Chen, X.Y., Zhang, X., Li, Y.Y., Fu, C.X., Qiu, Y.X., 2005. Genetic variation of Ginkgo biloba L. (Ginkgoaceae) based on cpDNA PCR-RFLPs: inference of glacial refugia. Heredity 94, 396–401.
311. Shi, Y.J., Sun, B.N., Zhang, C.J., Yan, D.F., 2005. Geochemical characteristics of the fossil Ginkgo huttonii cuticles from the Jurassic in Gansu, China. Acta Geol. Sin. 79, 289–294.
312. Shrivastava, R.N., Shah, S.C., 1966. Ginkgo (Ginkgoites) digitata Brong. From the Rajmahal Hills, Santhal Parganas (Bihar). Rec. Geol. Surv. India 94 (2), 309–312.
313. Si, X.J. (Sze, H.C.), 1989. Late Paleozoic plants from the Qingshuihe region of Inner Mongolia and the Hequ district of northwestern Shanxi. Palaeontol. Sin. 176, n. s. A 11, 1–268.
314. Sitholey, R.V., 1943. On Psygmophyllum haydenii Seward. J. Ind. Bot. Soc. 22, 183–190.
315. Sprecher, A., 1907, Le Ginkgo biloba, Geneve.
316. Srebrodolskaya, I.N. & Samylina, V.A., 1984. Dva novykh rannemelovykh vida ginkgovykh iz vostochnogo Zabaikaliya (Two new Early Cretaceous ginkgos from eastern Zabaikal). Ezhegodnik Vsesoeyusnogo Paleontologicheskoe Obschestva 27:190-198.
317. Srivastava, S.C., 1984. Sidhiphyllites, a new ginkgophytic leaf genus from the Triassic of Nidpur, India. Palaeobotanist 32, 20–25.
318. Stanislavsky, F.A., 1957. Jurassic plants from the Don Basin and Dnieper-Donetz region. Akademii Nauk Ukraine SSR, Kiev. (In Russian)
319. Stanislavsky, F.A., 1973. The new genus Toretzia from the Upper Triassic of the Donetz basin and its relation to the genera of the order Ginkgoales. Paleont. Zh. 1, 88–96 (in Russian).
320. Stewart, W.N., Rothwell, G.W., 1993. The Biology and Evolution of Plants. Cambridge University Press, Cambridge, 521.
321. Stewart, W.N. & Rothwell, G. W., 1993. Paleobotany and the Evolution of Plants, 2nd edn. Cambridge University Press, New York.
322. Stone, J.L., 1973. Problem with the name “Platyphyllum”. Taxon 22, 105–108.

323. Süß, H., 2003. Zwei neue fossile Hölzer der Morphogattung Ginkgoxylon Saporta emend. Süß aus tertiären Schichten der Insel Lesbos, Griechenland, mit einer Übersicht über Fossilien mit ginkgoaler Holzstruktur. Feddes Repertorium 114 (5/6), 301–319.
324. Sun, B.N., Dilcher, D.L., Beerling, D.J., Zhang, C.J., Yan, D.F., Kowalski, E., 2003.Variation in Ginkgo biloba L. leaf characters across a climatic gradient in China. PNAS 100 (12), 7141–7146.
325. Sun, B.N., Xie, S.P., Yan, D.F., Cong, P.Y., 2008. Fossil plant evidence for Early and Middle Jurassic paleoenvironmental changes in Lanzhou area, Northwest China. Palaeoworld 17 (3/4), 215–221.
326. Sun, G., 1993. Ginkgo coriacea Florin from Lower Cretaceous of Huolinhe, northeastern Nei Mongol, China. Palaeontographica B230:159-168.
327. Sze, H.C., 1956. Older Mesozoic plants from the Yenchang Formation, northern Shensi. Palaeontol. Sin. 139, n. s. A, 5, 1–217.
328. Sze, H.C., Lee, H.H., 1952. Jurassic plants from Szechuan. Palaeontol. Sin. n. s. A 3, 1–38.
329. Sze, H.C., Lee, H.H., et al., 1963. Fossil Plants from China 2. Mesozoic Plants from China. Science Press, Beijing, 429. (in Chinese).
330. Takhtajan, A.L., 1956. Higher Plants. I. From Psilophytes to Coniferophytes. Akad. Nauk SSSR, Moscow-Leningrad (in Russian).
331. Takhtajan, A.L.,Vachrameev,V.A., Radtschenko, G.P., 1963. Gymnosperms and angiosperms. In: Orlov, A. (Ed.), Osnovy Paleontologii, 15. Gosgeoltekhizdat, Moscow, 1–743.
332. Taylor, T.N., Taylor, E.L., 2009. The Biology and Evolution of Fossil Plants. Prentice Hall, New Jersey, 743-755.
333. Taylor, W.A., Taylor, T.N., Archangelsky, S., 1989. Comparative ultrastructure of fossil and living gymnosperm cuticles. Rev. Palaeobot. Palynol. 59, 145–151.
334. Thomas, B., Spicer, R.A., 1987. The Evolution and Palaeobotany of Land Plants. Croom Helm, Kent, England, 309.
335. Thomas, H.H., 1913. On some new and rare Jurassic plants from Yorkshire: Eretmophyllum, a new type of ginkgoalean leaf. Proc. Cam. Philos. Soc. 17, 256–262.
336. Tidwell, W., Munzing, G., 1995. Gymnospermous woods from the Lower Permian Hueco Formation of South Central, New Mexico. Early Permian footprints and facies. New Mexico Mus. Nat. Hist. Sci. Bull. 6, 91–100.
337. Tiffney, B.H., 1984. Seed size, dispersal syndromes, and the rise of angiosperms: evidence and hypothesis. Ann. MO Bot. Gard. 71, 551–576.
338. Tolenbaeva, L.V., 1967. Anatomical structure of the trunk of a problematical ginkgoceous plant. Paleont. Zh. 3, 125–128 (in Russian).
339. Tralau, H., 1966. Botanical investigations in the fossil flora of Eriksdal in Fyledalen, Scania. Sveriges Geologiska Undersökning Series C NR 611,1-36.
340. Tralau, H., 1967. The phytogeographic evolution of the genus Ginkgo L. Bot. Notis. 120, 409–422.
341. Tralau, H., 1968. Evolutionary trends in the genus Ginkgo. Lethaia 1, 63–101.
342. Troncoso, A. & Herbst, R., 1999. Ginkgoales del Triásico del norte de Chile, Rev. geol. Chile v.26 n.2 Santiago.
343. Uemura, K., 1997. Cenozoic history of Ginkgo in East Asia. In: Hori, T., Ridge, R.W., Tulecke,W., Del Tredici, P., Trémouillaux-Guiller, J., Tobe, H. (Eds.), Ginkgo biloba—A Global Treasure from Biology to Medicine. Springer Verlag, Tokyo, pp. 207–221.
344. Vachrameev, V.A., 1987. Climate and the distribution of some gymnosperms during the Jurassic and Cretaceous. Rev. Palaeobot. Palynol. 51, 205–212.
345. Vachrameev, V.A., 1991. Jurassic and Cretaceous Floras and Climates of the Earth. Cambridge University Press, Cambridge, 318.
346. Vachrameev, V.A., Doludenko, M.P., 1961. Upper Jurassic and Lower Cretaceous flora from the Bureja Basin and their stratigraphic significances. Trud. Geol. Inst. AN. SSSR 54, 1–136 (in Russian).
347. Van der Pijl, L., 1982. Principles of Dispersal in Higher Plants, 3rd ed. Springer, Berlin, 215.
348. Van Konijnenburg-van Cittert, J.H.A., 1971. In situ gymnosperm fructifications from the Jurassic flora of Yorkshire. Acta Bot. Neerl. 20, 1–96.
349. Van Konijnenburg-van Cittert, J.H.A., 1972. Some additional notes on the male gymnosperm fructifications from the Jurassic flora of Yorkshire. Acta Bot. Neerl. 21, 95–98.
350. Van Konijnenburg-van Cittert, J.H.A., Van der Burgh, J., 1989. The flora from the Kimmeridgian of Culgower, Scotland. Rev. Palaeobot. Palynol. 61, 1–51.
351. Van Konijnenburg-van Cittert, J.H.A., Schmeissner, S., Dütsch, G., 2001. A new Rhaphidopteris from the Lower Liassic of Bavaria, Germany. Acta Palaeobot. 41 (2), 107–113.
352. Villar de Seoane, L., 1997a. Comparative study between Ginkgoites tigrensis Archangelsky and Ginkgo biloba Linn. leaves. Palaeobotanist 46 (3), 1–12.
353. Villar de Seoane, L., 1997b. Estudio cuticular comparado de nuevas Cycadales de la Formación Baqueró (Cretácico inferior), provincial de Santa Cruz, Argentina. Revist. Esp. Paleontol. 12 (1), 129–140.
354. Villar de Seoane, L., 2001. Cuticular study of Bennettitales from the Springhill Formation, Lower Cretaceous of Patagonia, Argentina. Cret. Res. 22, 461–479.
355. Vozenin-Serra, C., Privé-Gill, C., 1994. Bois pléistocènes du Gisement de Binh Thang, Vietnam. Palaeontographica B 232, 175–195.
356. Vozenin-Serra, C., Broutin, J., Toutin-Morin, N., 1991. Bois permiens du Sud-Ouest de l'Espagne et Sud-Est de la France—implications pour la taxonomie des Gymnospermes paléozoiques et la phylogénie des Ginkgophytes. Palaeontographica B 221, 1–26.
357. Wang, Z.Q., 1984. Plant Kingdom. In: Tianjin Institute of Geology and Mineral Resources (Ed.), Palaeontological Atlas of North China II. Mesozoic. Geological Publishing House, Beijing, 223–296, 367–384 (in Chinese).
358. Wang, F.X., Chen, Z.K., 1983. A contribution to the embryology of Ginkgo with a discussion on the affinity of the Ginkgoales. Acta Bot. Sin. 20, 199–207 (in Chinese, with English abstract).
359. Wang, X., Duan, S.Y., Geng, B.Y., Cui, J.Z., Yang, Y., 2007. Schmeissneria: a missing link to angiosperms? BMC Evol. Biol. 7, 14.
360. Wang, Y.D., Guignard, G., Thevenard, F., Dilcher, D., Barale, G., Mosbrugger, V., Yang, X.J., Mei, S.W., 2005. Cuticular anatomy of Sphenobaiera huangii (Ginkgoales) from the Lower Jurassic of Hubei, China. Am. J. Bot. 92 (4), 709–721.
361. Watson, J., 1969. A revision of the English Wealden flora. I. Charales-Ginkgoales. Bull. Nat. Hist. Mus. (Geol.)

17, 207–264.
362. Watson, J., Sincock, C.A., 1992. Bennettitales of the EnglishWealden. Monogr. Palaeontogr. Soc. Lond. 145, 1–288 (Publ. no. 588).
363. Watson, J., Lydon, S.J., Harrison, N.A.A., 1999. Consideration of the genus Ginkgoites Seward and a redescription of two species from the Lower Cretaceous of Germany. Cret. Res. 20, 719–734.
364. Watson, J., Lydon, S.J., Harrison, N.A.A., 2001. A revision of the English Wealden flora. III. Czekanowskiales, Ginkgoales and allied Coniferales. Bull. Nat. Hist. Mus. (Geol.) 57 (1), 29–82.
365. Wheeler, E.A., Manchester, S.R., 2002. Woods of the Eocene Nut Beds Flora, Clarno Formation, Oregon, USA. IAWA J. (Suppl. 3), 1–188.
366. White, E.M., 1986. The Greening of Gondwana, Australia, 256.
367. Wilson, L.C., 2005. The Telome Theory. The Botanical Review, vol. 71, 485-505.
368. Wolf, J.A., 1987. An overview of the origins of modern vegetation and flora of the northern Rocky Mountain. Ann. MO Bot. Gard. 74, 785–803.
369. Wu, S.Q., 1999. A preliminary study of the Jehol flora from western Liaoning. Palaeoworld 11, 7–57 (in Chinese, with English abstract).
370. Wu, X.W., Yang, X.J., Zhou, Z.Y., 2006. Ginkgoalean ovulate organs and seeds associated with Baiera furcata-type leaves from the Middle Jurassic of Qinghai Province, China. Rev. Palaeobot. Palynol. 138, 209–225.
371. Xiang, B.X., Xiang, Z., Xiang, Y.H., 2006. Investigation of wild Ginkgo biloba in Wuchuan County of Guizhou, China—Guizhou ancient Ginkgo biloba germplasm resources investigation VII. Guizhou Sci. 24 (2), 56–67 (in Chinese, with English abstract).
372. Xiang, B.X., Xiang, Z., Xiang, Y.H., 2007. Report on wild Ginkgo biloba in Qianzhong Altiplano—Guizhou ancient Ginkgo biloba germplasm resources investigation VIII. Guizhou Sci. 25 (4), 47–55 (in Chinese, with English abstract).
373. Xiang, Y.H., Xiang, B.X., Zhao, M.S.,Wang, Z.L., 2000. A report on the natural forest with Ginkgo population in west Tianmu Mountain, Zhejiang Province. Guizhou Sci. 18, 77–92 (in Chinese, with English abstract).
374. Xiang, Z., Zhang, Z.L., Zhang, Y.H., 2001. Investigation of natural Ginkgo biloba population on the Golden Buddha Mountains of Nanchuan, Chongqing. Guizhou Sci. 19, 37–52 (in Chinese, with English abstract).
375. Xing, S.Y., Li, S.M., Li, B.J.,Wang, F., Han, K.J.,Wang, L., 2007. Comparative morphology and its systematic implication on epiphyllous microsporangia from Ginkgo biloba L. Acta Horti. Sin. 34 (4), 805–812 (in Chinese, with English abstract).
376. Xiao, S.Z., Zhang, E.P., 1985. Plant Kingdom. In: Tianjin Institute of Geology and Mineral Resources (Ed.), Palaeontological Atlas of North China. I. Palaeozoic. Geological Publishing House, Beijing, pp. 530–586 (in Chinese).
377. Yang, X.H., 1978. The Vegetable Kingdom (Mesozoic). In: Chengdu Institute of Geology and Mineral Resources (Ed.), Atlas of Fossils of Southwest China Sichuan. II. Carboniferous to Mesozoic. Geological Publishing House, Beijing, 469–536 (in Chinese, with English title).
378. Yang, X.H., 1986. Sphenobaierocladus—a new ginkgophytes genus (Sphenobaieraceae n. fam.) and its affinities. Bull. Chengdu Inst. Geol. Miner. Resour. 7, 49–59 (in Chinese, with English summary).
379. Yang, X.J., Friis, E.M., Zhou, Z.Y., 2008. Ovulate organs of Ginkgo ginkgoidea (Tralau) comb. nov., and associated leaves from the Middle Jurassic of Scania, South Sweden. Rev. Palaeobot. Palynol. 149, 1–17.
380. Yao, Z.Q., 1989. Psygmophylloids of the Cathyasia Flora. Acta Palaeont. Sin. 28 (2), 171–191 (in Chinese, with English summary).
381. Yokoyama, M., 1889. Jurassic plants from Kaga, Hida and Echizen. J. Coll. (College) Sci. Imp. Univ. Tokyo 3, 1–66.
382. Zalessky, M.D., 1911. Note préliminaire sur le Caenoxylon scotti, nov. gen. Et sp. Étud. Paléobot. (St. Petersburg) I, 13–16.
383. Zalessky, M.D., 1912. Sur le Cordaites aequalis Goepp. de Sibérie et sur son identité avec la Noeggerathiopsis hislopi Bunb. sp. de la flore du Gondwana. Mém. Com. Géol. St.-Pétersb., n. s. 86, 1–43.
384. Zalessky, M.D., 1932. Observations sur l'extension d'une flore fossile voisine de celle de Gondwana dan la parte septentrionales de L'Eurasie. Bull. Soc. Geol. France, Ser. 5 (11), 109–129.
385. Zeba-Bano, Z., Maheshwari, H.K., Bose, M.N., 1979. Some plant remains from Pathargama, Rajmahal Hills, Bihar. Palaeobotanist 26, 144–156.
386. Zeng, Y., Shen, S.Z., Fan, B.H., 1995. Flora from the Coal-Bearing Strata of Yima Formation in Western Henan. Jiangxi Science and Technology Publishing House, Nanchang, 92. (in Chinese).
387. Zhang, B.L., Zhou, Z.Y., 1996. A new species of Rhaphidopteris Barale (Gymnospermae) and its taxonomic position. Acta Palaeont. Sin. 35, 528–543 (in Chinese, with English summary).
388. Zhang,W., Chang, C.C., Zheng, S.L., 1980. Phyllum Pteridophyta, Subphyllum Gymnospemae. In: Shenyang Institute of Geology and Mineral Resources (Ed.), Paleontological Atlas of Northeast China. II. Mesozoic and Cenozoic. Geological Publishing House, Beijing, 112–191 (in Chinese).
389. Zhang, W., Zheng, S.L., Shang, P., 2000. A new species of Ginkgoalean wood (Ginkgoxylon chinensis Zhang et Zheng sp. nov.) from Lower Cretaceous of Liaoning. Acta Palaeont. Sin. 39 (Suppl.), 220–225.
390. Zhao, L.-M., Ohana, T. & Kimura T., 1993. A fossil population of Ginkgo leaves from the Xingyuan Formation, Inner Mongolia. Paleontological Society of Japan Transactions & Proceedings 169:73-69.
391. Zheng, S.L., Zhang,W., 2000. Late Paleozoic ginkgoaleanwoods from Northern China. Acta Palaeont. Sin. 39 (Suppl.), 119–126.
392. Zheng, S.L., Zhou, Z.Y., 2004. A new Mesozoic Ginkgo from western Liaoning, China and its evolutionary significance. Rev. Palaeobot. Palynol. 131, 91–103.
393. Zhou, Z.H., Zhang, F.C., 2002. A long tailed seed-eating bird from the early Cretaceous of China. Nature 418, 405–409.
394. Zhou, Z.Y., 1991. Phylogeny and evolutionary trends of Mesozoic ginkgoaleans—a preliminary assessment. Rev. Palaeobot. Palynol. 68, 203–216.
395. Zhou, Z.Y., 1993. Comparative ultrastructure of fossil and living ginkgoacean megaspore membranes. Rev. Palaeobot. Palynol. 78, 167–182.
396. Zhou, Z.Y., 1994. Heterochronic origin of Ginkgo biloba-type ovule organs. Acta Palaeont. Sin. 33 (2), 1–9 (in Chinese, with English summary).
397. Zhou, Z.Y., 1997. Mesozoic ginkgoalean megafossils: a systematic review. In: Hori, T., Ridge, R.W., Tulecke,

W., Del Tredici, P., Trémouillaux-Guiller, J., Tobe, H. (Eds.), Ginkgo biloba—A Global Treasure from Biology to Medicine. Springer Verlag, Tokyo, 183–206.
398. Zhou, Z.Y., 2000.Aproposed classification of Mesozoic ginkgoaleans. Abstracts of the Sixth Conference of International Organization of Palaeobotany (IOPVI), July 31–August 3, 2000, Qinhuangdao, China, pp. 157–158.
399. Zhou, Z.Y., 2003. Mesozoic ginkgoaleans: phylogeny, classification and evolutionary trends. Acta Bot. Yunnanica 25 (4), 377–396 (in Chinese, with English abstract).
400. Zhou, Z.Y., 2007. Karkeiniaceae, Yimaiaceae, Umaltolepidaceae and Schmeissneriaceae. In: Anderson, J.M., Anderson, H.M., Cleal, C.J. (Eds.), Brief History of the Gymnosperms: Classification, Biodiversity, Phytogeography and Ecology. Strelitzia 20, pp. 174–177. Pretoria, South African National Biodiversity Institute.
401. Zhou, Z., 2009. An overview of fossil Ginkgoales. Palaeoworld. vol. 18, Issue 1. March 2009, 1-22.
402. Zhou, Z.Y., Guignard, G., 1998. Leaf cuticle ultrastructure of two czekanowskialeans from the Middle Jurassic Yima Formation of Henan, China. Rev. Palaeobot. Palynol. 102, 179–187.
403. Zhou, Z.Y., Wu, X.W., 2006a. Early Mesozoic radiation and diversification of ginkgoaleans. In: Rong, J.Y., Fang, Z.J., Zhou, Z.H., Zhan, R.B., Wang, X.D., Yuan, X.L. (Eds.), Originations, Radiations and Biodiversity Changes—Evidences from the Chinese Fossil Record. Science Press, Beijing, 519–549, 904–906 (in Chinese, with English summary).
404. Zhou, Z.Y.,Wu, X.W., 2006b. The rise of ginkgoalean plants in the early Mesozoic: a data analysis. Geol. J. 41 (3/4, Spec. issue), 363–375.
405. Zhou, Z.Y., Zhang, B.L., 1988.Two newginkgoalean female reproductive organs from the Middle Jurassic of Henan Province. Sci. Bull. (Kexue Tongbao) 33 (4), 1201–1203.
406. Zhou, Z.Y., Zhang, B.L., 1989. A Middle Jurassic Ginkgo with ovule-bearing organs from Henan, China. Palaeontographica B 211, 113–133.
407. Zhou, Z.Y., Zhang, B.L., 1992. Baiera hallei Sze and associated ovule-bearing organs from the Middle Jurassic of Henan, China. Palaeontographica B 224, 151–169.
408. Zhou, Z.Y., Zhang, B.L., 2000a. On the heterogeneity of the genus Rhaphidopteris Barale (Gymnospermae) with descriptions of two new species from the Jurassic Yima formation of Henan, Central China. Acta Palaeont. Sin. 39 (Suppl.), 14–35.
409. Zhou, Z.Y., Zhang, B.L., 2000. Jurassic flora from Yima, Henan Province. Field Guide Book for the Sixth Conference of International Organization of Palaeobotany (IOP-VI), July 31–August 3, 2000, Qinhuangdao, China, 36–39.
410. Zhou, Z.Y., Zheng, S.L., 2003. The missing link of Ginkgo evolution. Nature 423, 821–822.
411. Zhou, Z.Y., Thévenard, F., Barale, G., Guignard, G., 2000. A xeromorphic conifer from the Cretaceous of East China. Palaeontology 43, 561–572.
412. Zhou, Z.Y., Wu, X.W., Zhang, B.L., 2001. Tharrisia, gen. et sp. nov., a new fossil vegetative organ genus, with description of three species from China. Palaeontographica B 256, 95–109.
413. Zhou, Z.Y., Zhang, B.L., Wang, Y.D., Guignard, G., 2002. A new Karkenia (Ginkgoales) from the JurassicYima formation, Henan, China and its megaspore membrane ultrastructure. Rev. Palaeobot. Palynol. 120, 91–105.
414. Zhou, Z.Y., Zheng, S.L., Zhang, L.J., 2007. Morphology and age of Yimaia (Ginkgoales) from Daohugou Village, Ningcheng, Inner Mongolia, China. Cret. Res. 28, 348–362.
415. Ziegler, A.M., Rees, P.M., Rowley, D.B., Bekker, A., Qing, L., Hulver, M.L., 1996. Mesozoic assembly of Asia: constraints from fossil floras, tectonics, and paleomagnetism. In: Yin, A., Harrison, M. (Eds.), The Tectonic Evolution of Asia. Cambridge University Press, Cambridge, 371–400.
416. Zimmermann, W., 1959. Die Phylogene der Pflanzen. Fisher Verlag, Stuttgart.

Ginkgo adiantoides. (Sprecher, 1907)

Ginkgo biloba leaves (Montana, USA). Paleocene. Photo by Michael Pop, USA. In Smithsonian National Museum of Natural History, USA. (40)

* "*Ginkgo adiantoides* (Unger) Heer (auctorum multorum) is a composite morphogeneric name for *Ginkgo biloba*-like leaves of Tertiary (Quan, Sun and Zhou, 2010, A new Tertiary *Ginkgo* (*Ginkgoaceae*) from the Wuyun formation of Jiayin..., American Journal of Botany 97(3): 446–457). We recently proposed to rename the ovulate organs found from the Paleocene of North Dakota, USA by Peter Crane et al., (1990) referred to *Ginkgo adiantoides* as a new species *Ginkgo cranii*. The reconstructions of *G. adiantoides* we made before (including the new beautiful figure you drawn in P. 61) should use this new name later, if our work will be accepted for publication." (Z. Zhou, China, 2011/03/08).

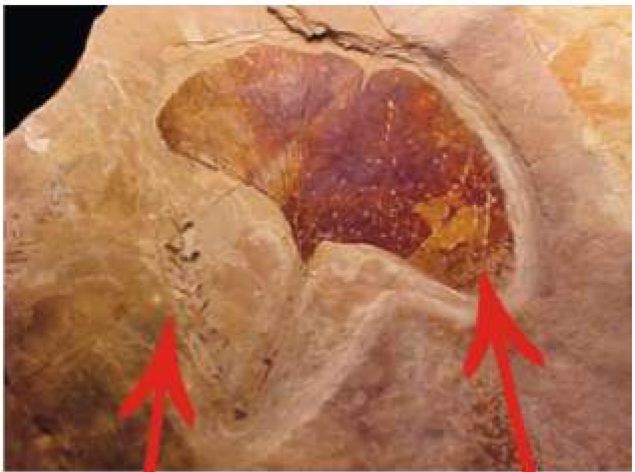
* Fundamentals of animated maps - source: http://www.skyscrapercity.com/showthread.php?t=420169&page=18, http://www.paleoportal.org Graphic editing: B. Begović, Croatia.

Fruits (seed)

Leaf

Ginkgo yimaensis. Discovered in mine Yima, Henan Province, central China. 170 millions years ago. (5b). The photos was published good deed Yima Coal Industry Group Co., Ltd., Henan Yima City, China.

Fruits (seed)



Leaf

Male flower

An example of excellent preserved fossils *Ginkgo biloba* from the Eocene (cca 40 mill. years ago) - from the lacustrine deposits of the McAbee Flora of British Columbia, Canada. (34) The photo was published good deed Virtual Fossil Museum http://www.fossilmuseum.net/.

3

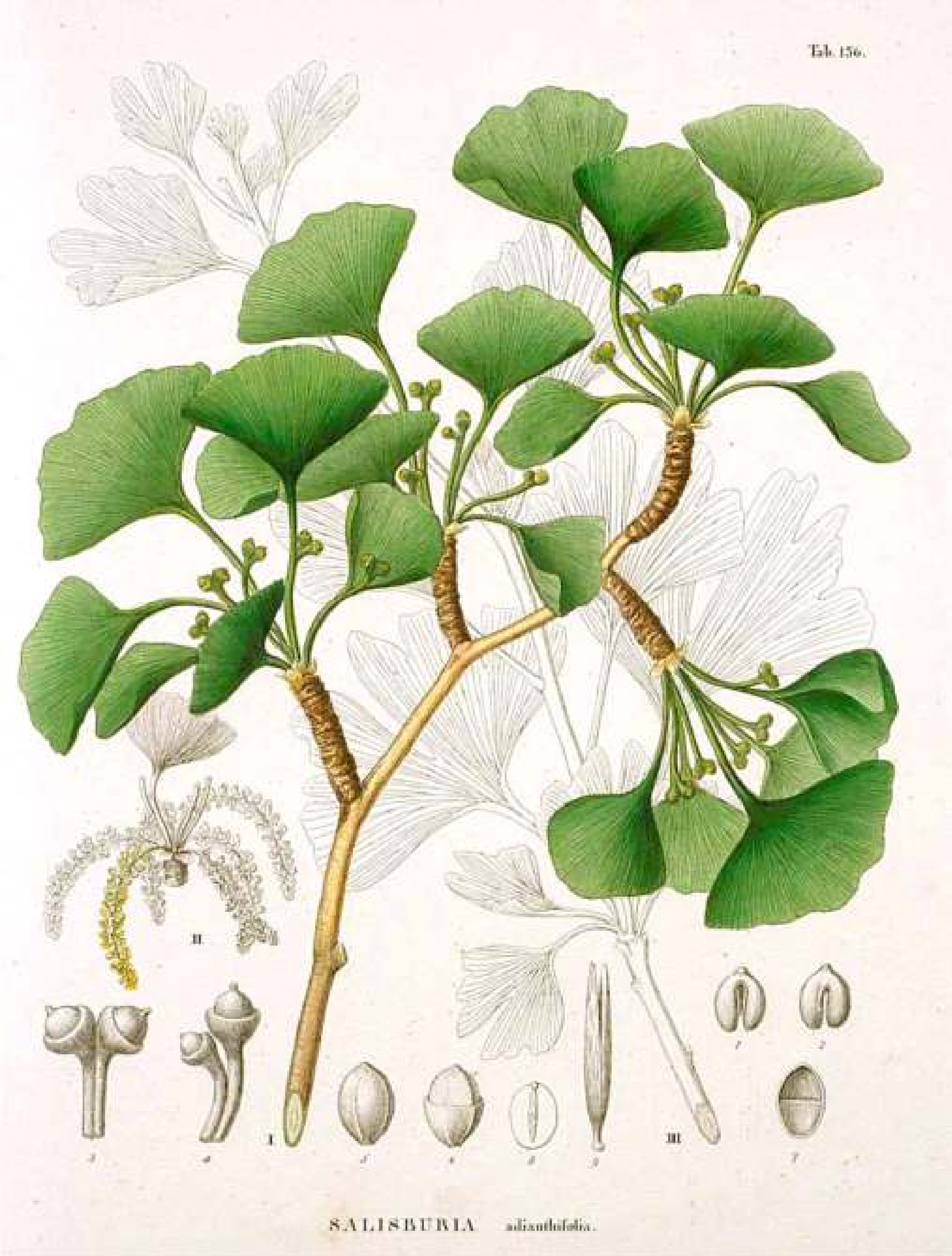
Morphological characteristics of species *Ginkgo biloba* L. (or Maidenhair tree)

Foreword

We could already see that the *Ginkgo biloba* or maidenhair tree is bicameral plant. His leaf is very specific basically divided into two parts. But the specific is fruit also. The gardening he is an extremely valued plant for its amazing beauty. Even the most refined lover of ornamental plants will admit that Gingko is unique pearl in horticultural areas.

Treetop of a well cherished ginkgo is magnificent even in the winter when leafs drop off and keep an eye buds very noticeable for human eyes and in Summer when it is completely green. In spring it's full of flowers and in Autumn in the end treetop gets a beautiful golden yellow color. Even when the leafs drop off yellow carpet under the tree will rarely leave anyone indifferent. The charms that ginkgo provides with its appearance does not depend on an age of the plant. It is unique since its first year and until sometimes quite envious few thousand years old speciments.

On morphological characteristics of Ginkgo we could say a lot and basic description of the appearance of Ginkgo are now nearly overwhelmed books, a variety of botanical and horticultural handbooks and journals, manuals and journals on medicinal plants, an official pharmacopoeia and medicine..., while the newest medium - Internet there are numerous data about this miracle plant. Here we will try to summarize and describe in useful manner layout of *Ginkgo biloba* so that you will be able to known *Ginkgo* in full.



Siebold F. & Zuccarini J., 1835 – 1870. *Flora Japonica*. Leiden.

Left: *Ginkgo biloba* L. 1771 in the herbarium.

1
Description of typical tree species - in general

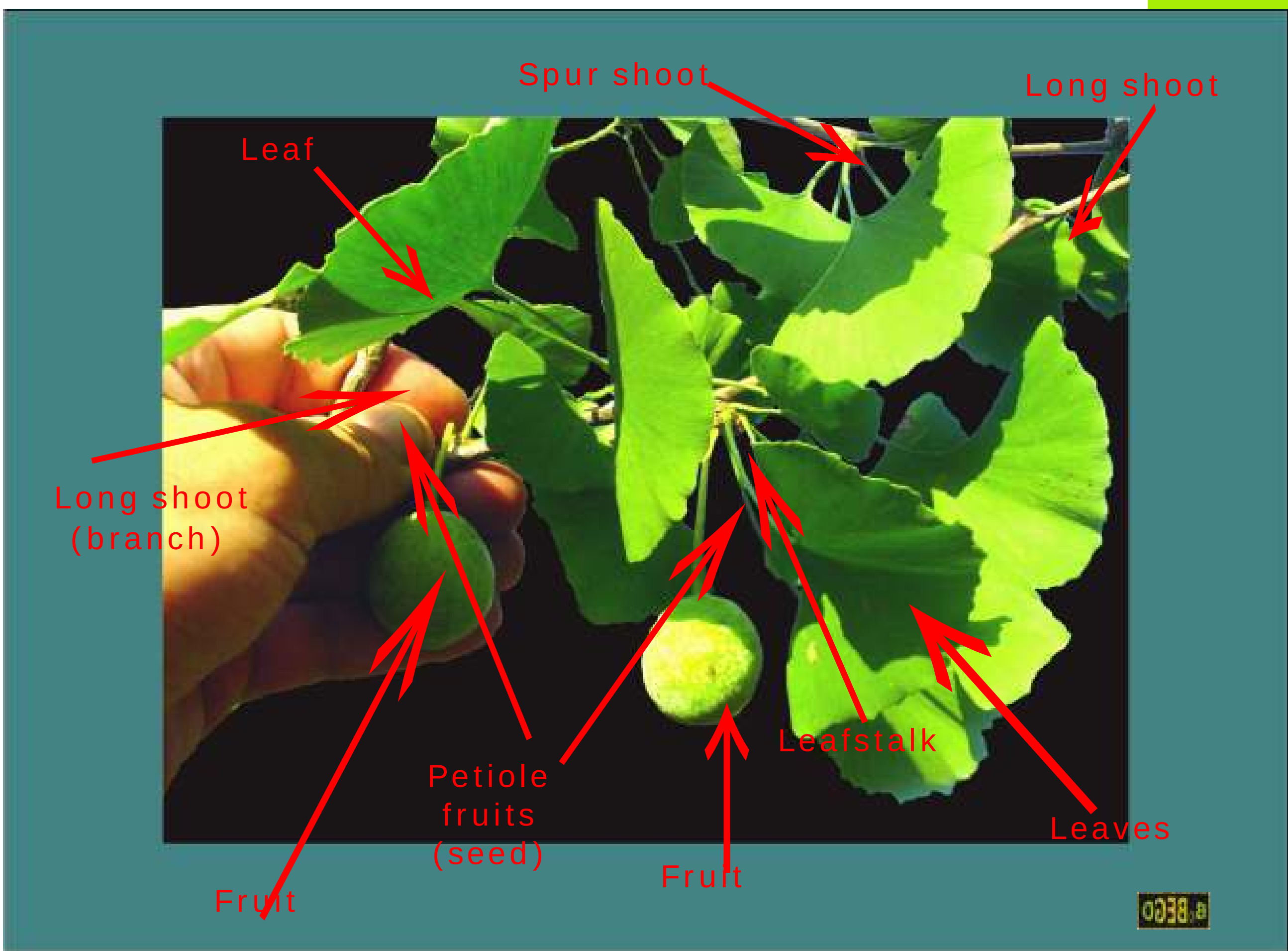
Ginkgo biloba is a deciduous tree and there are male and female plants. Basic features include a fany silky leaves on long stalks, and seeds (pips) is wrapped with fleshy casing like plum, cherry or apricot. Ginkgo is one of the most vital plant species in the world. He impresses with his resistance to poisoned environment, insects and various diseases and survives all sorts of pollution including the atomic bomb. This is a brief description of Ginkgo.

In the world gingko is relatively rare species represented in parks and in general as garden and home decorative form. For that there are many reasons and one of them is a slow growth and it is quite difficult to obtain seedlings. In recent times this is changing and gingko is becoming a very valued as horticultural species although quite expensive. It is known that Ginkgo can be regarded as medical plant: Improves circulation, memory and generally makes the body healthier. For the drug mostly are used: leafs, content of the seed, fleshy casing around kernel of the seed (which is despite the odor loved by voles), then the root, bark. The core kernel is rich in carbohydrates and edible just like almonds or hazelnuts. The core kernel when dried is white and hard, and tastes like almonds. In Japan and Korea roasted seeds are considered to be a specialty and

Easily recognizable tree of the Ginkgo. Autumn. Photo by Kawasaki Green Inv., Japan.

somewhere in the East they are served in conjunction with the extravagant and expensive meals such as from the swallow's nests. Let us say that the seed oil once was used for lamps and now days for a massage.

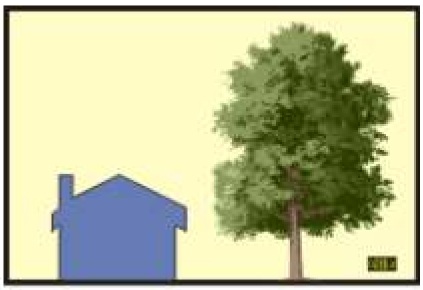
The tree reaches a height over 30 meters and diameter of tree was recorded to be over 9 meters. Until about a hundred years of age tree is growing symmetrically and round while later he starts to deflect and distort an has no proper but distorted form. In China, apparently, there are dozens of specimens of maidenhair tree older than 1500 years. For example in Lengqi (Luding Xian,



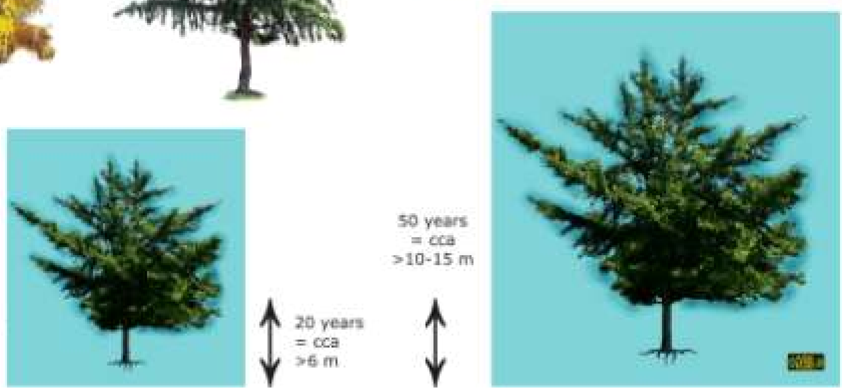
Some forms of Ginkgo trees of various ages and sex.

southern Sichuan) one ginkgo is estimated to be 1700 years old and another up to 4000 and more. The data says that there are some trees that are old up to about 4500 years for example tree from the Li Jiawan in Guizhou province. Standard type of ginkgo in early adolescence is in conical form and later it is more widespreaded.

Habitus is similar to oak. Until about thirty years of age tree bark is medium dark gray and smooth for a long time and then in an old age it is cracked and dark brown. Older branches hangs. Leaves are on short or long shoots and at 3-9 in a tuft spirally lined. At it's basic form leaves are long from 7-12 cm and 6-10 cm wide. At Cultivars we have various discrepancies. It is fan formed mostly from two lobes but sometimes more. Edge is carved with a series of wavy and branched parallel veins. Pedicle is 7-9 cm long. The form of the leaf blades is quite variable. Leaves on long shoots are larger and the leaf blades are more committed than leaves of short shoots and smaller areas. But this is not the rule. The main species in spring has light green and dark green leaves in summer, while in autumn gets golden-yellow or open-yellow (cadmium yellow). Ginkgo is very resistant to low temperatures and can handle up to -25°-30° C. Ginkgo does not like a shadow jet only the sun (except in early adolescence). It is very adaptable plant. Under natural conditions ginkgo starts to grow new leaf buds at the end of March while "forced" or in conditions with room temperature leaf buds open much earlier. It turned out that these plants later tolerate outside conditions. Plants as it was mentioned before are not significantly vulnerable to various diseases and insects do not attack them. Over millions of years of evolution Ginkgo has developed a specific and strong immunity. Only young plants especially twigs, bark and root is loved by voles, some species of ants and crickets. We need to mention that part of the cultivar has a very wide range and even grow in the range of 4/5 to 8/9 in climatic zones (so it means of even -34° C to 8 Hardiness zone which covers a range of -7° C) - (HZone). Some reports suggest that ginkgo trees do not like cleaning a strong tearing and damage to branches and that such practices may often lead to death of plant itself. The wood is light colored and in medium hardness which makes it ideal for hand and similar processing. When dried it can be attacked by various insects (but quite rarely). Ginkgo seed has 2 hypogen cotyledons which after germination of plants remain in the soil. When



Some typical forms of ginkgo (above). The optimum height of the tree 5, 10, 20 and 50 years ago.



plant has multiple cotyledons it has less dense foliage. The number of chromosomes (carriers of hereditary traits that form the nucleus of the cell - gene carriers - in fact, filamentous creations constructed from nucleic acids of nuclear proteins in the cell nucleus), Ginkgo biloba has n = 12; isobrahial approximately two and ten supterminale centromeres.

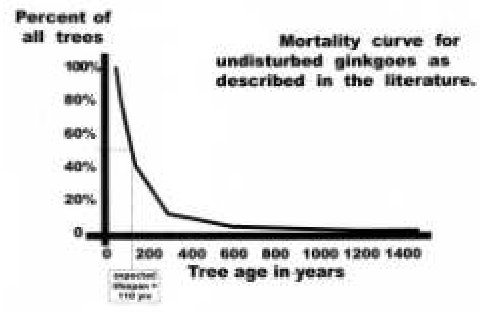
2
The trunk – in general

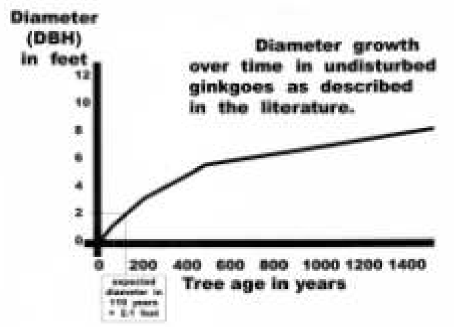
Ginkgo tree has a form similar to a number of deciduous species however at any time of the year is very distinctive and specific. Basically the top tree has a pyramidal shape. Very young plant in the first few years has a central stem on which there are spirally arranged leaves. At every place where there was a leaf after three years separate branches begin to form, and formation of branches will continue in the following years. Branches arrangement is usually formed from the bottom of the tree so if the lower branches are not pruned plant will not have a high trunk with a cylindrical shape. Therefore plant must have enough space around herself.

Old Ginkgo tree in Saitama (Japan).
This individual has been coppiced: the original trunk was cut, and the tree is resprouting with multiple stems.
Photo by Matt Opel, USA.
(69)

Male speciment - Basically it is quite difficult to identify which sex is specific plant. Ginkgo is sexually mature after about 30-35 years of age. It depends on the microclimate where the plant grows. Jet male trees have a little bit more horizontal branches located in relation to the central trunk so that the tips hangs a little bit more. For the avenues or parks in the cities most wanted are male trees and the reason why is smelly fruit in Autumn from the female trees so unfortunately a lot of plants is tried to be grown as an male through transplantation (grafting). Therefore it is the reason why mostly male cultivars were grown. Let us say that in average for optimal fertilization one male tree is needed for about five females. In connection with tree top forms it is important to mention that any ginkgo

Left & down:
this particular group of trees is the product of asexual reproduction. An older Gingko was cut down and new shoots came up around the stump (Brooklyn, USA).
Photos by Katie Archer, USA.
(65)





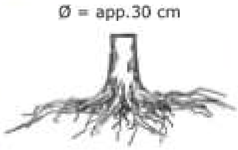
Oldest Ginkgo tree (male) in East Europe (Daruvar, Croatia, 1777). Right: mortality curve for undisturbed Ginkgoes as described in the literature & diameter growth over time in undisturbed Ginkgoes as described in the literature. By Dr. Kim D. Coder - see p. 213-216. (101)

tree if it is pressed among other species adapt to the situation and try to rise up to get to the sun. In such situation often happens that such plant has a very pronounced tapering branches upward which is not typical for this type. Male plants in the autumn drop off leafs a lot earlier than female individuals which is regulated genetically and evolutionarily because the female trees have fruit from which they fed until maturation. Both male and female specimens flowers at the time of growing leaf buds in early spring. The flowers on male plants are located on top of lengthy axis and each has 2-7 pollens. Mature sperm gently falls down and the wind blows them up to a few kilometers away.

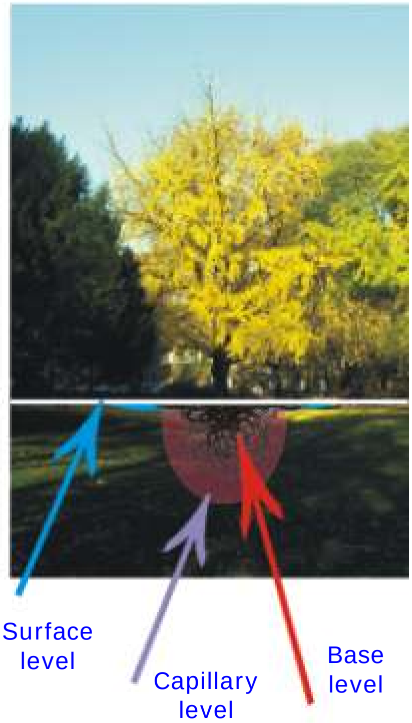
<u>Female speciment</u> - Female trees, those that are sexually mature, have flowers individually at the longer end of thickened pedicle with 1 or 2 seed embryo which are wrapped dome and are situated sideways. The flowers emerge from foliar axil. Seed embryo is erect, broadly roundish with one integument. Fertilization is done with movable sperm. Pollination is done solely by the wind. It is proven that in the nature gap between male and female plants can be several kilometers and jet reproduction is excellent if you have male mature tree located within a radius of about 1-2 kilometers and nearer. Ginkgo blooms in continental climate from April to late May, when the pollinated and fertilization steps up and lasts about 2 months after pollination with movable sperms. By comparing the appearance of leaf from female and male specimen it can be concluded that apparently there are no differences. But they do exist although they are insignificant. Note once again that female tree is less valued, which led to the threat of extinction. In the future it may happen that the *Ginkgo biloba* plant species becomes a unicameral (male), which reproduces only vegetative (by cuttings, from root, root shoots, etc.). Forms of female trees compared to men is in more vertically placed branches. The difference is not great, but it is still noticeable..

Maidenhair tree in Schönbrunn, Austria (1781) - the four Seasons. Photo by “W”. (33, 34)

Kamakura, Japan (app. 1200 years). Photo by Yoshino Masahiro Japan. (90)



App. 25 years.



Surface level

Capillary level

Base level

The root system: different ages. Left: On a Ginkgo plantation in China. Liyi Association For Science & Technology. Photo by Hong-Sheng Li. Around 6 years old plant.

Root: 2 years

Root: 3 years.

3
Wood, bark and root system

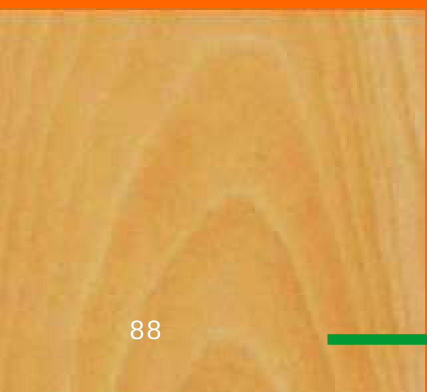
As noted before Ginkgo tree during its lifetime can grow very large and have large trunk diameter. Trees which assumed to bee more than a thousand years and more in age does not have a stereotypical shape of the trunk. It is distorted and diameter of a trunk is almost impossible to measure. However, trees that are fifty or a hundred years old have the form of timber with a central axis with lateral branches. If the first branches were never pruned the starting line can be almost from the base of the plant and later it begins to lose its central axis and all branches have somewhat the same purpose. The most common trees are the ones that have a central axis. Those are the ones on which intervention during the time was carried out by pruning lower branches to reduce space occupied by plants. Certainly there are many trees that are based on the central trunk and without human intervention. Such trees with a trunk have its technical value. Let us say that the Ginkgo tree is very convenient for processing. It is almost white (like ash) a bit soft ocher color, but strong and resistant, therefore it has been used for centuries by carvers, cabinetmakers and carpenters to create a variety of souvenirs or ornaments, decorative items, and for making objects for religious purposes (in East). Fossilized Ginkgo tree has a specific and extremely eye-catching colors and numbers that preserved in fossilized are relatively high. It is no coincidence. Ginkgo's wood is very resistant to wormholes and various other insects and pests that break down wood. It has been proved to be very resistant to high temperatures. It is hardly flammable almost the same as the leaf which is coated with a layer of non flammable paraffin, ie one type of wax.

Tree crust is in early age grayish-brown, smooth, and as the tree gets older it gets deeper and deeper grooves and is becoming more and more dark brown, sometimes almost black-brown. Since that together with the age tree increases furrows it comes to cracks in the crust and it is very often that it falls down on some places on his own. However each new branch and offspring will always be smooth and grayish in color as a certain way and rejuvenation of the tree. Let us say also that as older plant gets that the trunk of a tree at its basement gets increasingly distorted and there are more and more bumps that slowly began to emerge from the soil together with part of the root that is in the top layer of a soil from it's youth since his root system is relatively primitive and simple. In such cases it is not rare that shoots emerge directly from the roots (if grass around the

Above: Chi-chi - a specific root that grows on the branches - just in Ginkgo. Left: photo by Tony Kirkham, Kew Garden ("Old Lion"), UK. Up: Kumano-taisha shrine, Japan. Photos by Shouta Azumi (or "Bachstelze"), Japan.

Ginkgo wood & Thuja wood. Croatia.

tree is not being removed) which may well serve for the purpose of reproduction. The bark of trees over fifty years old is relatively thick - up to 5 and more centimeters in some places, while in young trees you may peel it the same as with lime. If you try to break away from the tree a branch of two-four centimeters it will easily break but the crust will still hold tightly ripped piece. Although highly resistant to different pruning damages Ginkgo will react very negatively on any kind of ripping and branch tearing. In that case plant will focus all it's immune system only in this part where the problem is, and it will weaken the entire immune system and plant which has more of such damages can be easily severely damaged. This applies mainly to younger plants. Another thing is to carefully pruned branches and then healed the wounds with some specific preparations, or being pruned drastically but professional. The older trees will bear good even drastic pruning of a large



Ginkgo wood is not resinous like conifers. Left: about 100 years old waiting for sawing logs, Japan. (71).
Down: Ginkgo wood - treated and untreated.
(See 36, 50, 56, 88)

portion of the canopy, which is known to be done to reduce the size of the canopy. There are examples where the whole stem has been pruned to just a few meters away from the ground and has renewed. As the whole ginkgo plant is medicinal for the cooking of a tea and the preparation of other products in certain places in the East bark is being used.

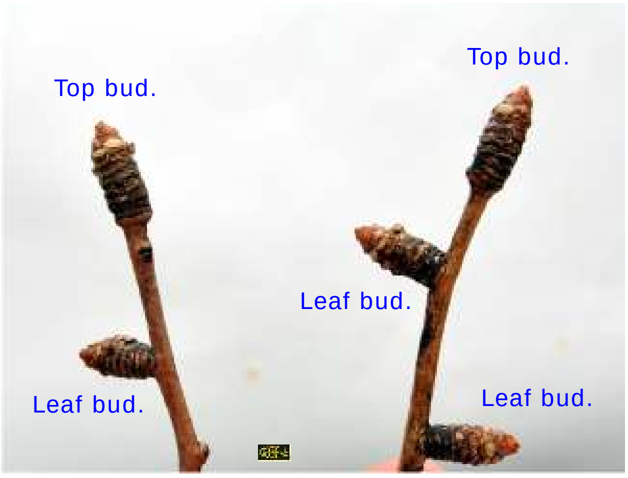
In this section we should mention so called chi-chi threes or growths on tree trunks and branches. One hangs down. Such trees are not rare, but the formation of these growths appears in older trees, and it gives them a distinctive look that almost any other plant species on Earth has. In fact it is about a specific type of plant roots, through which it also takes the nutrients and moisture from the atmosphere. Some felt that those are air roots, but this is not true. Chi-chi growths in fact have the function of vegetative rejuvenation of the tree, and when they are cut and planted in the ground it will sprout a new plant. The researchers indicated its good ability to regenerate attributed to the presence of basal characteristics of chi-chi in the genes (the cotyledons) of each Ginkgo herb which has developed during evolution.

Ginkgo has relatively primitive and simple root system. It is to be expected in a plant that has changed only slightly in the last hundred million years, but this system is, just as it is simple on the other hand it so effective. We can only wonder how this plant survived so many millennia, and the answer partly lies precisely in the root system, which was probably able to adapt very quickly to the situation (climate change, etc.).

Let us say that regarding the volume of Ginkgo, he has a relatively small root system in relation to the tree, especially in older age. It all boils down mainly to a few sideways and slightly less in depth placed primary vessel from which branched smaller capillaries. All this is located mainly in one or two levels and as tree gets older capillaries become larger, or does not increase which depends on the type and quality of soil where the plant grows. Ginkgo needs deep soil, but a bit loose and sandy due to their large number of tiny capillaries that can penetrate deep into the soil in search of food and water. Only the

Right up: bark of Ginkgo tree various age.

Root Ginkgo above the ground - right. The Ginkgo tree in village Tiantan, China (about 4000 years old tree). Photo by Qin Gang, China (2009).



The buds and shoots of Ginkgo tree. Right up: top and leaf buds. Left and up left: leaf buds.

Right and down: young shoots various age Ginkgo trees.

Excellent grown
plant (4 years) -
leaf in the Summer.

Leaf: burnt from
the sun (August)

All photos =
Hardiness zone 7/8

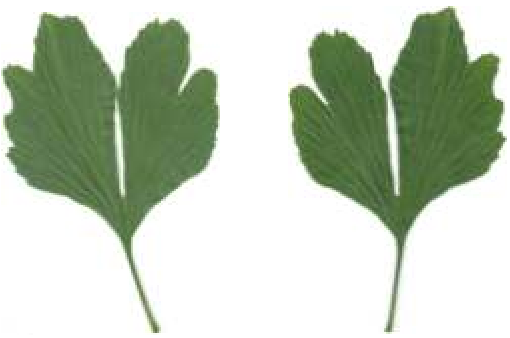
Leaf: burned - the effect of
magnifyng glass (July)

Naturally dried leaf (cca.15 hours) - humidity
approx. 10-15% (August). Medicinal herb.

Leaf dried at temp.
cca. 80°C (about 20 min) (July)

Young leaf: plant 1 year old (May)

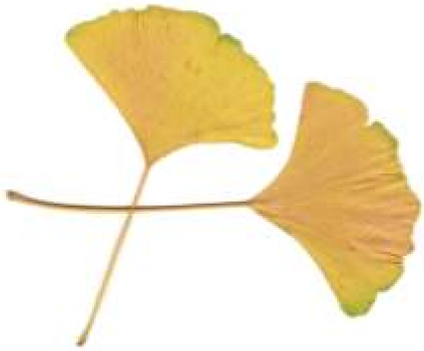
Leaf: plant 120 years old (June)



Leaf: plant 6 years old (Summer - August)

Leaf: the tree (Autumn - October)

Leaf: domaged by moisture (plant
3 years ago - August)



Leaf: Autumn (October)

Leaf dried plants. Cause: ? (June/July)

Medicinal herb. Naturally dried leafs
(cca.20 hours) - humidity approx. 10%.
Age: 1 years.

Leaf, which is dried on a healthy
plant. Cause: ? (August)

Leaf: herbarium (11 years old).

Three years old leafs who was the humidity.

One year ago old leaf Ginkgo: bad guarded.

Leaf after one year under the plant. (August)

Autumn leaf in the herbarium. (5 years ago)

Autumn leaf in the herbarium. (2 years ago)

Leaf in the Summer - is infected? (June)

first years of life, the plant has several strong primary veins that are up to about three to four years of age nearly as long as a trunk of a tree. After this period small capillary systems begin to form and later plant can survive for almost ten years with an incredibly small root (for example if we keep her in small container for a few years). It will prevent its developing, but it does not destroy the plant itself.

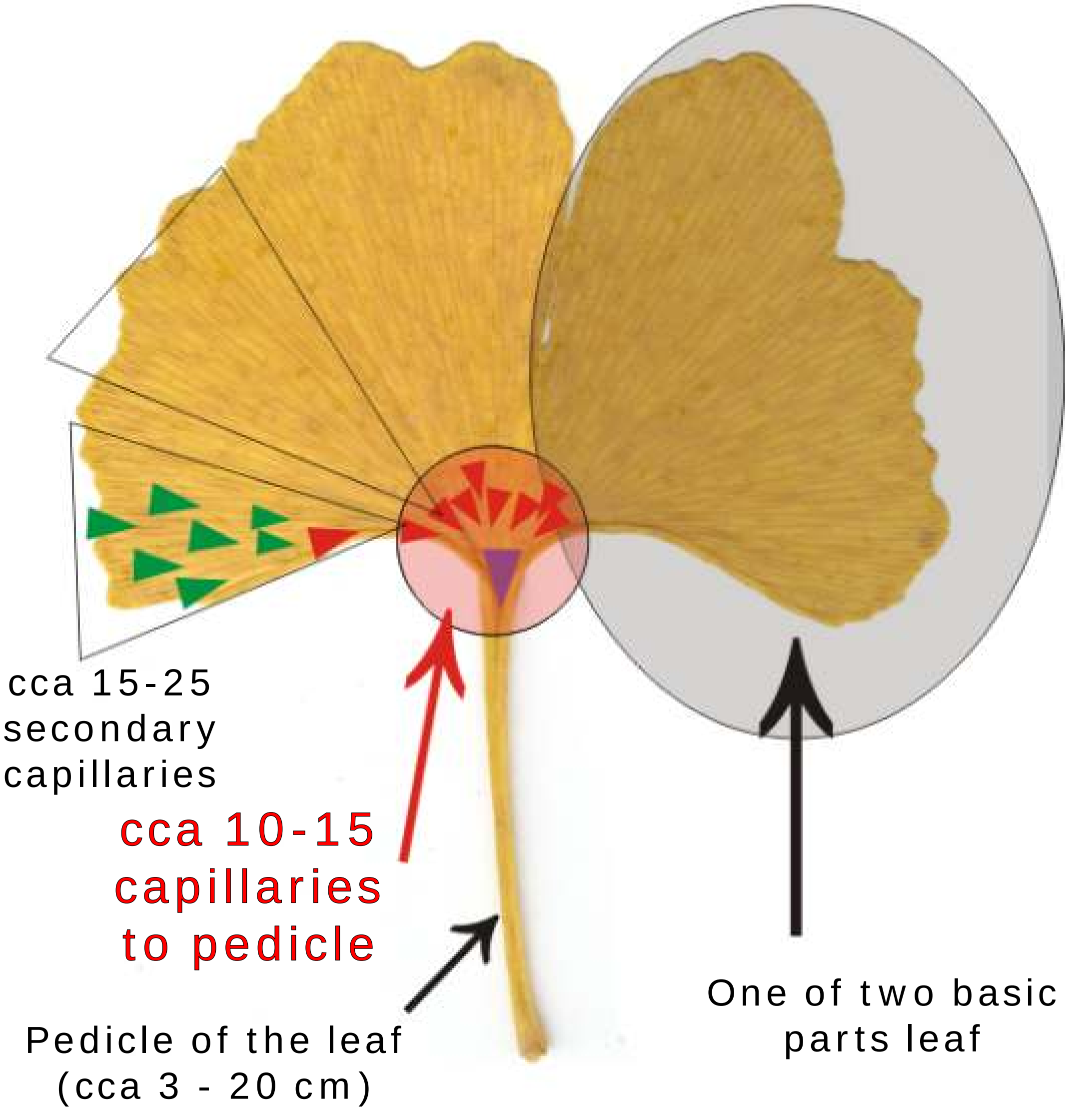
4
Leaf

We have already mentioned that Ginkgo's leaf basically consists of two leaf blades. However, this is not the rule. The largest part of Ginkgo's leaf really consists of two almost identical or very similar parts, but on the trees of the female and male individuals we can find many variations or forms that are reminiscent of Ginkgo ancestors, such as *Ginkgo yimaensis*, *Ginkgo digitata*, etc. So we have leaves that are composed entirely of full leaves virtually no parting, to the leaf, which consists of 6, 7 or more lengthy leaf blades in the form of strips. All of them are located on the long stalks, sometimes long and up to 10 or more inches, and they are imbued with parallel capillaries that branch off from the stalk to the top of the leaf. It was one of the characteristics of the last kind of *Ginkgo* (*biloba*). To describe Ginkgo's leaf it is very difficult. Firstly he's never identical. However, the number of (base) capillaries almost does not vary, and has approximately 120 capillaries per sheet. We can say that the capillary system from adult leaf of mature age coincides with the leafs who are not sexually mature. It should be noted that the capillary outer parts of the leaf blades from the edge of the branch, which means that it is not bound by the capillary system directly to the stem, but this system is gradually adjusted and capillaries are associated in most cases those who are closer to the petiole, or the middle leaf. Judging from this, the outer edge of the leaf blades take rate (partial) function of the central veins in which links connection string from the second row of capillaries. It can be easily seen that to the stem comes only 10-15% of capillary vessels around the leaf. In fact large role in this system has an outer edge of the leaf which, on average, with each side separately covers more than 100 veins, which merge into a sum of only about 5-10, or rarely more important diseases related to the stem, i.e. leaf configuration that is similar to the capillary system we do not have at any other species that *Ginkgo biloba* could relay.

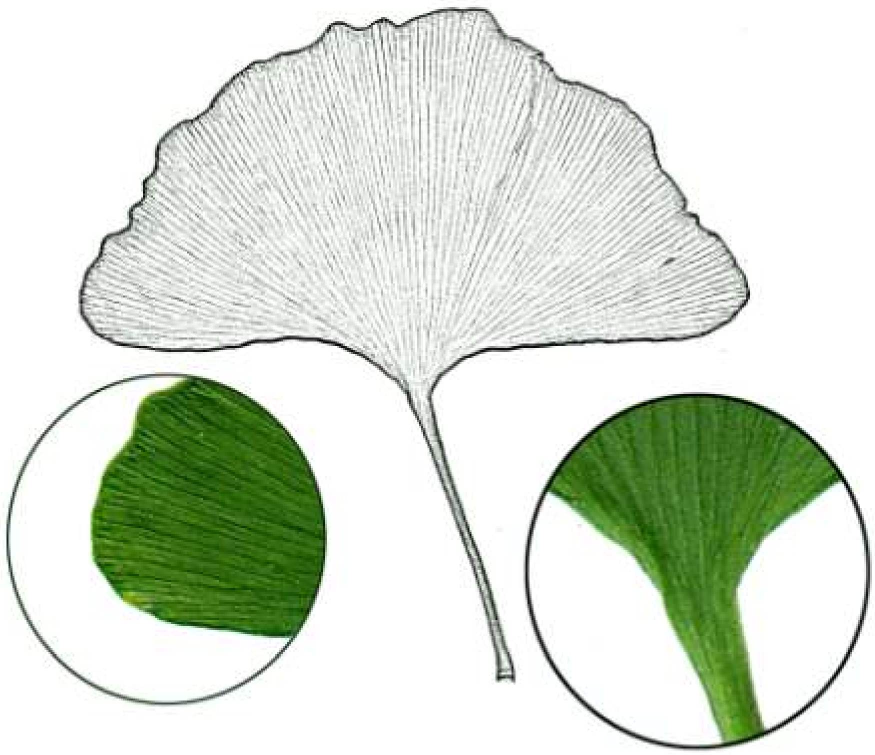
Let us also say that the younger plant is, its leaf will have more typical form, two lobes and is almost complete range of forms of contiguous edges - except for the gap. What leaf is older the more noticeable partition parts of the leaf are. But this is not the rule, because each leaf has its own genetically-formatted version divided mainly into two or more parts. The edges become wrinkled. Leaves are grouped in a tuft of 3-7 or more leaves.

Up: the famous Chi-chi growths. Photo by Kamatsuka, Japan.

Leaves in the Summer.



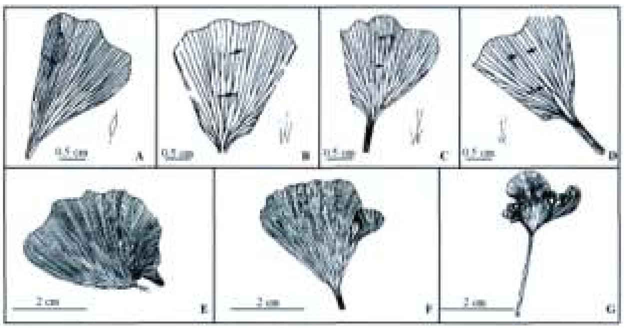
Basic anatomy of the Ginkgo leaf.



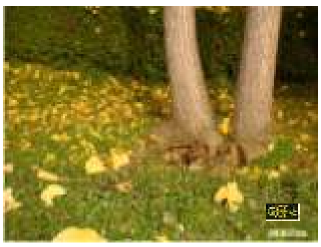
Explanation of plates: 1 - 6, The development of the ovule-like organ on the leaf (at date of 04 - 20, 04 - 27, 05 - 08, 05 - 18, 06 - 04, 09 - 23); 7 - 12, The development of the normal ovule (at date of 04 - 20, 04 - 27, 05 - 08, 05 - 18, 06 - 04, 09 - 23); 13 - 18, The variation of the leaf shape and leaf color in *Ginkgo biloba* (var. *epiphylla* Mak.); 19 - 23, The variation of the ovule-like organ on the leaf. (G)

Anomaly Ohatsuki comes from the Japanese language “oha-tsu”. Location of the tree: Lučenec, Slovakia. Photos by P. Hrubik-K. Ražná, Nitra, Slovakia.

Anastomoses of normal leaf (A, B, C, D) and the veins of leaf with ovule-like organ (E, F, G) of *Ginkgo biloba*. (G)



This photo by Josip Barišić, Croatia (2010).



The fallen leaves in Autumn.

Up: an unusual form leaf (typical species) in the form of bells. Photos by A. Novak, Croatia (2011).

This leaf is very similar leaf of cultivar *Ginkgo biloba* ‘Tubifolia’ (’Tubiforme’). See pages 276, 283 and 341.

Beautiful yellow colors in Autumn.

An unusual form leaf (typical species) in the form of bells, Japan. (70)

There are some indications by comparing the leaf and look at the tuft of leaves when it comes to determining the sex of male and female individuals.

As with any other plant species so the Ginkgo has various mutations. The most famous mutation, rather the phenomenon is called. Ohatsuki, where the leaf is developing both sexes, however, has not confirmed that the fetus develops in order to be capable of further propagation. Such leaves have a distinctive appearance and are a rare occurrence.

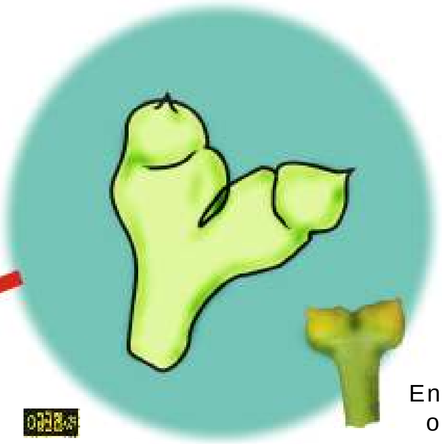
In the spring shoots are light green, and after the formation of leaf gets a fresh green color. In the Summer leaf has a bit darker green color, that begins to fade in early Autumn on this green and slowly, sometimes completely and sometimes in bands appears yellow. At the end leaf gets completely yellow. Let us say that the leaf which is picked in Summer and dried in the sun gets bright beige-golden-yellow color, but soon fades. Leaf picked from the end of July to September and dried in the shade at a higher temperature will remain green and will fade insignificantly. If the fresh leaf dries and saves in moisture it will start getting brownish color and after a longer time exposed to the moisture will begin the process of decay (despite the cold - up to about -5° C - if placed in a location). When the leaf turns yellow in the tree, it will remain on it sometimes (depending on surface temperature) and up to a month or even more. If the weather is warm, rainy and windy, then it will fall off sooner. If the weather is stabile and mild then it will stay on much longer. When the yellow leaf drop off he remains yellow up to a month, then he gets orange and then brown and blackish color (also depends on climatic conditions). Let us say that the top of the leaf is noticeably darker than the lower part. The form of the leaf reminds on the wild type *Adiantum capillus-veneris* (Maidenhair fern), so on this basis in the past numerous synonyms was created for the whole *Ginkgo biloba* plant.

5
Flowers: male and female

Flowers of both male and female plants primarily reflect with its specific visual beauty. Very rare plant species have such a beautiful, special, specific and extravagant flowers. To flourished all the plants must be at least 30-35 years old, which

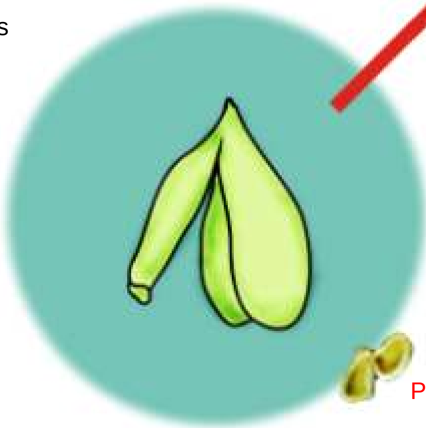
Male and female flowers species *Ginkgo biloba* L. 1771.
Especially: the Ginkgo flower not smell and taste.

Stalks of
paired
ovules



Enlarged
ovules

Microstrobilus
showing two
pollen sacs



Polliniferous
strobilus

depends on the microclimate where the plant grows and how it is grown. In male plants, flowers were placed individually. They are on top of lengthy axis and each of them has between two seven pollens. Women also have a single stem flowers on callosity pedicle which is relatively long. There are one to two seed embryo, wraped by the dome, and they are ngs. located on the side. The flowers of female plants emerge from foliar axil of leafe (ie mid-tuft), while seed embryo is standing upright and has a broad roundish one ingument. The embryo fertilizes with movable sperm, while pollination is done by the wind. It is assumed, but it is not proven, that some insects partly carry out pollination and perhaps birds (?). It is difficult to describe the appearance of flowers, but it is certainly supplemented by photographs and drawings.

The male flowers usually consist of five or more separate pollens and are located exclusively around the leaf shoots. Each looks similar to a blades of wheat, and when they are sexually mature, usually parallel with the formation of leaves, flowers open and sperm carried by the wind wandered from the first female specimens. The flowers are usually light green and even yellow in color, and usually they are deployed on top of the branches (or sideways). Before flowering grayish greenish buds appear from which beautiful flower will bloom. Flowering does not dependent on the age of the sprout. It does not matter whether the bud is on an one year old branch or on the tree itself. The same can be said for the female flowers on which during the blossom period formation of the fruits can be seen, usually by two to on one pedicle. Each of the flowers is placed on the wooden shoot in which bud was placed before blooming. Those flowers are almost yellow-greenish in color and how much fruit will be there depends on pollination - ovulation - ovum. In the most cases fertilized and mature becomes about 20% of the flowers, however, this number may well vary depending on local climatic conditions in particular years. During fertilization, plant rejects large amounts of unfertilized flowers, and until maturation of fruit rejections even enlarger during maturation process.

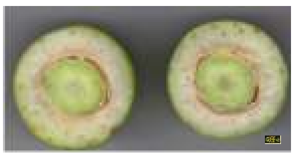
Aborted unfertilized female flowers (May, Hard. zone 7).

6
The fruit and seeds

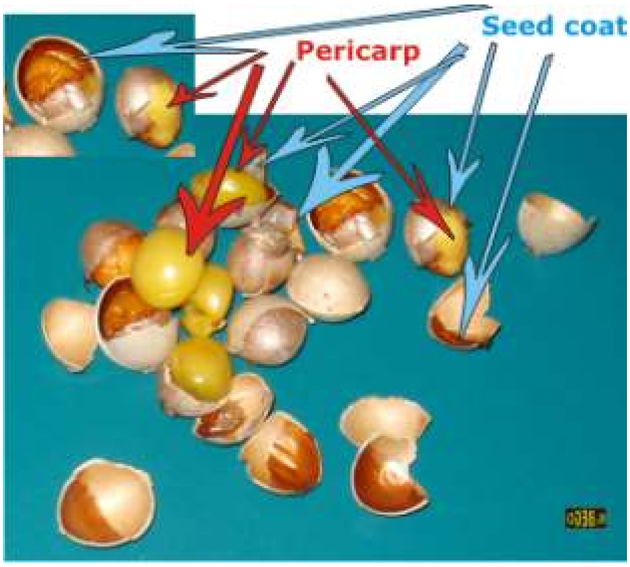
The fruit ripens in the fall from September to early November (HZone 7). It basically consists of three parts. It belongs to a group of false or apparent stone fruit. It is roundish and stone sized 2 to 3 cm. Matures in one year. The so-called. Arilus, the outer layer, is fleshy. Before maturation it is green in colour, then purple-green, purple, and finally bluish-yellow foggy color. The fruits fall off without and with the stalks, and this can happen until late in the winter. Depending on weather conditions all the seeds can fall off even within 2-3 days if the climate is favorable: hot, sunny and a long fall with enough moisture. The warmer the weather – the fruits will fall off sooner. When dried fruit is dark purple color and very hard. Fleshy part has a very unpleasant odor, however, immediately after the fall, almost overnight, a yellow fleshy part is eaten by voles or mice's, and probably some birds (fruit contains butanoic acid, so it has a flavor of the “adulterated butter" or “the smell of sewage” - as noticed by one botanist). Therefore, under the old mature female trees every 24 hours we can find a new and almost completely cleaned seeds (endocarp) from 1 to 1.5 centimeters long and white-yellowish in color (but this is not a rule). In about 1 kilogram goes around 600-1400 pure

Young female fruits (June-July, Hard. zone 7).

Down. Seed collected from street tree in Upland, California, either directly from the tree or recently dropped to the ground below. Photo by Curtis Clark, USA. (93)



Not mature and mature fruits Maidenhair tree or Ginkgo.



Amateur harvests Ginkgo seeds in the Rivington (USA - Photo by J. Schumacher), Europe and China (Photo by WordPress - Stevish Entries). (83, 84)

A comparison of the phenology of the sexual reproduction cycle of Ginkgo biloba growing in China versus middle Europe and USA. (117, 143)

Location	Pollination	Seed Abscission	Outdoor Germination
Asia, China, Guizhou 25° Nort. lat. HZone 9	mid-March to early April	mid-September	mid-March
Europe, Croatia & south Hungary 45-47° Nort. lat. HZ 7	late March to early April	early October	mid-May
USA, Massachusetts 42° Nort. lat. HZ 5/6	mid-May	late October to early November	mid- to late June

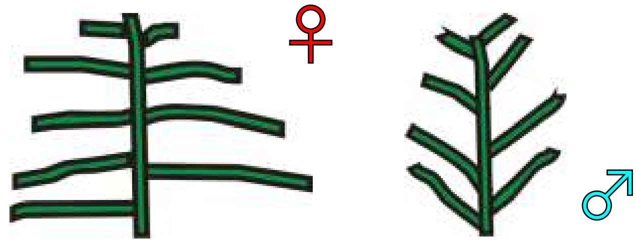
Gathering Ginkgo nuts, Washington Square Park - NYC, USA.
This photo is not required to post comments. Photo by Hubert Steed 2004. (82)

edible seeds, while in 1 kg goes 150-200 mature fruits. Weight of one seed is an average 0.8 to 1 gr., while the average fruit weight about 5-8 gr. The most beautiful plants we gets from the seeds, and this is the way we can make the selection for obtaining new cultivars. Fruit is one of the few “parts” of the Ginkgo plant that after pollination and fruit formation is being attack by insect or a worm (which one it has not been found?) who eats the green mass of the seeds and stems and so the green fruit fall off. But this does not happen in large quantities and fruit remains intact although useless. It should be noted that the raw ripe fruit (seed) is edible, however because of the is the presence of 4-Metho-xypyridoxina (which can destroy vitamin B6) in a certain extent it is toxic too especially for the children. It is therefore essential if you eat the seeds to destroy the toxicity by the temperature (cooking or baking) because 4-Metho-xypyridoxin is not thermostable. Ginkgo seeds have a reputation as poisonous seeds, especially for children which eaten larger amount of fresh semen. Poisoning is beeing manifested by vomiting, nausea, etc. The seed containes poisonous 4-O-Methylpyridoxine; inhibits glutamic acid decarboxylase and Prevents formation of gamma-aminobutyric acid (GABA). In China, Japan and surrounding countries fried ginkgo seed are beeing used as a cure for a hangover resulting in alcohol consumption.

We should mention that the mature dry seed in the East, but lately in the West is a special

Ginkgo biloba in Charleston. Charleston Library Society. Plant: males, 1923. Photo by Robert Salvo, USA. (2010)

delicacy although very expensive. We can say that from harvested ripe fruits (after you take out seeds) or the meaty part you can make the marc, which has about 12% to 16% sugar and which will ferment in warm weather like grapes. Although unpleasant in odor in a form of fresh fruit after the fermentation this odor is partially lost. There are evidence that in some areas of China they still produce medicinal wine from Ginkgo's fruit. We experimented to a result that after fermentation about 4-5% unfermented sugar left and alcohol content was 9 - 10 mg. In the East thus resulting



Characteristic: men's individual= branches grow very vertical and leaves was significantly thinner. Femal’s individual= inversely. (91)

liquor is beeing used for massage, while the juice from fresh fruit is being used as a natural insecticide. From the fruit of the East detergents are also being done and the seeds are being stored in a variety of traditional cosmetic creams.

Cleaned seed looks like almonds or pistachios. Taste of freshly cleaned seed is nearly neutral and after frying or baking takes on the taste of cooked young corn. Let us also add that the seeds can germinate and wait quite a few years. Specifically ginkgo has in this direction also developed a special controller he will germinate when optimal climate conditions are created.

7
Plant sex recognition

Ginkgo sexual gender until maturity is very difficult to determine. It is known that from the male tree leaves begin to decline almost a month earlier in relation to an female individual, however, it is difficult to notice needs to be continuously monitored. Falling leaves in the first year seedlings, which can grow during this one year (depending on seeding) and up to 25 or even 50 cm, can be by good, regular daily monitoring from around mid-October (depending on what was the weather during the year: dry, wet and etc.) in about 50% cases observed the differences in defoliation and thus select the male from female plants. The following year this selection is also about 50%, while according to some experiences in this way best determination of the sex of the plants can be made after the fifth year of life, that is, after the plants have already developed and are being placed for a separate breeding. Earlier the creation of carotenoids in male plants can be explained by the fact that female plant to feed the fruit to full maturity, therefore she needs a longer time of green vegetation that will nourish the tree. We can enumerate several ways in which we can determine the sex of plants, however, to determine the sex of individual younger plants you should have a great experience. (For HZone 7)

Among male trees branches are more horizontal in relation to the tree and have a less pronounced leaf lobes. Female trees have more branches located at a sharp angle in height and have a more pronounced lobes. But this does not have to be the rule.

Seed (kernel) has two or three longitudinal ridges or lines. It has been proven that those with two grooves (eg like plums) produce female plants, while those with three produce male plants. Three

ridged seeds are basically quite low. Up to 5% maximum.

It is noted that among male plants in the tuft has more leaves than in the female plants. Male plants almost always have 7-9 leaves and rarely less. In full vegetation tuft is mostly composed of 9 leaves. Female plants are often up to five leaves and rarely or never more than 7.

On male plants on the leaf has been observed decreased expression of narrow longitudinal thin stripes (capillaries) that (wider ones) are on the front side (face side) more impressed. In female plants it has been observed a stronger expression in lines and the leaf is more wavy and wider stripes are more prominent and on the reverse side impressed.

In most cases on the male plants the edges of the leaf are starting from the stalks a little more bended upwards (as seen from the face of the leaf), while at the female plant those edges are either quite straight or slightly bend down. If we leave leaf to dry in the shade facing the reverse face down this phenomenon will become increasingly visible. But even this is not an absolute rule!

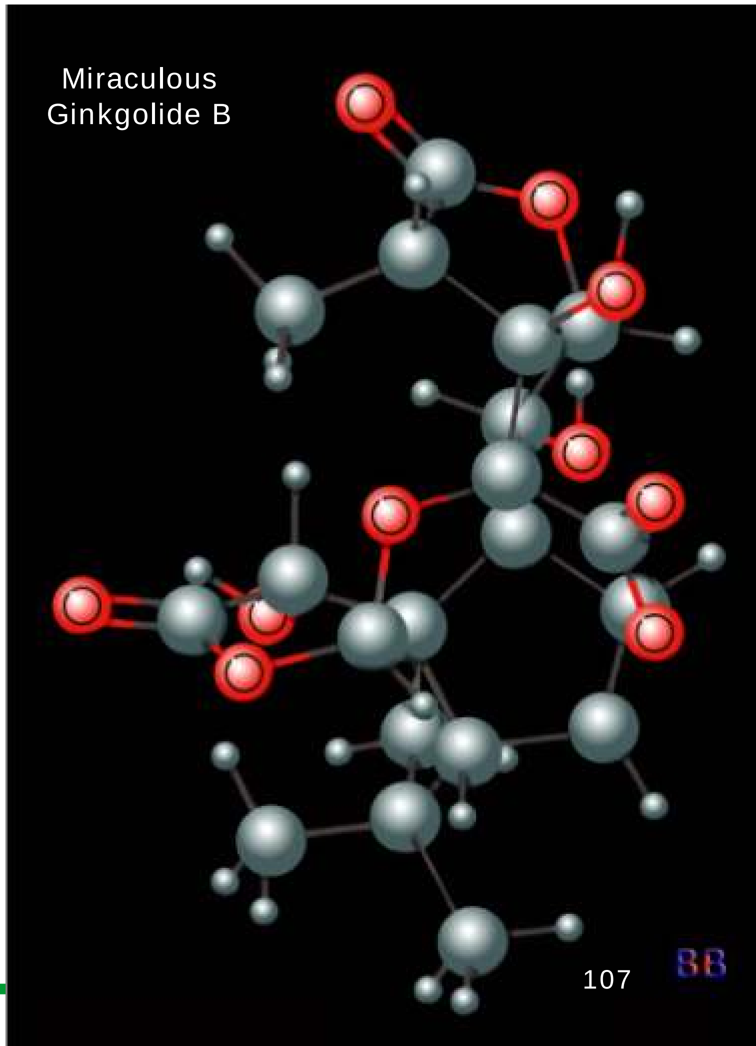
The edges of the leaves of the male plants in most cases are not very undulating while at the female plants they are noticeably wavy. However, it is also not absolutely rule!

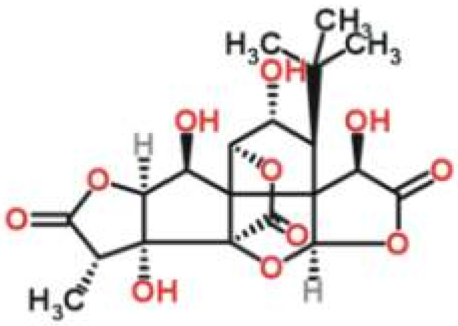
It should be noted that as older plants are mentioned differences are lower. These comparisons are made on samples of about 15 different plants in different age and in stage of mainly dense vegetation (May-August) on the typical species. Age of plants was from about 150 to 1-2 years of age.

To determine the sex of young or older plants taking into account all these (and other) elements the key role has experience and knowledge. But sometimes it is impossible to ascertain sex in any way until the maturity of the plant. So, if you want to get the specific gender of the plant you should use vegetative transplantation approach i.e. plant grafting.

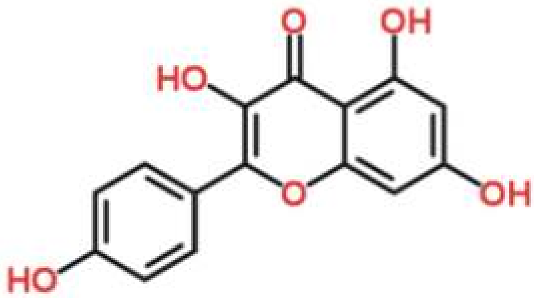
8
Chemical, microbiological and other characteristics of Ginkgo leaf, bark and seeds

Chemical tests of ingredients on Ginkgo's leaf, seeds, wood and bark for the purpose of efficiency, above all, in medicine, pharmacology, and other scientific purposes began in 1930-ies.





Ginkgolide B - $C_{20}H_{24}O_{10}$ (47, 48)



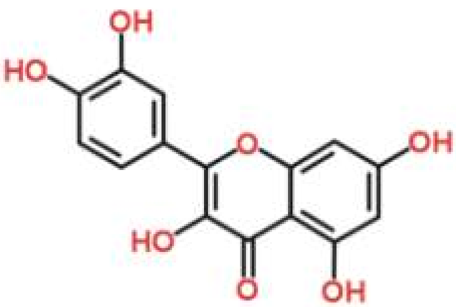
Kaempferol $C_{15}H_{10}O_{6}$ (47)
Isorhamnetin $C_{15}H_{12}O_{6}$ (47)

Ginkgo Biloba PE 24% / 6%

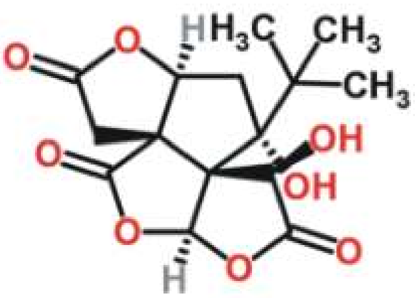
CERTIFICATE OF ANALYSIS

Synonym:	**Maidenhair Tree, Gymnospermous Tree**	
Quantity:	**100 grams (3.53 ounces)**	
Appearance:	White crystaline powder	
Raw Material:	Ginkgo biloba leaf	
CAS#:	90045-36-6	**Batch Qty:**
Batch Number:	20070220	750kg
Country of Origin:	China	
Manufacture Date:	2007-02-20	**Shelf Life:**
Expiration Date:	2010-02-20	3 years
Product Testing:	**Limits**	**Results**
Ginko Flavones:	> 24%	26.12%
Terpene Lactone:	> 6%	6.88%
Ginkgolides (A):	Assay results	2.81%
Ginkgolides (B):	Assay results	1.06%
Ginkgolides (C):	Assay results	0.82%
Ginkgolides (J):	Assay results	0.32%
Bilobalides:	Assay results	1.68%
Pesticides:	No detection	Conforms
Loss on drying:	< 3.0%	2.8%
Aflatoxins:	< 0.2ppb	Conforms
Extract solvents:	Ethanol & water	Conforms
Bulk Density:	0.500 ~ 0.600 g/cc	0.564g/cc
Storage conditions:	Tightly sealed, cool, dry, dark	

Example: certificate of analysis Ginkgo extract. (55)



Quercetin $C_{15}H_{10}O_{7}$ (47)
Bilobalide $C_{15}H_{18}O_{8}$ (47)



First isolation of chemical compounds from Ginkgo's leaf were made in 1965, when the prof. J. Fisel isolated quercetin, kaempferol and izoramnetin. Significant research were conducted from 1960-ies in the laboratory of "Dr. Willmar

Dry Ginkgo leaves.
Down: miraculous powder Ginkgo leaves for the Ginkgo extract (Gbe 761) - Ginkgo Biloba Extract - Made in China.

Schwabe" and 1989th the same German company, "Dr. W. Schwabe", has patented first extract derived from ginkgo's leaf. But that was after ten years of successfully producing the same.

According to numerous scientific papers Ginkgo has toxic only fruit specifically the seed, but only when being improperly used. Leaf has most medical agents and is mostly used in folk medicine, and has been accepted in the form of extract (GBE) by WHO as an alternative in the treatment of many diseases. It is known that the most valuable ingredients in Ginkgo are ginkgolides. What's in seeds, leaves, and elsewhere, at a glance, looks like this:

100 g. seeds (ZMB) contain 403 calories, 10.2 to 10.5% protein, 3.1 to 3.5% fat, 83.0% total carbohydrate, 1.3 g fiber, 3.1 to 3.8 g ash, 11mg Ca, 327 mg P, 2.6 mg Fe, 15.3 mg Na, 1139 mg K, 392 mg beta-carotene equivalent, 0.52 mg thiamine, 0.26 mg riboflavin, 6.1 mg niacin, and 54.5 mg ascorbic acid. Dry kernels (ca 59% of the seed weight) contain: 6% sucrose, 67.9% starch, 13.1% protein, 2.9% fat, 1.6% pentosans, 1% fiber, and 3,4% ash.

The globulin of the kernel, accounting for 60% of the total nitrogen, is rich in tryptophane. Fruit pulp, bitter and astringent, contains a volatile

Several ways of preparing Ginkgo seeds for eating. Up right: Ginkgo ice tea - for health, thirst and eyes. Left: roasted seeds. Down: This is dessert, yam paste with ginkgo nut and pumpkins. Photo by Janet Goh, Singapore.

oil and a number of fatty acid from formic to caprylic. Press-juice contains: ginnol ($C_{27}H_{36}O$), bilobol ($C_{21}H_{34}O_2$), ginkgol ($C_{24}H_{34}O$), ginkgic acid ($C_{24}H_{42}=2$), ginkgolic (hydroxy) acid ($C_{22}H_{34}=3$), ginkgolic (saturated oxy) acid ($C_{21}H_{32}O_3$), ginkgolic acid ($C_{24}H_{48}O_2$), an acid corresponding to the formula $C_{21}H_{42}O_3$), an acidic oil, asparagine, reducing sugars, and phosphoric acid.

Autumn leaves contain ginnol, sitosterol ($C_{27}H_{64}$), ipuranol ($C_{33}H_{56}O_6$), shikimic acid or shikimin ($C_7H_{10}O_5$), linolenic acid, acacetin, apigenin, and substances conforming to the formula $C_{11}H_{14}O_5$ and $C_{11}H_{14}O_6$. Fallen leaves of the plant contain a bright yeloow crystalline substance, ginkgetin ($C_{32}H_{22}O_{10}$). Leafy branches contain ceryl alcohol and sterols. Staminate flowers of Paris-grown trees contain 3.27 to 3.57% (ZMB) deoxyribonucleic acid. Male inflorescence may contain raffinose (up to 4% on fresh weight basis). Wood contains raffinose and xylan (2.5%). Bark contains tannin dissolved in a pectinous mucus.

Major chemical constituents in leaves are: Folium Ginkgo contains a wide variety of phytochemicals, including alkanes, lipids, sterols, benzenoids, carotenoids, phenylpropanoids, carbohydrates, flavonoids, and terpenoids (18, 19). The major constituents are flavonoids of which mono-, di-, and tri-glycosides and coumaric acid esters that are based on the flavonols kaempferol and quercetin dominate. Lesser

Ginkgo leaf motif on a plate of red clay. Photo by Zhou Xiaolin from www.youduo.com, China.

Ginkgo wood is great for manual processing. Up: pen to write of Ginkgo wood. (94)
Right: handmade furniture of Ginkgo wood, USA. Photos by Ginkgo Woodworks, USA. (56).
Down: Ginkgo leaf-shaped jewelry. Created by Lyn Stoll, USA.

"Ginkgo Through Time", Silver, Blue Moonstones (Left).

"Ginkgo Nature 2", Sterling Silver, Turquoise, Pearls (Right).

quantities of glycosides are derived from isorhamnetin, myricetin, and 3'-methylmyricetin. Nonglycosidic biflavonoids, catechins, and proanthocyanidins are also present (15). Characteristic constituents of this plant material are the unique diterpene lactones ginkgolides A, B, C, J, and M and the sesquiterpene lactone bilobalide (17). Representative structures of the major and characteristic constituents are presented below. (See D)

9
Ginkgo as a technical value

As for the technical value of *Ginkgo biloba* we mean the participation of the plant as a purely practical values in technical and industrial nature. Since the plant is in fact used totaly from leaf to tree.

Wood and bark: even though the whole plant is hardly flammable, such as birch wood, when dried it can be used for firewood and kindling and in the past in China and surrounding countries it has been used in that purposes. In addition wood has very high quality in hand and machine processing so on the East various ritual objects of local religions were made mostly of Ginkgo's wood. Although the Ginkgo tree is difficult to obtain and the plant itself is under the protection in the last decade we still have smaller companies throughout the West engaged in producing furniture exclusively from ginkgo's tree (tables, chairs, cabinets, etc.).

Ginkgo wood furniture - Ginkgo wood chair. Photo by Swankety Swank, USA. (56a)

Ginkgo leaf and fruit are very popular as a motif and theme in the various arts, especially painting. Because of its miraculous nature of Ginkgo was significantly involved in mythology, religion and legends of the East in particular. This should be more to say in a separate section.

Leaf: the most valuable part of this plant because it was used as a medicine (in the form of tea, small powder, compress, etc.) for many diseases before many millennia so he has entered into a number of ancestral legends and mythology of China. Its medicinal value is so significant that even the official medicine could not ignored it and has officially designated specifications for manufacture and use of Ginkgo's leaf extract. By cultivation of plants for the leaf picking for the production of Ginkgo's extract in the recent years significant profit is achieved by grower of plants for leaf picking, especially the pharmaceutical and cosmetic industries, which today produces countless medicines and preparations. In addition to esthetic value in horticulture his autumnal yellow color of the leaves is often left below the plants like a decorative carpet and sometimes it is being used it as mulch around other plants or as bedding for livestock. When rotens together with other plant material it is turned into compost and a fresh leaf is used in organic gardening as a insecticide such as other known plant *Urtica dioica* (Nettle).

The fruit-seed in the distant past in China, Japan, Korea, Mongolia, boiled, fried or was an alternative to the survival of poor people. In addition fleshy part of fresh fruit is also used as an insecticide and in some cases a variety of medications for humans and animals are being made. The seeds also have medicinal properties although the over-consumption is harmful. In addition from fruits and seeds a variety of drinks are being made. For example, various energy

Bowl of Ginkgo wood. Photo by www.hobbithouseinc.com. (37)

drinks, a type of whiskey, a type of wine and juices. Today China produce most Ginkgo's seeds which is already the largest exporter of fresh cooked or cleaned or vacuumed cleaned or uncleaned seeds, while botanists have succeeded in cultivating a few specific cultivars that produce large quantities of seeds and rode quickly even after about 10 years of age or even earlier.

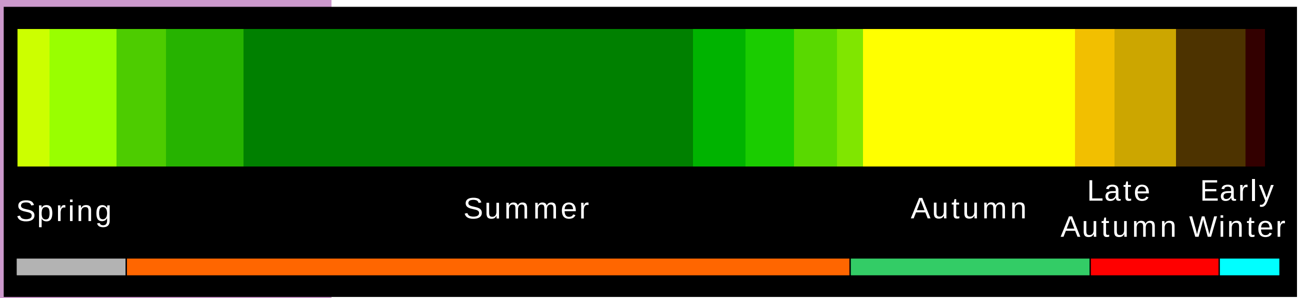
Valorization

Ginkgo biloba is a plant with very specific look or specific morphological features. Ginkgo has specific everything, every part of the plant: leaf, fruit, seeds, flowers, tree, wood, roots, etc. Since it preserved features that has had many millions of years ago plant has developed so that it can quickly adapt and survive specific living conditions which would be fatal foe many other plant species.

Ginkgo produces special chemical compounds that have been in a long use through centuries as a human medicine.

Having specific appearance mostly characterized by the most fan-shaped green in summer and completely yellow leaf in fall he is highly valued horticultural plant species in recent decades especially in the West. In China, Japan and in that part of the world of Ginkgo is known for millennia.

As ginkgo plant has almost every part as medical agent or has other purpose in the last few decades the plant is significantly grown in plantations around the world primarily for the use of dried leaf that contains many useful ingredients for the human body.



The approximate range of Ginkgo leaves change color throughout the year.

A new branch growing on the old trunk.

A) Elwes, J. H. & Henry, A., 1906, The Trees of Great Britain & Ireland, Vol 1. Edinburgh. (p. 55-62).

GINKGO

Ginkgo, Linnaeus, *Mantissa*, ii. 313 (1771); Bentham et Hooker, G*en. Pl.* iii. 432, 1225 (1880); Masters, *Jour. Linn. Soc. (Bot.)*, xxx. 3 (1893). *Salisburia*, Smith, *Trans. Linn. Soc.* iii. 330 (1797).

TREES, several extinct and one living species, bearing fan-shaped, fork-veined leaves on both long and short shoots. Flowers dioecious, arising from the apex of short shoots, which bear at the same time ordinary leaves. Male flowers: catkins, 3-6 on one shoot, each being a pendulous axis bearing numerous stamens loosely arranged. Stamen a short stalk ending in a knob, beneath which are 2-4 divergent anthers, dehiscing longitudinally. Female flowers, 1-3, more or less erect on the shoot, each consisting of a long stalk, which bears an ovule on either side below the apex. The ovule is sessile, straight, surrounded at its base by an aril or collar-like rim (1), and naked (*i.e. n*ot enclosed in an ovary). Fruit: a drupe-like seed (sessile in the small bowl-shaped little developed aril) consisting of an orange fleshy covering enveloping a woody shell, within which, embedded in the albumen, lies an embryo with 2-3 cotyledons. The albumen is covered by a thin membrane which is only adherent to the woody shell in its lower part. Two embryos often occur in i seed, and of the 2 ovules only one is generally developed into a seed.

Ginkgo was formerly considered to belong to the Coniferse, but recent investigations show that it is distinct from these, and is the type of a Natural order Ginkgoaceae, which has affinities with Cycads and ferns. The seeds resemble closely those of Cycads, and at the end of the pollen tube are formed two ciliated antherozoids which are morphologically identical with the antherozoids occurring in ferns. Ginkgo, however, is a true flowering plant, as it produces seeds, and is a gymnosperm, since it bears ovules which are not enclosed in an ovary. The extinct species have been found in the Jurassic and succeeding epochs. Gardner (2) considers the specimens which have been found in the white clay at Ardtun in the Isle of Mull to be specifically identical with *Ginkgo biloba.*

1) Considered now to be a reduced carpel. 2) J. S. Gardner, *British Eocene Flora* (1886), ii. 100.

GINKGO BILOBA, MAIDENHAIR TREE

Ginkgo biloba, Linnaeus, *Mantissa,* ii. 313 (1771); Kent in *Veitch's Man. Coniferae,* 2nd ed. 107 (1900); Seward and Gowan, *Ann. Bot. x*iv. 109 (1900).
Salisburia adiantifolia, Smith, *Trans. Linn. Soc.* iii. 330 (1797); Loudon, *Arb. et Frut. Brit.* iv. 2094 (1838).

The Ginkgo when young is pyramidal in habit, with slender, upright branches: older, it becomes much more spreading and broader in the crown. It attains a height of 100 feet and upwards, with a girth of stem of about 30 feet. Bark: grey, somewhat rough, becoming fissured when old.

Leaves : deciduous, scattered on the long shoots, crowded at the apex of the short shoots, which grow slowly from year to year, their older portions being covered with the leaf-scars of former years. The short shoot may, after several years, elongate into a long shoot bearing scattered leaves. The leaves are stalked, and unique in shape amongst trees, recalling on a large scale the pinna of an adiantum fern; they show much variation in size (2-8 inches in breadth) and in margin, but generally are bilobed and irregularly crenate or cut in their upper part. There is no midrib, and the veins, repeatedly forking, are not connected by any cross veinlets. The stomata are scattered on the lower surface. In the bud the leaves are folded together and not rolled up, as in the crozier-like vernation of ferns.
Flowers and fruit: see description of the genus. The drupe-like seeds have a fleshy outer covering of a bright orange colour when ripe, and when they fall upon the ground, this bursts and emits an odour of butyric acid which is very disagreeable. (1) They are imperfectly developed as they fall, though apparently ripe; and the fertilisation of the ovule and the subsequent development of the embryo occur while they are lying on the ground during winter. The kernels are edible, being known to the Chineseas *pai-kuo* (white fruits), and are sold in most market towns of China. They are supposed to promote digestion and diminish the effects of wine-drinking; and are eaten roasted at feasts and weddings, the shells being dyed red.
Fruit-bearing trees are now common in Southern Europe; but no fruit, so far as we know, has ever been produced in England. The well-known tree at Kew is a male, and produces flowers freely in exceptional years, *e.g.* in 1894, supposed to be due to the fact that the preceding summer was remarkably warm, with continual sunshine.
Extraordinary cases of abnormal formation of fruit have been observed in Japan. Shirai (2) described and figured in 1891 fruit which was produced on the surface of ordinary leaves of the tree. Fujii has studied since then the various stages of the development of ovules and of pollen sacs upon leaves. The so-called aril of the fruit is considered by him to represent a carpel, as he has observed transitional stages between the ordinarily shaped aril and a leafy blade bearing ovules.

1) "The pulp surrounding the seed has a most abominable odour. Although warned not to touch it, I gathered the seeds with my own hands; but it took me two days' washing to get the odour off." (W. Falconer in *Garden*, 1890, xxxviii. 602.)
2) Shirai, in *Tokyo Bot. Mag.* 1891, p. 342.

Jacquin (1) grafted on the male tree at Vienna, when it was quite small, a bud of the female tree, from which a branch developed. This tree is now of large size; and numerous branches regularly bear male flowers, whilst one branch, now very stout, bears female flowers. This female branch puts forth its foliage about fourteen days later than the male branches, and retains them much later in autumn. In this case the shoot retains its individual characters, and the stock does not affect it even in regard to its annual development.

Seedling.—The germination in Ginkgo is not unlike that of the oak. We are indebted to Mr. Lyon (2) of Minneapolis for figures of the seedling, which are repro duced on Plate 15 C, D. When the seeds are sown the hard shell is cracked at its micropylar end by the swelling of the embryo within. Through this opening the body of the embryo is thrust out by the elongation of the cotyledons, which remain attached to the caulicle by two arching petioles ; between these the plumule or young stem ascends, while the root turns down into the soil. The cotyledons remain attached throughout the first season's growth. The first two or three leaves directly above the cotyledons remain small and scale-like. After reaching 4 or 5 inches in height the stem stops growing, having expanded into a rather close crown of ordinary leaves at its apex, which ends in a large terminal bud. The root attains in the first season about the same length as the stem, and develops numerous lateral fibres. This primary root, as is usually the case in Gymnosperms, persists as the tap-root of the plant.

Sexes.—Certain differences, besides those of the flowers, are observable in male and female trees. (3) The male trees are pyramidal and upright in habit, the ascending branches being of free and vigorous growth. The female trees are closer and more compact in habit, more richly branched below, and the branches sometime become even pendent. (4)

Monsieur L. Henry (5) states that in Paris the leaves of the female Ginkgo fell three or four weeks later than those of the male. Generally male trees are completely denuded of foliage by the beginning of November, while the female trees retain their leaves till the end of November or the beginning of December.

Burrs.—In Japan there often develops on old Ginkgo trees peculiar burrs, which are called *chi-chi* or nipples. These may be observed in an incipient stage on the large tree at Kew. They occur on the lower side of the larger branches of the tree, and vary in size from a few inches in length to 6 feet long by i foot in diameter. They occur singly or in clusters, and are enerally elongated, conical in shape, with a rounded tip. If they reach the ground, as is sometimes the case, they take root, and then bear leaves. They are due to the abnormal development of dormant or adventitious buds. A description of this curious phenomenon and a photograph of a tree bearing a large number of these growths is given by Fujii in *Tokyo Bot. Mag.* 1895, P-444- We are indebted to Mrs. Archibald Little for a photograph taken by her in Western China, of a tree 19 ½ feet round the base, and larger above, which very well shows these excrescences (Plate 23).

1) Kerner, *Nat. Hist. of Plants* (Eng. trans.) ii. 572.
2) See Lyon's paper in *Minnesota Botanical Studies*, 1904, p. 275.
3) Sargent denies this, and says it is impossible to distinguish the sexes till the trees flower; but observations on the Continent go to show that the sexual differences pointed out above really exist. See Sargent, *Garden and Forest*, 1890, p. 549.
4) See Schneider, D*endrologische Winterstudien*, 127 (1903), and Max Leichtlin in *Woods and Forests*, Jan. 16, 1884.
5) *Bull. de l'Assoc. des ane. èlév. de l'école d'Hort. de Versailles*, 1898, p. 597, quoted in *Card. Chron*. 1899, xxv. 201.

IDENTIFICATION

In summer the leaves are unmistakable. In winter the long and short shoots should be examined. The long shoot of one year's growth is round, smooth, brownish, and shining, the terminal buds being larger than the scattered lateral buds, which come off at a wide angle. The buds are conical, and composed of several imbricated brown dotted scales. The leaf-scars show 2 *small cicatrices, a*nd are *fringed above with white pubescence. T* he short shoots are spurs of varying length, up to an inch or more, stout, ringed, and bearing at their apex a bud surrounded by several double-dotted leaf-scars. In Pseudolarix and the larches, which have somewhat similar spurs, the leaf-scars are much smaller, and show on their surface only one tiny cicatrice. In Taxodium there are no spurs, and the scars which are left where the t*wigs h*ave fallen off show only one central cicatrice.

VARIETIES

The following forms are known in cultivation:
Var. *variegata. L*eaves blotched and streaked with pale yellow.
Var. *pendula. B*ranches more or less pendulous.
Var. *macrophylla laciniata. L*eaves much larger than in the ordinary form, 8 inches or more in width, and divided into 3 to 5 lobes, which are themselves subdivided.
Var. *triloba. S*carce worthy of recognition, as the leaves in all Ginkgo trees are exceedingly variable in lobing.
Var. *fastigiata. C*olumnar in shape, the branches being directed almost vertically upwards. (1)

DISTRIBUTION AND HISTORY

The wild habitat of *Ginkgo biloba, t*he only species now living, is not known for certain. The late Mrs. Bishop, in a letter to the *Standard, A*ug. 17, 1899, reported that she had observed it growing wild in Japan, in the great forest north ward from Lebungé on Volcano Bay in Yezo, and also in the country at the sources of the great Gold and Min rivers in Western China. However, all scientific travellers in Japan and the leading Japanese botanists and foresters deny its being indigenous in any part of Japan; and botanical collectors have not observed it truly wild in China. Consul - General Hosie (2) says it is common in Szechuan, especially in the hills bounding the upper waters of the river Min; but he does not explicitly assert that it is wild there. Its native habitat has yet to be discovered; and I would suggest the provinces of Hunan, Chekiang, and Anhwei in China as likely to contain it in their as yet unexplored mountain forests.

1) See *Garden*, 1890, x**xxviii. 6**02. An interesting article by W. Falconer, who gives some curious details concerning the Ginkgo tree in the United States.
2) *Parliamentary Papers, China*, No. 5, 1904; *Consul- General Hosie's Report,* 18. Mr. E. H. Wilson in all his explorations of Western China never saw any but cultivated trees.

The earliest mention of the tree in Chinese literature occurs in the *Chung Shu Shu, a* work on agriculture, which dates from the 8th century, A.D. The author of the great Chinese herbal (*Pen-Tsao-Kang-Mu, 1*578 A.D.) does not cite any previous writers, but mentions that it occurs in Kiangnan (the territory south of the Yangtse), and is called *Ya-chio-tze, "d*uck's foot," on account of the shape of the leaves. At the beginning of the Sung dynasty (1000 A.D.), the fruit was taken as tribute, and was then called *Yin-hsing,"s*ilver apricot," from its resemblance to a small apricot with a white kernel. In the *Chih-Wu-Ming, x*xxi. 27, there is a good figure of the foliage and fruit; and the statement is made that in order to obtain fruit the tree should be planted on the sides of ponds.

At present it occurs planted in the vicinity of temples in China, Japan, and Corea. It has always been the custom of the Chinese to preserve portions of the natural forest around their temples; and in this way many indigenous species have been preserved that otherwise would have perished with the spread of agriculture and the destruction of the forests for firewood and timber, in all districts traversed by waterways. Most of the curious conifers in China and Japan have a very limited distribution, and Ginkgo is probably no exception ; though it is possible that it may still exist in the region indicated above.

I have never seen any remarkable specimens in China; but Bunge (1) says that he saw one at Peking, of prodigious height and 40 feet in circumference.

In Japan Elwes says that it is planted occasionally in temple courts, gardens, and parks. He did not see any very large specimen of the tree, the best being one in the court of the Nishi Hongagi temple at Kioto, which was of no great height, but had a bole about 15 feet in girth at 3 feet, where it divided into many widespreading branches which covered an area of 90 paces in circumference. This tree had green leaves and buds on the old wood of the trunk close to the ground, which he did not notice in other places. Rein (2) says that the largest he knew of is at the temple of Kozenji near Tokyo, and this in 1884 was 7.55 metres in girth, and according to Lehman about 32 metres high. There is also one in the Shiba park, which in 1874 was 6.30 metres in girth. The tree is sometimes grown in a dwarf state in pots, but does not seem to be a favourite in Japan. The wood is somewhat like that of maple in grain, of a yellowish colour, fine grained, but not especially valued, though it is used for making chess boards and chessmen, chopping blocks, and as a groundwork for lacquer ware. The nuts are sometimes eaten boiled or roasted, but are not much thought of.

Ginkgo was first made known to Europeans by Kaempfer, (3) who discovered it in Japan in 1690, and published in 1712 a description with a good figure of the foliage and fruit. Pallas (4) visited the market town of Mai-mai-cheng, opposite Kiachta, in 1772, and saw there Ginkgo fruit for sale which had been brought from Peking.

1) Bunge, in *Bull. Soc. d'Agric. du Depart. de l'Herault,* 1833.
2) Rein, *Industries of Japan. 3)* Kaempfer, *Amaenitates Exotica,* 811.
4) Pallas, *Reisen durch versch. Provinzen des Russischen Reiches*, 1768-1773, vol. iii.

Fortune (1) mentions that the tree grows to a very large size in the Shanghai district, and in the northern part of the Chekiang province. The Japanese name Ginkgo is their pronunciation of the Chinese *yin-kuo*, "silver fruit "; but the common name in Japan is i-*cho.*

INTRODUCTION

The tree was introduced into Europe about 1730, being first planted in the Botanic Garden at Utrecht. Jacquin brought it into the Botanic Garden at Vienna sometime after 1768. It was introduced into England about 1754; and into the Unites States in 1784, by W. Hamilton, who planted it in his garden at Woodlawn, near Philadelphia. It first flowered in Europe at Kew in 1795. Female flowers were first noticed by De Candolle in 1814 on a tree at Bourdigny near Geneva. Scions of this tree were grafted on a male tree in the Botanic Garden of Montpellier; and perfect fruit was produced by it for the first time in Europe in 1835.

CULTIVATION

Ginkgo is easily raised from seeds, which retain their vitality for some months. Female plants may be obtained by grafting. It is easily transplanted, even when of a large size. Trees of over 40 feet high have been successfully moved. It thrives in deep, well-drained, rich soil. It is useful for planting in towns, as it is free from the attacks of insects and fungi; and the hard leathery leaves resist the smoke of cities. It may also be freely pruned. It is of course best propagated by seed; but layers and cuttings may be employed in certain cases. Falconer (*loc. cit.) s*ays that it is not readily propagated by cuttings, and that it took two years to root a cutting in the gardens at Glen Core (U.S.A.). Pyramidal forms can be obtained by careful selection, and the broad-leaved variety by careful grafting. The Ginkgo is well adapted for cultivation in tubs or vases, and may then be trained either as a pyramid or a bush.

The tree has a formal appearance when young, and is not really beautiful till it attains a fair age. The peculiar form of the leaves renders it a striking object. The foliage, just before it falls in autumn, turns a bright yellow (2) *c*olour, which makes it very effective in that season, but only for a few days, as the defoliation is very rapid.

1) See Fortune, *Wanderings in China*, US, 251; *Residence among the Chinese*, 140, 348, 363; *Yedo and Peking*, 59.
2) There is no trace of red in the autumnal tint, as is usual in other trees in their leaves before they fall. The tint in Ginkgo depends entirely on the yellow coloration of the disorganised chlorophyll corpuscles, and forms a beautiful object for the microscope.

REMARKABLE TREES

Ginkgo is perfectly hardy in England, and, as a lawn tree, is seen to great advantage. Many trees of considerable size occur in different parts of the country. The best known one is that at Kew, of which a photograph is given (Plate 21). In 1888 it was (measured by Mr. Nicholson) 56 feet in height, with a girth of 9 feet at a yard from the ground. It has a double stem, and in 1904 had increased to 62 feet high by 10 feet 4 inches in girth. Other remarkable trees near London (1) *a*re : One at Chiswick House, which measured in 1889, 57 feet by 6 - feet, and in 1903, 62 feet by 6 feet n inches; and another at Cutbush's Nursery, Highgate, which was in 1903 56 feet high by 4 ½ - feet in girth. Ginkgo trees may be seen in the following places in London: Victoria Park, Telegraph Hill, Lincoln's Inn Fields, Waterlow Park, Southwark Park.

At Grove Park, Herts, a tree measured in 1904 68 feet high by 8 feet 5 inches in girth.

At Bank House, Wisbech, the residence of Alexander Peckover, Esq., there is a tree which was 65 feet high and 7 feet in girth in 1904.

There is a very fine tree (2) at Frogmore, Windsor, which in 1904 measured 74 feet by 9 feet 3 inches, but divides into four stems (Plate 22).

At Barton, Suffolk, a tree planted in 1825 measured in 1904 50 feet by 2 feet 5 inches.

At Sherborne, Dorset, a tree 70 feet by 7 feet 7 inches in 1884.

At Melbury, Dorchester, the tallest tree in England is said to occur, being stated to be over 80 feet in height. (3) The tree at Panshanger (3) is reported to be 70 feet high by 10 feet at i foot above the ground. At Longleat (3) there is a tree 71 feet by 9 ½ feet girth at i foot above the soil.

At Cobham Park, Kent, a tree 68 feet by 9 feet 4 inches.

At Badminton, Gloucestershire, a pair of symmetrical trees each about 50 feet by 5 feet.

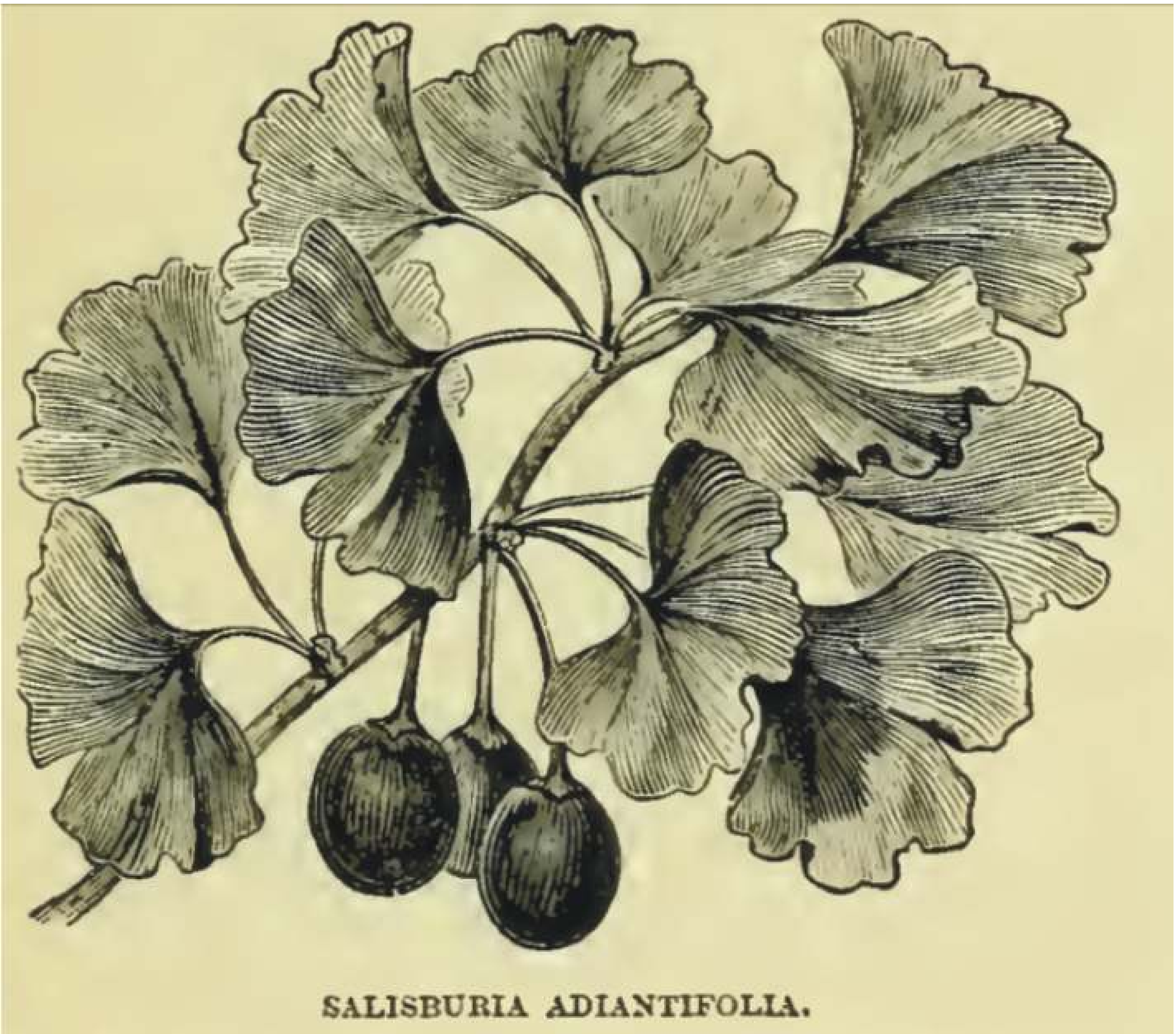
At Blaize Castle, near Bristol, there is a good tree, of which Lord Ducie has kindly sent a photograph and a letter from Miss Harford,

dated December 1903, which states: "The Salisburia is, I am glad to say, in perfect condition, and a very fine graceful tree. Its height, measured last summer, was 72 feet. I have always heard that the one at Kew (which is not nearly so well grown) and the one in the Bishop's garden at Wells came over from Japan in the same ship as our tree." (4)
In Wales the finest tree that we know of is at Margam Park, Glamorganshire, the residence of Miss Talbot, which in 1904 was about 70 feet high and 6 feet in girth. We have not heard of any fine specimens in Scotland or Ireland.
A curious form of the Ginkgo tree is reported (5) to occur at Cookham Grove, Berkshire. This tree grows within 10 feet of the river wall, which surrounds the lawn, and when there is high water the roots are under water for several days at a time. The bole is only 2 feet in height, but measures 4 ½ feet in girth ; at that point it breaks into many branches, some going upright to a distance of over 30 feet, while others grow almost horizontally, the spread of the branches being 45 feet.
1) The well-known trees in the Chelsea Botanic Garden and in High Street, Brentford, are now mere wrecks.
2) Figured in *Garden,* 1904, Ixvi. 344. 3) *Flora and Sylva,* ii. (1904), p. 357.
4) Elwes has since seen and measured this tree, which he made to be 68 feet by 9 feet 3 inches, with a bole about 12 feet high. 5) *Card. Chron.* 1886, xxv. 53.

Much finer trees occur on the Continent than those in England ; and it is evident that while the tree is healthy and hardy in this country, it requires hotter summers and colder winters to attain its best development and ripen fruit. A fine pair, male and female, stand in the old Botanic Garden of Geneva, where they were planted in 1815. They were measured by Elwes in 1905, when the male tree was 86 feet by 4 feet 10 inches, with a straight upright habit, the female, which bears good seed, was considerably smaller. A famous specimen in the garden adjoining the palace of the Grand Duke of Baden at Carlsruhe measured, in 1884, 84 feet, with a diameter of 25 inches at 3 feet from the ground. Beissner (1) says trees occur in this garden of 25 ½ and 30 metres high, with stem diameters of 1.90 and 1.80 metres. The finest tree in Europe is probably one mentioned by Beissner, (1) which stands in the Botanic Garden at Milan, and measures 40 metres high and 1.20 metre in diameter. There is also a noble specimen in the gardens of the Villa Carlotta on Lake Como. (A. H.)
1) Beissner, *Nadelholzkunde,* 1891, pp. 191, 192. One of the trees at Carlsruhe is figured in *Gartemuelt,* iv. 44, p. 520.

PLATE 22.
MAIDENHAIR TREE AT FROGMORE

PLATE 23.
MAIDENHAIR TREE IN CHINA



Henderson, P., 1910. Handbook of Plants and genera Horticulture, New York (p. 387).

B) SUN Xia, LI Shi-mei, XING Shi-yan et al., 2009. Observation on Ultra structure of Sclerotesta and Endotesta from Normal Seeds and Epiphyllous Seeds of *Ginkgo biloba* var. *epiphylla* Mak. (p. 1-9) Choice quote. (College of Forestry, Shandong Agriculture University, Tai'an Shandong)

Abstract: The comparative ultrastructure of sclerotesta and endotesta of *Ginkgo biloba* var. *epiphylla* Mak. was studied, which involved both normal seeds and epiphyllous seeds from 6 individuals of *Ginkgo biloba* var. *epiphylla* The research showed that normal seeds in 6 individuals consist of tracheid with bordered pit. However, difference was noticed between epiphyllous seeds. There were two types of tracheid, i.e. tracheid with bordered pit and spiral tracheid in the sclerotesta of *Ginkgo biloba* var. *epiphylla* in Zhinüdong, Zhongzhuang, Jinan, Taian, but there was only tracheid with bordered pit in sclerotesta in both normal seeds and epiphyllous seeds of *Ginkgo biloba* var. *epiphylla* in Youfang and Baiyu. In respect to tracheid length and tracheid diameter, greater variation was observed in epiphyllous seeds than that of normal seed. In addition, difference was also observed in endotesta. Based on the research, tracheid evolution and systematic significance of *Ginkgo biloba* var. *epiphylla* was discussed.

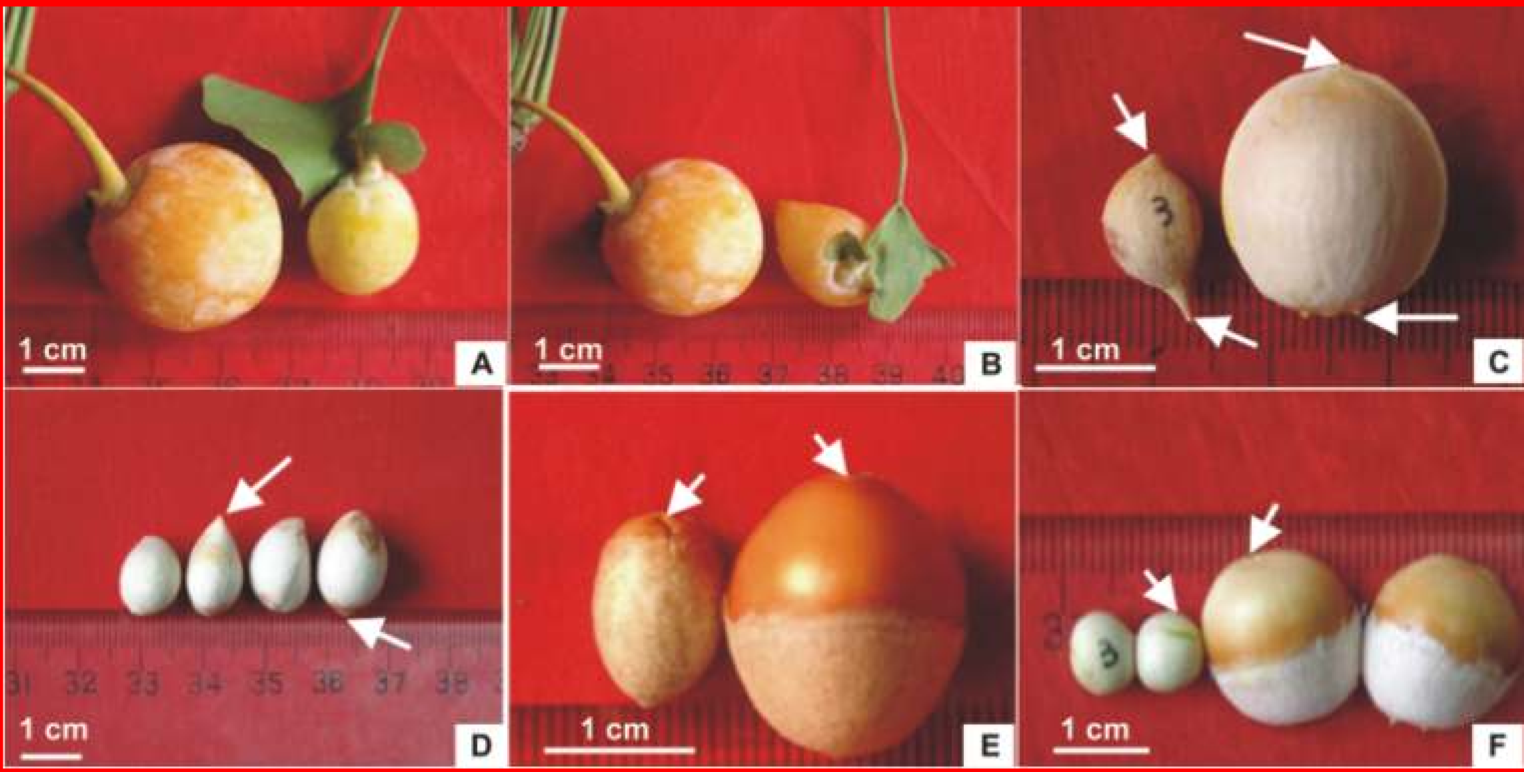


Fig.1 The morphological characteristics of normal seed and epiphyllous seed of *Ginkgo biloba* var. *epiphylla* Mak. in Zhinüdong

A. Normal seed(left) and epiphyllous seed (right), epiphyllous seed is spherical; B. Normal seed (left) and epiphyllous seed (right), epiphyllous seed is abnormal; C. Normal seed(right) and epiphyllous seed (left), epiphyllous seed has protuberant jut, and epiphyllous seed has one vascular bundle trace at chalazal end, while normal seed has two vascular bundles at chalazal end; D. Morphological variation of seed kernel; E. Seed kernel of normal seed (right) and epiphyllous seed(left), the white membrane cover majority of the epiphyllous seed; F. Seed kernel of normal seed (right two) and epiphyllous seed kernel (left two), the white membrane cover the whole kernel. ME: Micropylar end CE: Chalazal end Vbt: Vascular bundle trace.

Explanation of plates: 1. Tracheid with bordered pit in sclerotesta of normal seed; 2. Tracheid with bordered pit and spiral tracheid in sclerotesta of epiphyllous seed (YZ1, ZZ, JN, TA); 3. Tracheid with bordered pit in sclerotesta of epiphyllous seed (YZ1, ZZ, JN, TA); 4. Tracheid with bordered pit in sclerotesta of epiphyllous seed (YF, BY); 5 - 6. Spiral tracheid in sclerotesta of ep iphyllous seed (YZ1, ZZ, JN, TA); 7. Endotesta of normal seed; 8. Endotesta covered with thick wax of epiphyllous seed; 9. Endotesta constituted by fiber of epiphyllous seed. BP: bordered pit; W: Wax; B: Burl; ST: spiral tracheid; TBP: Tracheid with bordered pit; F: Fiber.

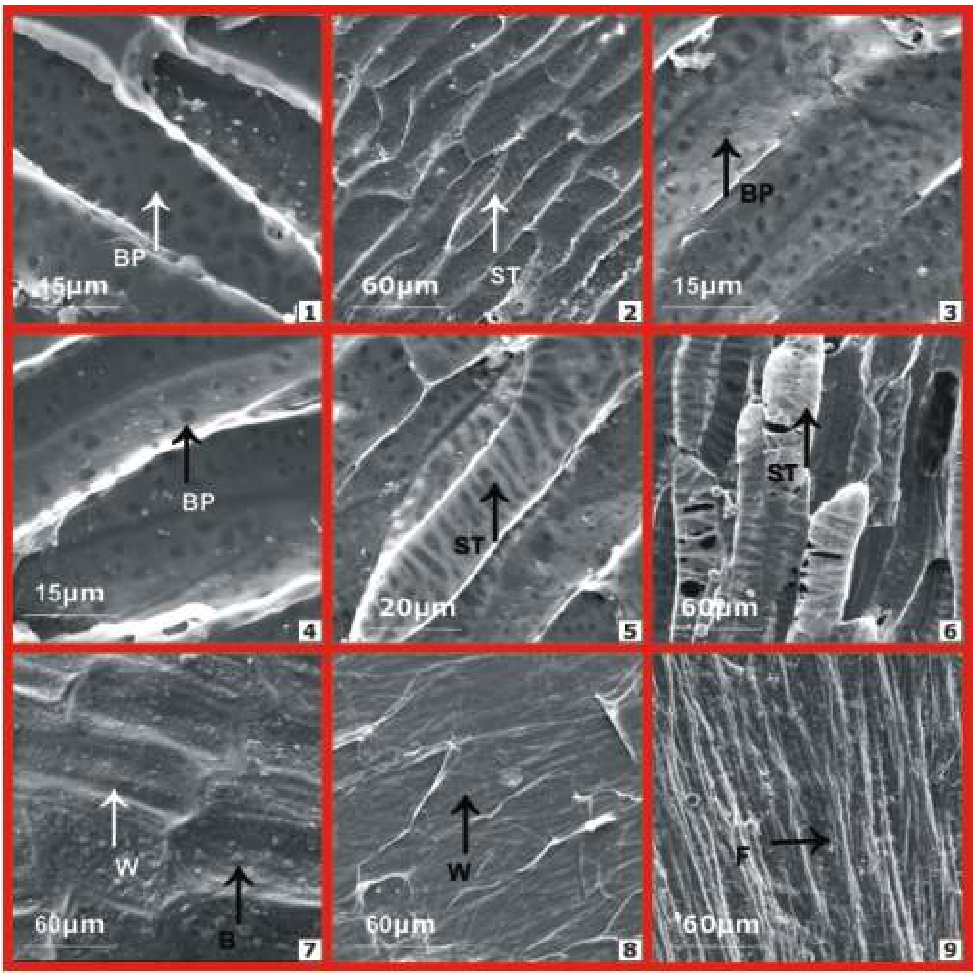


表 1　供试叶籽银杏植株的树址及其相关测定

Table 1　Location and relative measurement of *Ginkgo biloba* var. *epiphylla* MAK.

编号 NO.	来源 Location	树高 Height(m)	胸径 DBH(cm)	冠幅 Crown size(m)	树龄 Tree age(a)
YZ1	沂源县织女洞林场 Yiyuan Zhinfidong State-owned Forest Farm	25	102.2	20.5×16.3	800
BY	沂源县燕崖乡白峪村 Baiyu Village，Yanya Town，Yiyuan County	21.5	164	31×28	800
ZZ	沂源县仲庄镇仲庄村 Zhongzhuang Village，Zhongzhuang Town，Yiyuan County	15	114	20×22	700
YF	沂源县仲庄镇仲庄村油坊 Youfang Village，Zhongzhuang Town，Yiyuan County	21.5	215	16.5×12.5	1300
TA	泰安肥城牛山资圣院 Zishengyuan，Niushang,Feicheng County,Tai'an	20	100	18×15	1000
JN	济南滴豆寺 Tangdou Temple,Jinan	20	160	20×24	1400

表 2 叶籽银杏不同单株正常种子和叶生种子超微结构特征

Table 2 Ultrastructure of normal seeds and epiphyllous seeds in different individuals of *Ginkgo biloba* var. *epiphylla* Mak.

编号 NO.	种子类型 Seed type	中种皮特征 Characteristics of sclerotesta				内种皮特征 Characteristics of endotesta	图版 Plate
		管胞类型/μm Tracheid type	管胞长/μm Tracheid length	管胞直径/μm Tracheid diameter	纹孔孔径/μm Pit diameter		
YZ1	NS	TBP	95.1～229.4	22.1～35.1	1.5～4.2	表面有蜡质和瘤层 Covered with wax and burl	Ⅰ,1-3
	ES	TBP,ST	87.6～221.9	18.4～33.9	0.70～3.0	表面覆有很厚的蜡质 Covered with thick wax	Ⅰ,4-7
YF	NS	TBP	147.7～249.7	22.3～47.9	1.6～2.9	细胞形状较为规则,多为狭长形，表面覆有蜡质层 Regular slender cell，covered with wax	Ⅰ,8-10
	ES	TBP	115.5～256.6	22.2～36.0	0.74～2.6	细胞为狭长形,表面覆有蜡质层。Regular slender cell，covered with wax	Ⅰ,11-12；Ⅱ,1
BY	NS	TBP	75.3～296.3	28.92～48.6	1.0～4.6	由排列规则的细胞构成,细胞表面覆有蜡质 Regular cell, covered with wax	Ⅱ,2-4
	ES	TBP	72.9～157.6	17.9～27.6	1.40~3.27	主要由细长的纤维构成，种皮纤维成层（簇）Slender fiber, and endotesta fiber cluster round	Ⅱ,5-7
ZZ	NS	TBP	131.2～305.7	23.9～38.7	1.2～2.6	细胞形状较为规则,多为狭长形，表面覆有较厚的蜡质层 Regular slender cell，covered with thick wax	Ⅱ,8-10
	ES	ST,TBP	191.3～274.5	22.2～38.3	1.7～6.4	由细长的纤维构成,且表面覆有较厚的蜡质层 Slender fiber，covered with thick wax	Ⅱ,11-12；Ⅲ,1-2
JN	NS	TBP	125.2～264.0	27.1～49.5	3.4～5.4	由狭长的细胞构成,细胞表面有瘤层,胞间隙中也有这种瘤层 Slender cell, covered with thick burl, gap between cells also has burls	Ⅲ,3-5
	ES	TBP; ST	110.6～251.6	25.2～48.3	2.0～4.3	表面附有很厚的蜡质 Covered with thick wax	Ⅲ,6-9
TA	NS	TBP	153.9～230.8	25.4～52.1	2.3～5.6	表面有较厚的蜡质和和瘤层 Covered with thick wax and burl	Ⅲ,10-12
	ES	TBP; ST	107.8～212.5	27.8～42.4	1.0～3.0	表面蜡质较少,细胞性状不规则，两个细胞交界处有明显的穿孔 Covered with thin wax, irregular cell, with apparent pit between two cells	Ⅲ,13-15

注：NS：正常种子；ES：叶生种子；TBP：具缘纹孔管胞；ST：螺纹管胞

Note：NS：Normal seed; ES：Epiphyllous seed; TBP: Tracheid with bordered pit; ST: Spiral tracheid

Table 3　Duncan's multiple range test for the trachied length and trachied diameter of sclerotesta of *Ginkgo biloba* var. *epiphylla* Mak.

编号 NO.	SNS L（μm）	SNS D-T	编号 NO.	SES L（μm）	SES D-T	编号 NO.	SNS D（μm）	SNS D-T	编号 NO.	SES D（μm）	SES D-T
JN	203.87	A	ZZ	222.13	A	JN	35.27	A	TA	37.54	A
ZZ	200.68	A	JN	187.16	AB	BY	34.31	A	JN	37.09	A
YF	195.20	AB	YF	170.79	B	YF	33.40	AB	ZZ	28.83	B
TA	187.44	AB	YZ1	150.66	BC	ZZ	31.09	AB	YZ1	26.40	BC
YZ1	164.54	AB	TA	120.23	CD	YZ1	29.85	AB	YF	25.36	BC
BY	149.23	B	BY	97.27	D	TA	28.44	B	BY	21.96	C

注：SNS—正常种子中种皮；SES—叶生种子中种皮；L—管胞长度均值；D—管胞直径均值；D-T—多重比较结果。

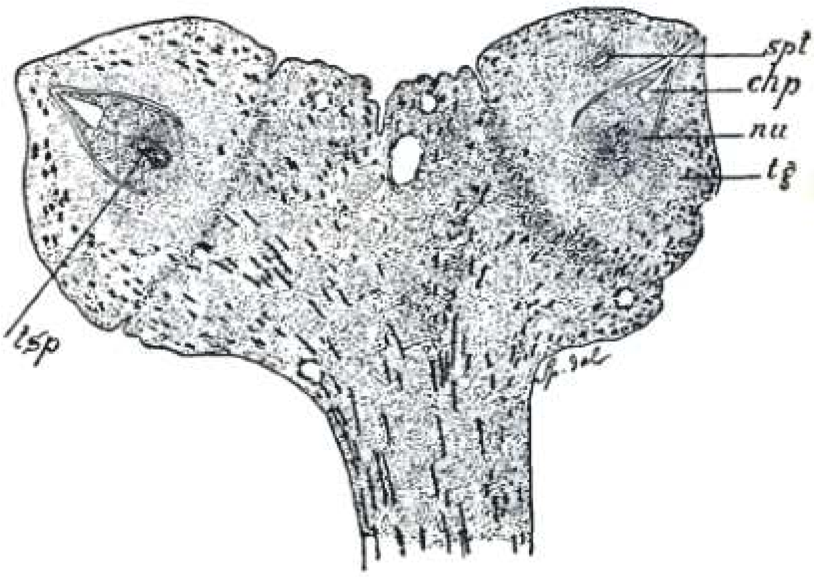
Note：SNS—Sclerotesta of normal seed；SES—Sclerotesta of epiphyllous seed；L—Mean tracheid length；D—Mean tracheid diameter；D-T—Result of Ducan's multiple range test.

References

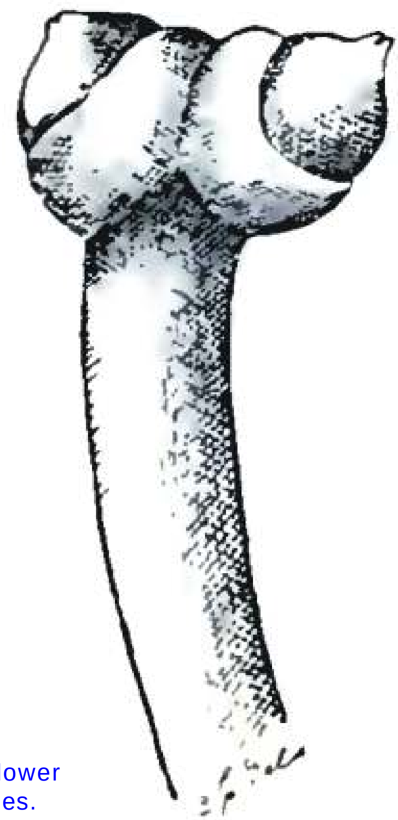
Cutter, E. G., 1978. Plant anatomy (Part I, 2nd edition). Li Zheng-li, Zhang Xin-ying,Li Rong-ao,et al.Trans. Beijing: Science Press. (in Chinese)
Friedman, W.E, Cook M. E., 2000.The origin and early evolution of tracheids in vascular plants: integration of palaeobotanical and neobotanical data. Philosophical transactions of the Royal Society of London, 355 (1398): 857-868
Fu, D., Z, Yang Y, Zhu G.H., 2004. A new scheme of classification of living gymnosperms. Kew Bulletin, 59: 111-116
Hasebe, M., 1997. Molecular phylogeny of Ginkgo biloba: close relation between Ginkgo biloba and Cycads . In: Hori T, Ridge R W, Tulecke W, et al. Ginkgo biloba-A global treasure from biology to medicine. Tokyo: Springer Verlag, 173-181
Huang, Yu-yuan, 2003. The primary report on discovered vessel in Ginkgopsida. Journal of Guangxi Agriculture and Biological Science,22(4): 331-333. (in Chinese)
Li, Bao-jin, Xing Shi-yan, 2007. Anatomical structure and stomatal characteristics on the leaf of Ginkgo biloba var. epiphylla Mak. Scientia Silvae Sinicae, 43(10): 34-39. (in Chinese)
Li, Bao-jin, 2008. Sequence analysis of matk gene and its region and phylogeny on Ginkgo biloba var. epiphylla Mak. Master degree thesis of Shandong Agricultral University. Mentor: Xing shiyan (in Chinese)
Li, Cheng-sen, 1992. Two kinds of special metaxylem tracheids found in the early vascular plants. Chinese Bulletin of Botany, 9 (4):13-17
Li, Shi-mei, Xing Shi-yan, Li Bao-jin, Wang Li, 2007a. Review on ontogeny and phylogeny of Ginkgo biloba var epiphylla and its genesis mechanism. Scientia Silvae Sinicae,43 (5): 90-98. (in Chinese)
Li, Shi-mei,Li Bao-jin, Xing Shi-yan, Wang-fang, 2007b. Morphological development of ovule-like organ on the leaf and variation characteristics of Ginkgo biloba var. epiphylla Mak.(Ohatsuki). Acta Horticulture Sinica,34(1):1-6.(in Chinese)
Ling, Yu-ping, Zhou Hong-gen, Zhou Wei-dong, Chen Peng, 2002. Study on ultrastructure of the seed of Ginkgo biloba. Journal of Yangzhou University (Agricultural and Life Science Edition),23(1):76-78.(in Chinese)
Martinez-Ortega, M. M., Rico, E., 2001. Seed morphology and its systematic significance in some Veronica species (Scrophulariaceae) mainly from the Western Mediterranean. Plant Systematics and Evolution,228:15-32
Mundry, M., Stützel, T., 2004. Morphogenesis of leaves and cones of male short-shoots of Ginkgo biloba L. Flora,199(5): 437-452
Sakisaka, M., 1929. On the seed-bearing leaves of Ginkgo. Journal of Japanese Botany, 4: 219 - 235
Shirai, M. Abnormal Ginkgo tree.Bot.Mag. Tokyo, 1891,5(56): 341-342 (in Japanese)
Su, Ying-juan, Wang Ting, Zhang Hong-da, 1997. A study on the aril micromorphological features of some gymnosperms and its taxonomic significance. Acta Botanica Boreali-Occidentalia Sinica,17(3):392-398
Timell, T. E., 1978. Ultrastructure of compression wood in Ginkgo biloba. Wood Science and Technology. 12: 89-103
Wang, Fu-xiong, Chen Zu-keng, 1983. A contribution to the embryology of Ginkgo with a discussion on the affinity of the ginkgoales.Acta Botanica Sinica,25(3): 199-207. (in Chinese)
Wang, Li, Xu Xiao-yong, Wang Qiong,Wang Yong-ping, Pan Ye, Chen Peng, 2007. Effect of $CaCl_2$ treatment on storage qualities of seed stone and ultrastructure of shell in Ginkgo biloba L. Jiangsu Journal of Agricultural Sciences, 23(5): 469-474. (in Chinese)
Wang, Yu-guo, Li Guang-zhao, Zhang Wen-ju, You Jia, Chen Jia-kuan, 2007. A systematic study of the genus Rhododendron (Ericaceae) using micromorphological characters of fruit surface and seed coat. Acta Phytotaxonomica Sinica, 45(1): 21-38. (in Chinese)
Xing, Shi-yan, Li Shi-mei, Li Bao-jin, Wang Fang, Han Ke-jie, Wang Li, Comparative Morphology and Its Systematic Implication on Epiphyllous Microsporangia from Ginkgo biloba L. Acta Horticulturae Sinica, 34(4): 805-812. (in Chinese)
Xing, Shi-yan, 1993. High-yield Ginkgo Cultivation.Jinan: Jinan Press. (in Chinese)
Yang, Ji, Guo You-hao, Yang Xiong, Rao Guang-yuan, 1999. Plant biology.Beijing:Higher Education Press/Springer(in Chinese)
Yu, Cheng-hong, 1981. Evolutionary trends in secondary xylem of gymnosperms.Acta Phytotaxonomica Sinica,19(2):179-183.(in Chinese)
Yu, Wei-hua, Chen Peng, Li Xiao-peng.Wang Zhong, Wang Yong-ping, 2004. Observation on Anatomical and Ultra-Structure of Seed at Different Development Phases in Ginkgo biloba. Journal of Yangzhou University(Agricultural and Life Science Edition), 25(2):72-75.(in Chinese)
Zhou, ZY, Zheng S., L., 2003. The missing link in Ginkgo evolution. Nature, 423: 821-822
Zhou, Zhi-yan, 2003. Mesozoic ginkgoaleans: phylogeny,classification and evolutionary trends. Acta Botanica Yunanica, 25(4):377-396.(in Chinese)

C) Sprecher, A., 1907. Le *Ginkgo biloba* L., Genève.

(The choice of illustrations.)

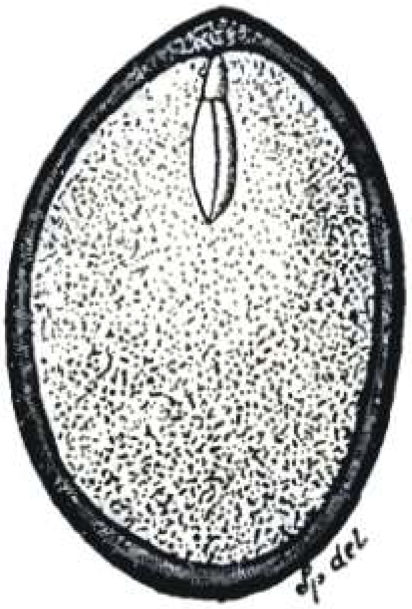


Female flower - section.
tsp = sporogenous tissue; *chp* = pollen chamber; *nu* = nucellus; *tg* = integument; *spt* = sporangium in the integument.

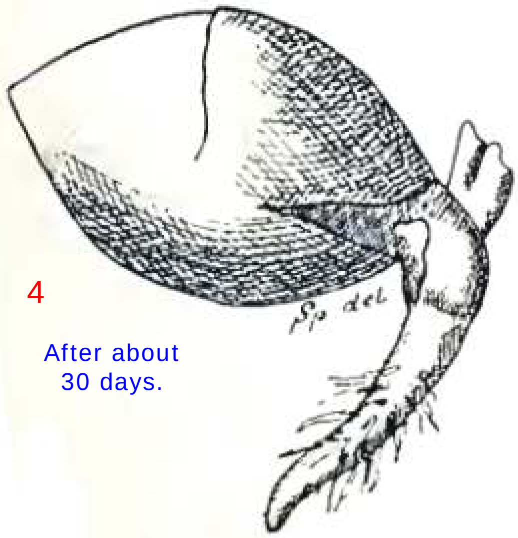


Young female flower with two ovules.

Longitudinal section the seed with a mature embryo.



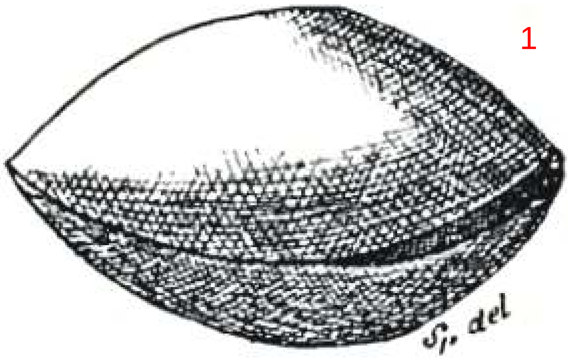
4



After about 30 days.

Open seeds.

1



After about 40 days.

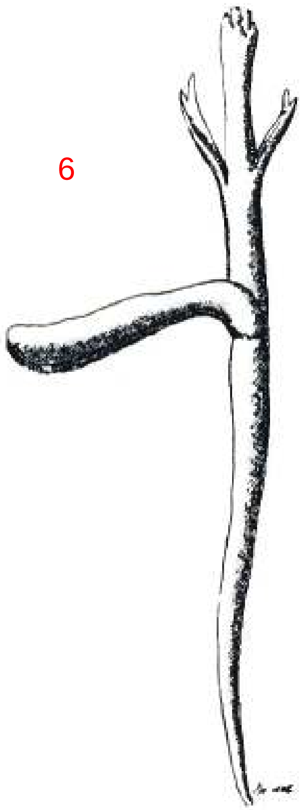
5

2

After about 15 days.

Young plant with first two leaves. After about 50-55 days.

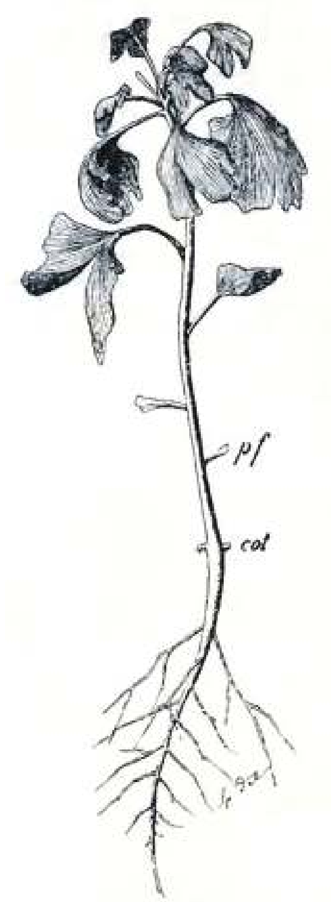
6



After about 20 days.

3

Germination of seed.
(1-6)



Young plant with a crown of leaves. *pf* = first leaf; *cot* = cotyledons.

LE

GINKGO BILOBA L.

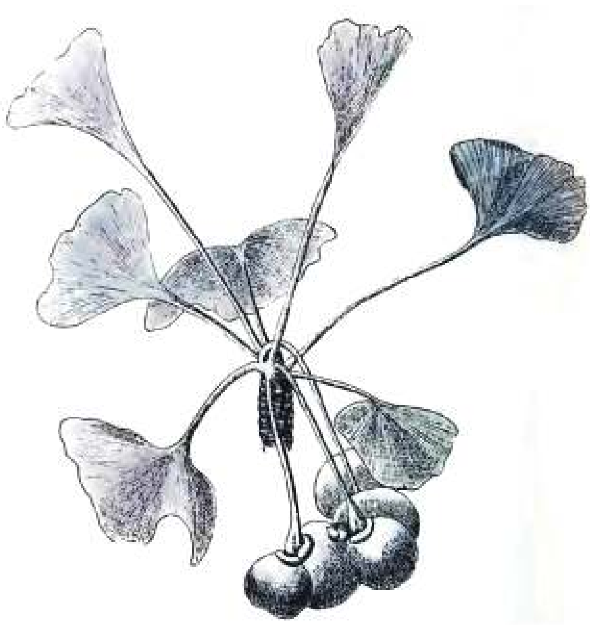
THÈSE

par

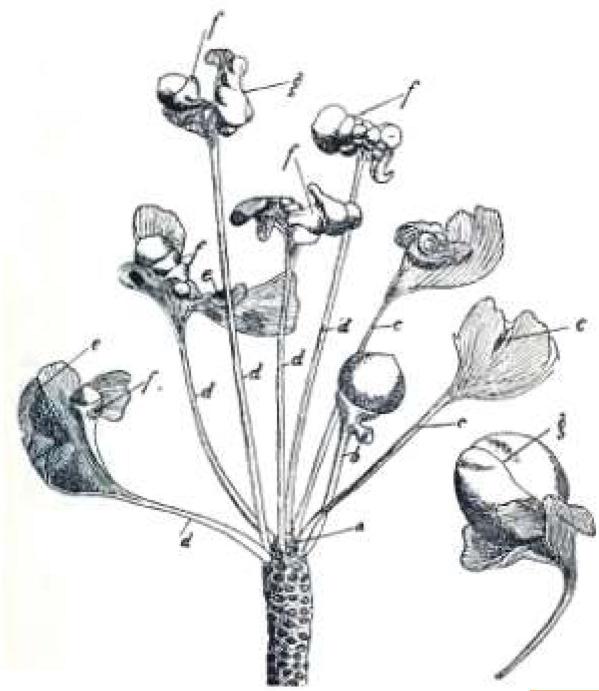
Andreas SPRECHER

GENÈVE

Female short branch bearing mature seeds.



Abnormalities of a male short branch: d = normal flower; e = leaf with the anomaly; g = leafstalk; h = leaf normal.



Anomalies of a short branch female: a = apical bud; b = normal flower; c = sheet with irregular outgrowth of tissue (e); d = petiole fruits and leaf; f = young fruit on leaf (ohatsuki); g = longitudinal striation on the pulp of the seed.

D) Quick presentations Ginkgo extract (Gbe), nutritional value etc. - Examples. (Source: http://www.cn-ginkgo.com.cn/athena/offerdetail/sale/changchunginkgo-10530-20512720.html, http://www.cn-ginkgo.com.cn/athena/offerdetail/sale/changchunginkgo-118-390705158.html)

1. The base of Ginkgo biloba produced rich nutrients, especially protein, vitamin C, carotene content rich, dry weight: leaf 10.6% -15.9% of protein, sugar 7.4% -8.7% 4.6% -5.6 sugar %, Vitamin C66.6-129.40mg. (100g) -1

2. Ginkgo biloba is rich in amino acids: total amino acid content was 10.7% -15.4%, and containing 9 kinds of essential amino acids, essential amino acids of the total amino acid content of about 40%

3. Rich in minerals, especially calcium, boron, phosphorus and selenium content

4. Lowering blood pressure, lower cholesterol, prevent cardiovascular diseases, enhance immunity, longevity" - this is basic ginkgo product specifications Chanchun Ginkgo Co. LTD, China. Source: http://www.cn-ginkgo.com.cn/athena/offerdetail/sale/changchunginkgo-10530-20512720.html

- Big Company Chanchun Ginkgo Co. LTD, China has to offer Ginkgo extract (Gbe):

具体标准如下
(Specific criteria are as follows:) :

总黄酮甙含量 (Total Ginkgo Flavone Glycosides) ≥24% 槲皮素 (Quercetin Glycosides) 12.76%
山奈酚 (Kaempferol Glycosides) 12.62%
异鼠李素 (Isorhamnetin Glycosides) 1.59 %
银杏内酯 (Total Terpene Lactones) ≥ 7.09 %
银杏内酯A (Ginkgolides A) 2.20 %
银杏内酯B (Ginkgolides B) 1.08 %
银杏内酯C (Ginkgolides C) 1.03 %
白果内酯 (Bilobalides) 2.78 %
银杏酸 (Ginkgo Acid) ≤ 2.6PPM

(Moisture) ≤ 5.0% 2.8%
(Ash Count) ≤ 0.80% 0.26%
(Heavy Metals) ≤ 10ppm ≤ 5ppm
(Total Bacteria Count) ≤ 1000 COL/G < 100 COL/G
(Yeast&Mold) ≤ 50COL/G < 15 COL/G
(Staphylococcus) (Negative)
(P. Aeruginosa) (Negative)
(Salmonella) (Negative)
(E.Coli.) (Negative)

Price 1 kg Ginkgo extract is different. It all depends on the quantities that are purchased.

E) GINKGO BILOBA: NEW USES FOR AN ANCIENT TREE

- "The ginkgo tree (Ginkgo biloba) is native to China and is the sole survivor of the ancient family Ginkgoaceae. In China, it is traditionally cultivated both for timber and its seeds, while outside China it is valued chiefly as an ornamental and shade tree. Recently, however, it has been extensively planted for its fern-like leaves which have valuable medicinal properties; in fact, the leaves and seeds contain biologically active substances used for the improvement of cerebral and peripheral blood circulation. As the developed world has started to appreciate the medicinal properties of this natural product, so the demand for dried ginkgo leaves and seeds has increased. The ginkgo leaf-processing industry is booming and nearly 200 processing enterprises have been set up in China with an annual production valued at US$250 million. In some rural areas, ginkgo cultivation is becoming one of the most vigorous industries with approximately 170 000 ha planted and 13 000 tonnes of seeds harvested annually. This provides an economic opportunity for poor farmers in rural regions where poverty alleviation is a government priority.

Ginkgo seed plantations can provide good economic returns. Trees usually set fruits from five years of age and, when in full production, can produce 15 kg of seeds per tree annually. The prices of ginkgo leaves and seeds have increased dramatically during the past decade owing to the limited supply and new product development. In the local market, seeds are sold at US$507 per kg and dried leaves at US$1.50 to $2 per kg. Income from one hectare of ginkgo plantation can support three households in rural areas. In addition, leaves and fruits harvested from large remnant natural trees can also be profitable.

However, appropriate technologies need to be developed in order to improve and sustain yields, and the industry needs careful management policies. As part of a research project supported by the International Development Research Centre (IDRC) and the Center for International Forestry Research (CIFOR) to improve policies and technologies which will benefit rural people in degraded areas, the Chinese Academy of Forestry, in partnership with local institutions, has carried out marketing studies and is researching management technologies to increase leaf production. The project aims to increase foliage output of leaf-producing ginkgo plantations using an optimal cultivation model comprising selected cultivars, improved propagation techniques and silvicultural management."
(Source: CIFOR News, No. 17, December 1997.)

- 2010 years in China's fresh ginkgo leaf was a good price. A kilo is worth an average of 3.4 yuan (about 0.55 U.S. dollars). It is estimated that the family could collect about 510 kg of leaves. In this way increased the household budget by about $ 280. Source: August 20, 2010, Author: Tancheng CAST (http://www.lyast.org.cn/newAst/ShowArticle.aspx?ArticleID=27512), China. For comparison cite the section states: 2009 years in the USA and China is practically the same. For example price cutting is several times cheaper in China. 2006 years average salary in China was about $ 170. And since then it has to increase. (http://hgd.mvpei.hr/gospodarski_prikaz/kina/12/ and http://www.forum.hr/archive/index.php/t-507648.html)

F) Wayne D. Shepperd, Ginkgo biloba L.: ginkgo

Other common names. maidenhair-tree, Kew-tree.

Growth habit, occurrence, and use. Ginkgo is a monotypic genus native to China, the sole survivor of the ancient family of Ginkgoaceae (Bailey 1923; Dallimore and Jackson 1948; Seward and Gowan 1900). Geologic records indicate that ginkgos have grown on Earth for 150 million years (AGINFO 1994). This tall (<35 m) deciduous, sparsely branched, long-lived tree has been cultivated extensively in the Far East and Europe (AGINFO 1994; Bailey 1923, 1947; Seward and Gowan 1900). The foliage of this broad-leaved gymnosperm consists of alternate, simple, fan-shaped, leathery leaves 2 to 5 cm long, with forking parallel veination. Ginkgo trees grow in an upright pyramidal form, becoming broader and regular with age (AGINFO 1994). Ginkgo was introduced into North America in 1784 and has generally been successful on good sites in the moist temperate zone of the midwestern and eastern United States and along the St. Lawrence River in Canada (Bailey 1947; Rehder 1940). Ginkgo trees prefer full sunlight and well-drained conditions and are adaptable to many soils, but they are slow to recover from transplanting (AGINFO 1994). It is along the St. Lawrence River in Canada (Bailey 1947; Rehder 1940). Ginkgo trees prefer full sunlight and well-drained conditions and are adaptable to many soils, but they are slow to recover from transplanting (AGINFO 1994). It is valued as an ornamental and shade tree, particularly as a park and street tree (Bailey 1947). Ginkgo is highly resistant to air pollution and could be grown in areas within its introduced range where air pollution damages other species. The cooked seeds are used for food by the Chinese, but the fleshy layer can cause dermatitis (AGINFO 1994; Porterfield 1940).

Flowering and fruiting.
The species is dioecious. The catkin-like male flowers appear in late March or early April, and the pistillate flowers appear later in April before leafout (Sakisaka 1927). A single naked ovule ripens into a drupe-like seed with a fleshy outer layer smelling of rancid butter and a thin, smooth, cream-colored, horny inner layer (figures 1 and 2). The fleshy-coated seeds are frequently called fruits. They are cast in the fall after the first frost, but at this time a larger percentage of the seeds have immature embryos and cannot be germinated under normal test conditions (Alexander 1974; Eames 1955; Willan 1985). Embryo development continues while seeds on the ground are exposed to temperatures normally encountered during fall and early winter. Embryo maturation is usually complete about 6 to 8 weeks after the seeds drop (Lee 1956; Maugini 1965). Because of the offensive odor of the outer layer of the seeds, only male clones are recommended for landscape use (AGINFO 1994). Ginkgo is also capable of reproducing vegetatively. Del Tredici (1992) describes the origin and development of basal chichi, tuber-like callus growths on the lower trunk that originate from superficial meristematic buds located in the cotyledonary axils of all ginkgo seedlings and allow clonal regeneration. Within 6 weeks of germination, these buds become embedded in the cortex of the stem and develop below the bark surface. If a traumatic event damages the tree, these buds grow down from the trunk to form basal chichi from which both aerial shoots and adventitious roots can grow. Up to 40% of mature trees Del Tredici observed at 1 location in China were multi-stemmed, with 2 or more secondary stems originating from 1 or more basal chichi. This form of vegetative regeneration may have played a role in the remarkable survival of ginkgo since the Cretaceous Period.

Collection, extraction, and storage.
Ginkgo trees begin bearing seeds when they reach 30 to 40 years of age (Hadfield 1960; Ponder and others 1981). The flesh-coated seeds may be collected on the ground as they ripen or picked by hand from standing trees from late fall through early winter. Seeds may be prepared for cleaning by covering them with water for several days until the flesh

Figure 1—Ginkgo biloba, ginkgo: seeds enclosed in their fleshy outer layers (far left and right) and cleaned seeds with fleshy layers removed (center).

begins to soften (Munson 1986). Food processing blenders can be used to macerate the softened fruits after their metal blades are replaced with plastic tubing propellers. Fruits should be covered with water, then macerated thoroughly in a blender cup using short bursts of the motor. The pulp is then floated away by slowly adding additional water and allowing filled seeds to sink to the bottom of the cup (Munson 1986). About 12.5 kg (27.5 lb) of cleaned seeds can be obtained from 50 kg (110 lb) of seeds with fleshy layers (Swingle 1939). Cleaned seed density varies from 400 to 1,150 seeds/kg (180 to 520 seeds/lb) (Alexander 1974; Swingle 1939). Cleaned seeds have been kept in ordinary dry storage in both open and closed containers at 5 to 21 °C without any apparent adverse effects (Davis and Henery 1942; Hatano and Kano 1952; Swingle 1939).

Germination.
Recommended germination test conditions for ginkgo call for the placement of the seeds, with their coats removed, on the top of or between moist blotters at alternating day/night temperatures of 30 and 20 °C for 30 days (ISTA 1993). Germination tests conducted in moist sand for 60 days using 20 °C. nights and 30 °C days ranged from 46% germination for seed collected in October to 90% germination for seed collected in December (Alexander 1974). Germination of untreated seed planted in a soil medium varied from 32 to 85% (Davis and Henery 1942; Swingle 1939). A stratification period of 30 to 60 days at 5 °C before planting has been recommended (Ponder and others 1981), however 1- to 2-months of warm stratification before cold stratification is also advised to allow seeds to fully mature (Dirr and Heuser 1987; Willan 1985).

Nursery practice.
Seeds should be sown in the late fall (November), preferably in furrows, and covered with 5 to 8 cm (2 to 3 in) of soil and a sawdust mulch (Heit 1967; Alexander 1974). About 50% of the viable seed that are sown will produce usable 2+0 seedlings (Alexander 1974). Ginkgo seedlings grown in artificial growth chambers were able to grow continuously for a 20-week period under a 32 to 25 °C day/night regime (16-hour day-length). This regime produced similarsized plants as those grown under a 24/17 °C regime for 40 weeks (Flesch and others 1991). Ginkgo can also be propagated in the nursery from cuttings, although rooted cuttings are slow growing. Cuttings 10 to 15 cm (4 to 6 in) long should be collected from mature trees in midsummer, treated with 8,000 ppm indole-butyric acid (IBA) in solution or in talc, and misted for 7 to 8 weeks (Dirr and Heuser 1987).

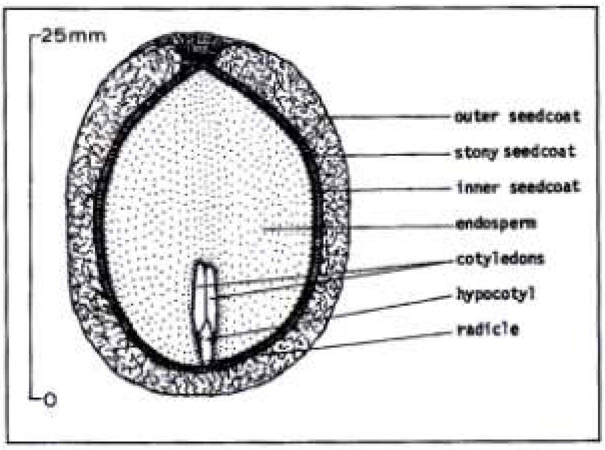


Figure 2—*Ginkgo biloba*, ginkgo: longitudinal section through a seed

References

AGINFO. 1994. Plant database. Newark, DE: University of Delaware, College of Agricultural Sciences. www.ags.udel.edu
Alexander RR. 1974. Ginkgo biloba L., ginkgo. In: Schopmeyer CS, tech. coord. Seeds of woody plants in the United States. Agric. Handbk. 450. Washington, DC: USDA Forest Service: 429B430.
Bailey LH. 1923. Cultivated evergreens. New York: Macmillan: 177B178.
Bailey LH. 1947. Standard cyclopedia of horticulture. 2nd ed. New York: Macmillan. 338 p.
Dallimore W, Jackson AB. 1948. Handbook on coniferae. 3rd ed. London: Edward Arnold Co.: 229B233
Davis SH, Henery JT. 1942. A Xylaria pathogenic to Ginkgo biloba (L.) seeds. Phytopathology 32: 91B92.
Del Tredici P. 1992. Natural regeneration of Ginkgo biloba from downward growing cotyledonary buds (basal chichi). American Journal of Botany 79(5): 522B530.
Dirr MA, Heuser CW Jr. 1987. The reference manual of woody plant propagation: from seed to tissue culture. Athens, GA: Varsity Press. 239 p.
Eames AJ. 1955. The seed and Ginkgo. Journal of the Arnold Arboretum 36: 165B170.
Flesch V, Jacques M, Cosson L, Petiard V, Balz JP. 1991. Effects of light and temperature on growth of Ginkgo biloba cultivated under controlled long day conditions. Annales des Sciences Forestieres 48:133B147.
Hadfield M. 1960. Some notes on the Ginkgo. Quarterly Journal of Forestry 54(4): 331B337.
Hatano K, Kano T. 1952. A brief report on the afterripening of seeds of Ginkgo biloba. Journal of the Japanese Forestry Society 34(2): 369B370.
Heit CE. 1967. Propagation from seed: 8. Fall planting of fruit and hardwood seeds. American Nurseryman 126(4): 60B69.
ISTA [International Seed Testing Association]. 1993. International rules for seed testing. Rules 1993. Seed Science & Technology 21 (Suppl.): 1B259.
Lee CL. 1956. Fertilization in Ginkgo biloba. Botanical Gazette 117: 79B100.
Maugini E. 1965. Anatomical and histological differences between male and female plants of Ginkgo biloba. Giornale Botanico Italiano 72(2/3): 233B242.
Munson RH. 1986. Extracting seeds from fleshy fruits. Plant Propagator 32(2): 14B15.
Ponder HG, Shumack RL, Gilliam CH. 1981. Liners: the first step in shade tree production. American Nurseryman 153(11): 10B11, 54, 64.
Porterfield W. 1940. Chinese vegetable foods in New York: 11. Seeds of the Ginkgo. New York Botanical Garden Journal 41: 186B188.
Rehder A. 1940. Manual of cultivated trees and shrubs. 2nd ed. New York: Macmillan. 996 p.
Sakisaka M. 1927. On the seed bearing leaves of Ginkgo. Japanese Journal of Botany 4: 219B236.
Seward AC, Gowan J. 1900. The maidenhair tree (Ginkgo biloba L.). Annals of Botany 14(53): 109B164.
Swingle CF. 1939. Seed propagation of trees, shrubs, and forbs for conservation planting. SCS-TP-27. Washington, DC: USDA Soil Conservation Service. 198 p
Willan RL. 1985. A guide to forest seed handling with special reference to the tropics. For. Pap. 20/2. Rome: FAO.

(Sourche: Shepperd, W.D., 2008. In Bonner, F. T. & Karrfalt, R. P. The Woody Plant Seed Manual. Agric. Handbook No. 727. Washington, DC. U.S. Department of Agriculture, Forest Service. 559-561.)

Ginkgo biloba young plants in nursery. Age: about 2-3 years old.
Photo by Jan Purkrábek, Czech Republic.

G) Shi-mei, L. et al. 2007. Morphological Development of Ovule-like Organ on the Leaf and Variation Characteristics of *Ginkgo biloba* var. *epiphylla* Mak. (Ohatsuki)

(Source: Acta Horticulturae Sinica, 34 (1): p. 1-6)

"Abstract: Many features of *Ginkgo biloba* var. *epiphylla* Mak., the one which was firstly found at Yiyuan County of Shandong Province in China, were continually observed and the comparative morphology research was conducted, including the variation characteristics, the morphological development of ovule-like organ on the leaf blade and veins of leaf. The results of analysis showed that the development of the ovule-like organ on the leaf blade is comp rised of initial stage, formation stage, expansion stage and mature stage. There were one to eight ovule-like organs on each leaf, but only one developed normally. The leaves were divided into five types, i. e. multilobed type, nonlobed type, bilobed type, the leaf with ovule-like organ and deformation leaf, leaf color into two types, i. e. green and variegated types. Compared with normal ovules, ovule-like organ on the leaf blade disp layed variation in insertion, heterochrony and hysteresis in development of ovule-like organ on the leaf blade, which was reported for the first time. The ovule-like organ lagged behind the normal ovule for fifteen days at initial stage, moreover no pollination drop was found on the ovule-like organ. The ovule-like organ on the leaf blade was divided into five types according to the insertion on the leaf, i. e. unilobed solitary type, unilobed clustered type, bilobed clustered type, multilobed solitary type and adsperse type. The vein of normal leaf could be separated into four types according to anastomoses, i. e. closed type, W type, V +W type and double V +W type. And that of the phyllosporous leaf was classified into three types, i. e. uni-arcuate, biarcuate and mutli-arcuate type. The variation characteristics and the phylogeny of *Ginkgo biloba* var. *epiphylla* Mak. were discussed in the paper."

Ginkgo in Fukaura Town, Aomori Prefecture. Photo by "aomorikuma", Japan. (Source: http://ja.wikipedia.org/)

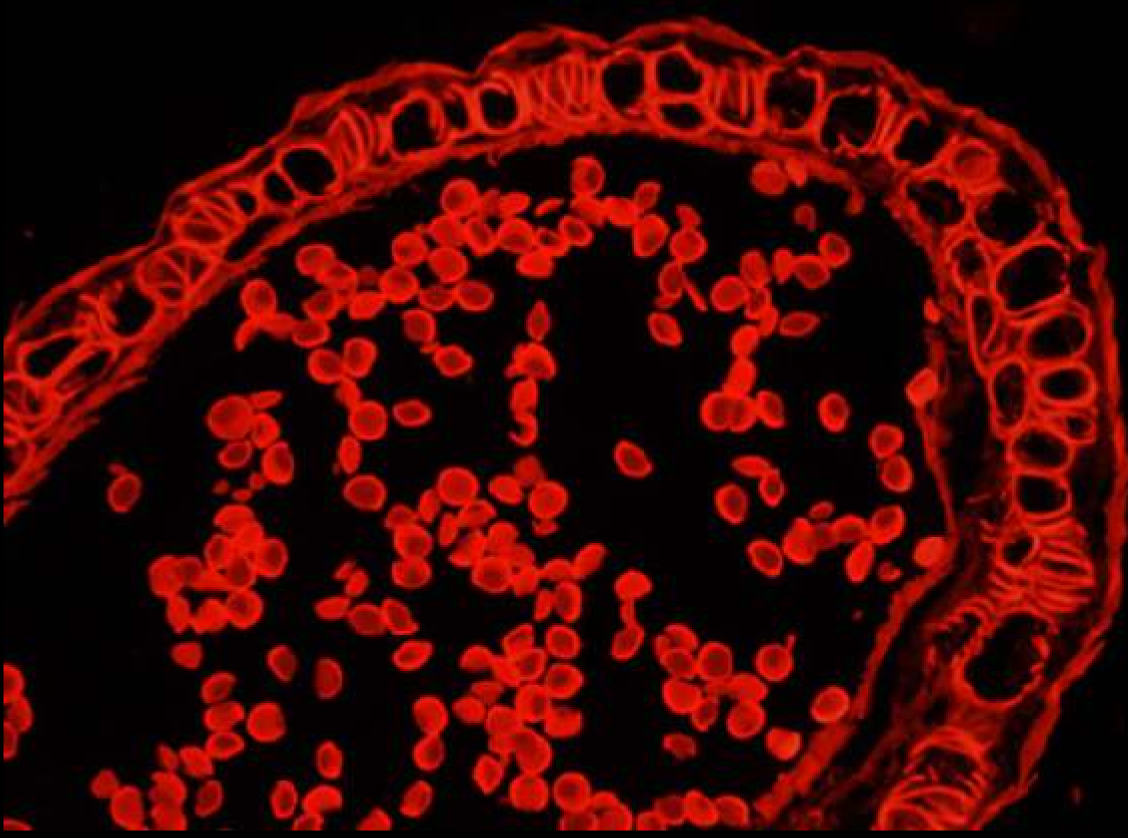
The largest Japanese Ginkgo, Fukaura Town, Aomori Prefecture (around the stem 20 m). Photo by Kawasaki Green Investigation, Japan. (92)

Page 129: *Ginkgo biloba* in 7-15 Place François-Joseph Dargent, 1413 Luxemburg/The geographic coordinates are (WGS84): 49.627294°, 6.130306°. Photo by "Ginkgotree". (4)

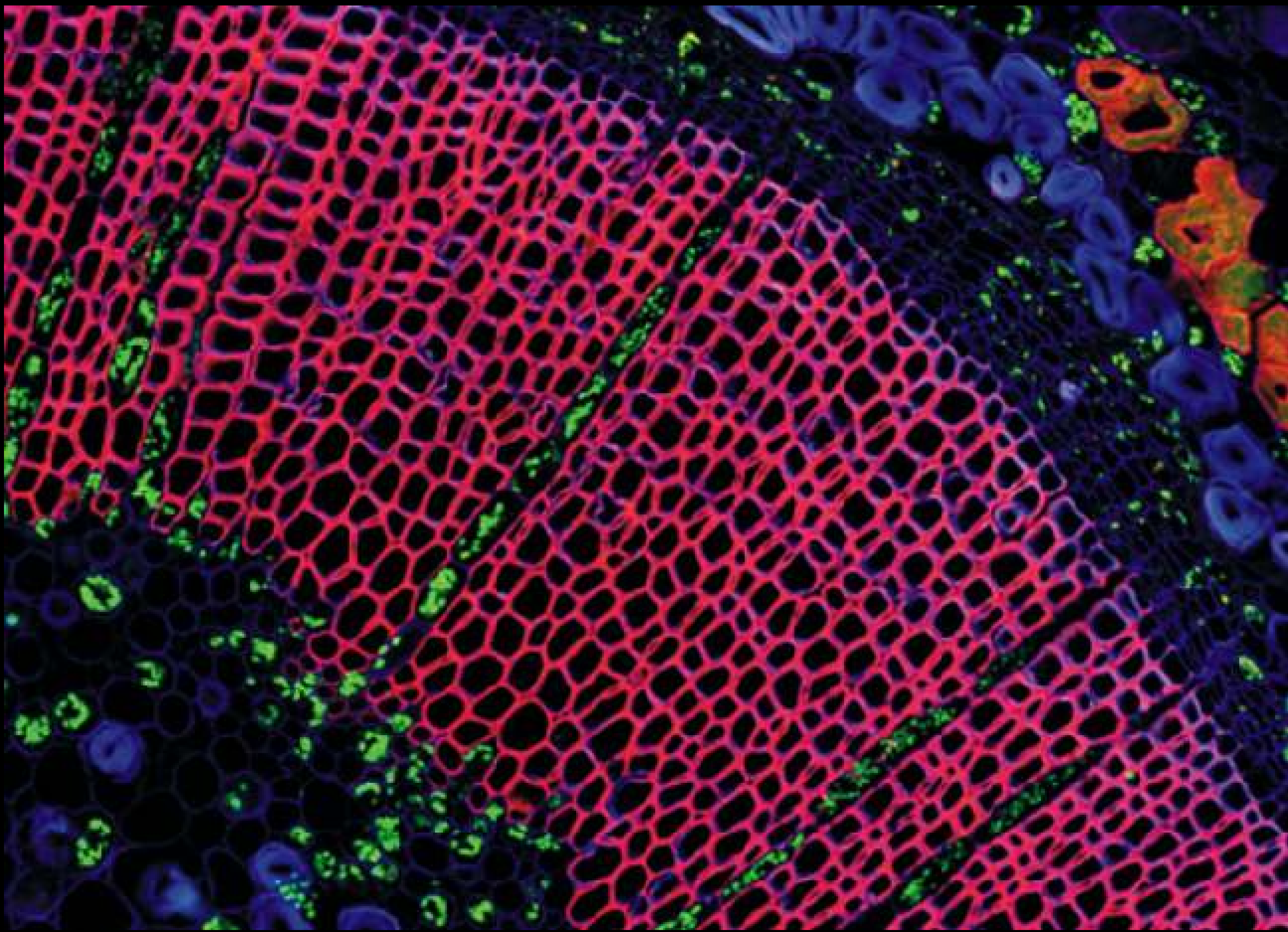
Beautiful Maidenhair tree in the Autumn (Ginkgo in East Europe). Page 130: photo by Josip Barišić, Croatia (2010).

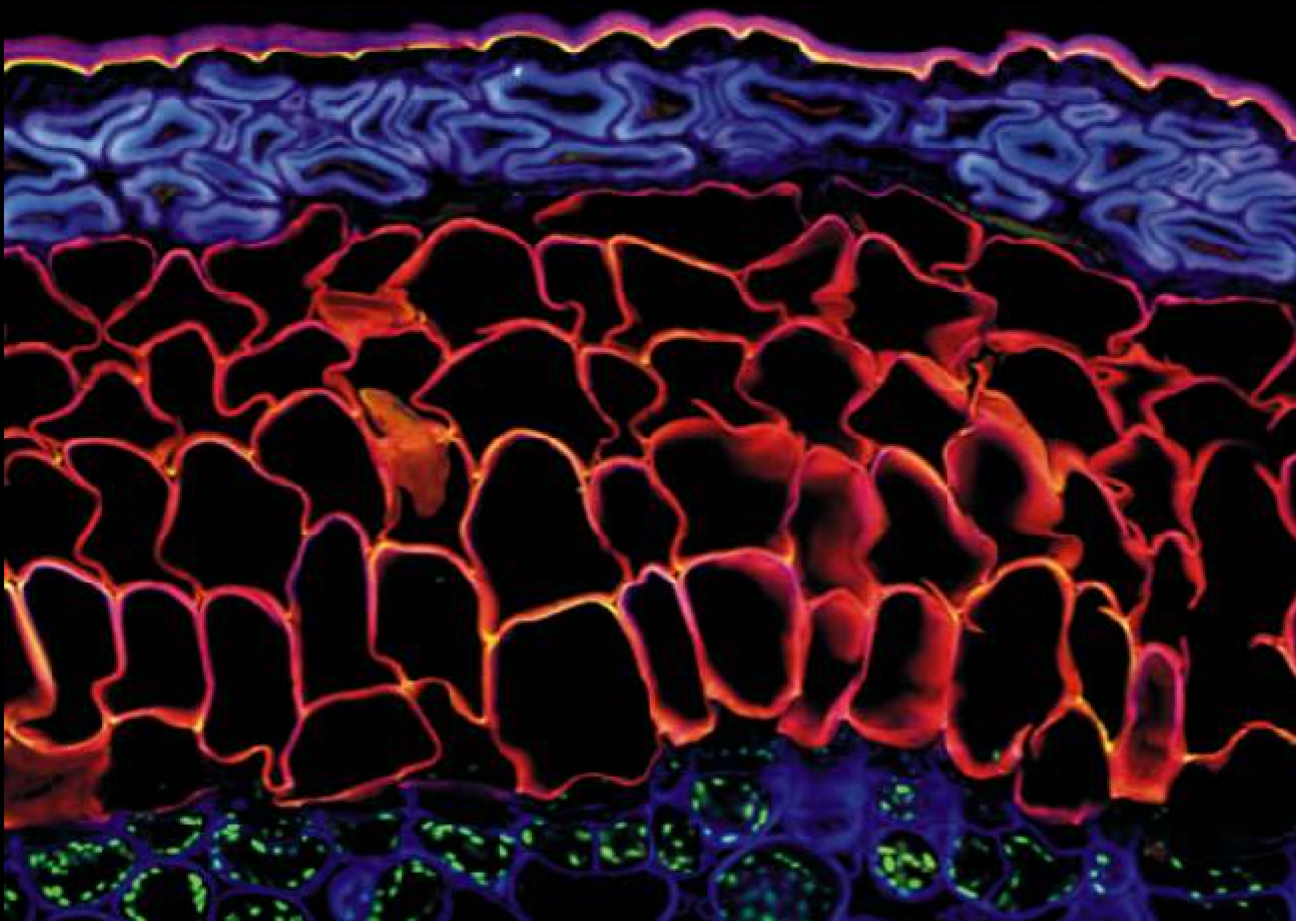
Microscopic image Ginkgo leaf. Source: National High Magnetic Field Laboratory, The Florida State University, USA. (78)

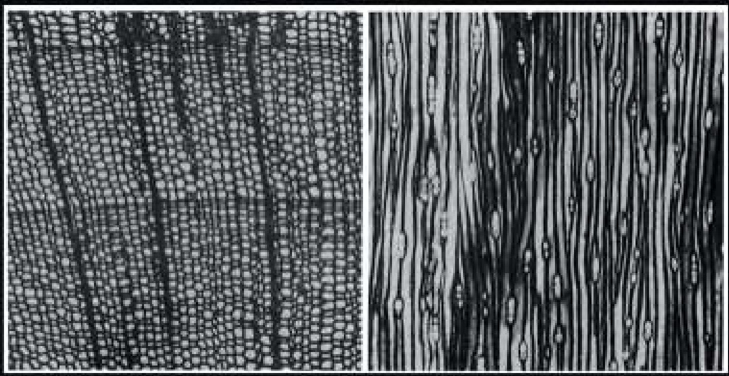
Ginkgo staminate strobilus tissue. Source: National High Magnetic Field Laboratory, The Florida State University, USA. (95)



Microscopic photos the Ginkgo stem (big photos). Source: Scientific Equipment Group, Olympus America Inc., USA. (77)

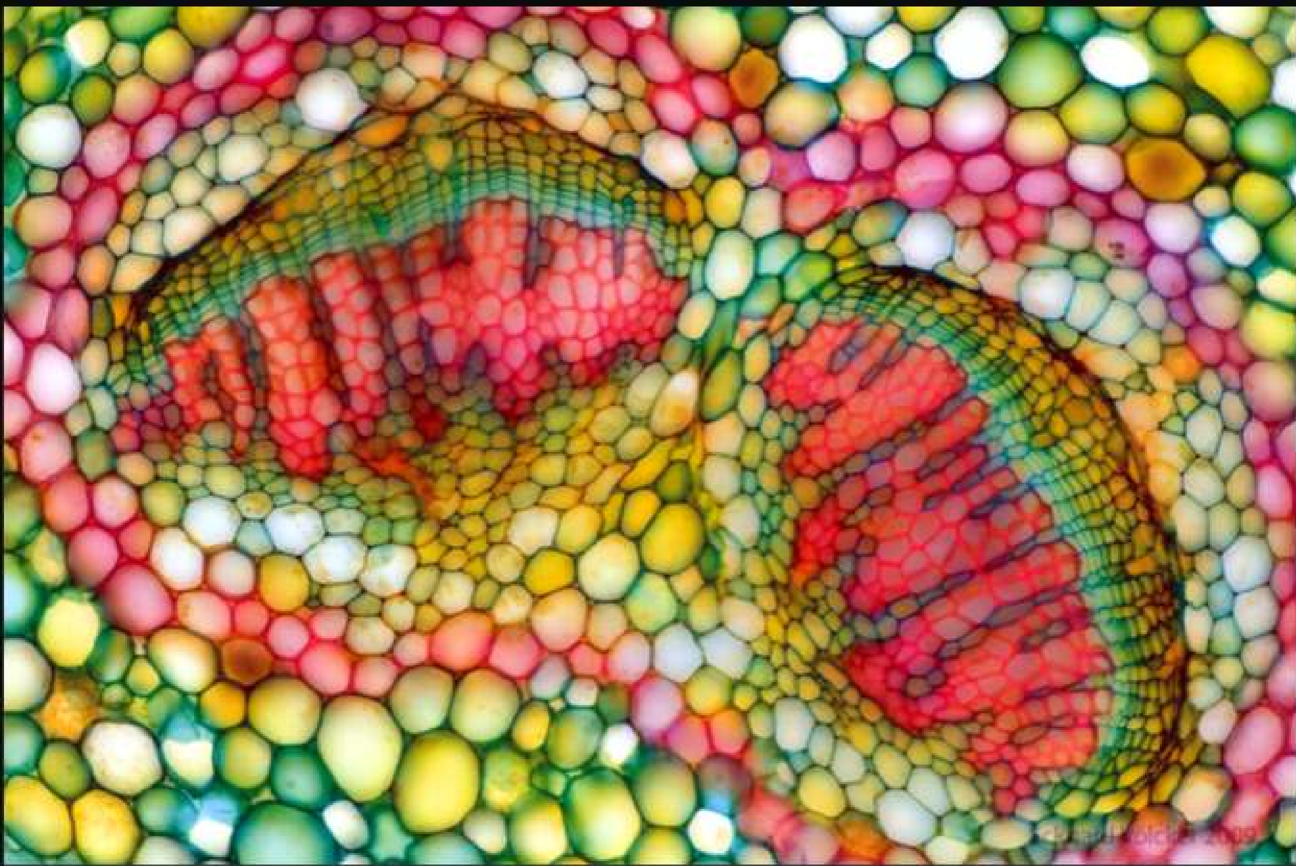






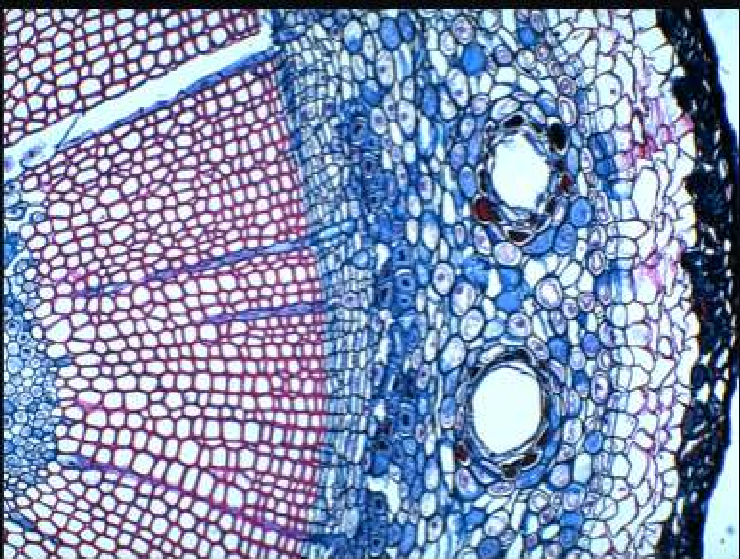
Wood anatomy *Ginkgo biloba*. (80)

A moment of fertilization. Tsukuba University and Tokyo University. (45)

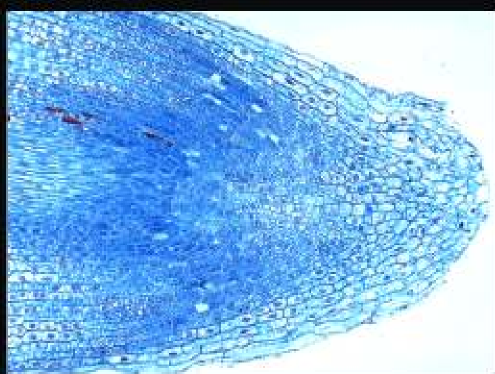


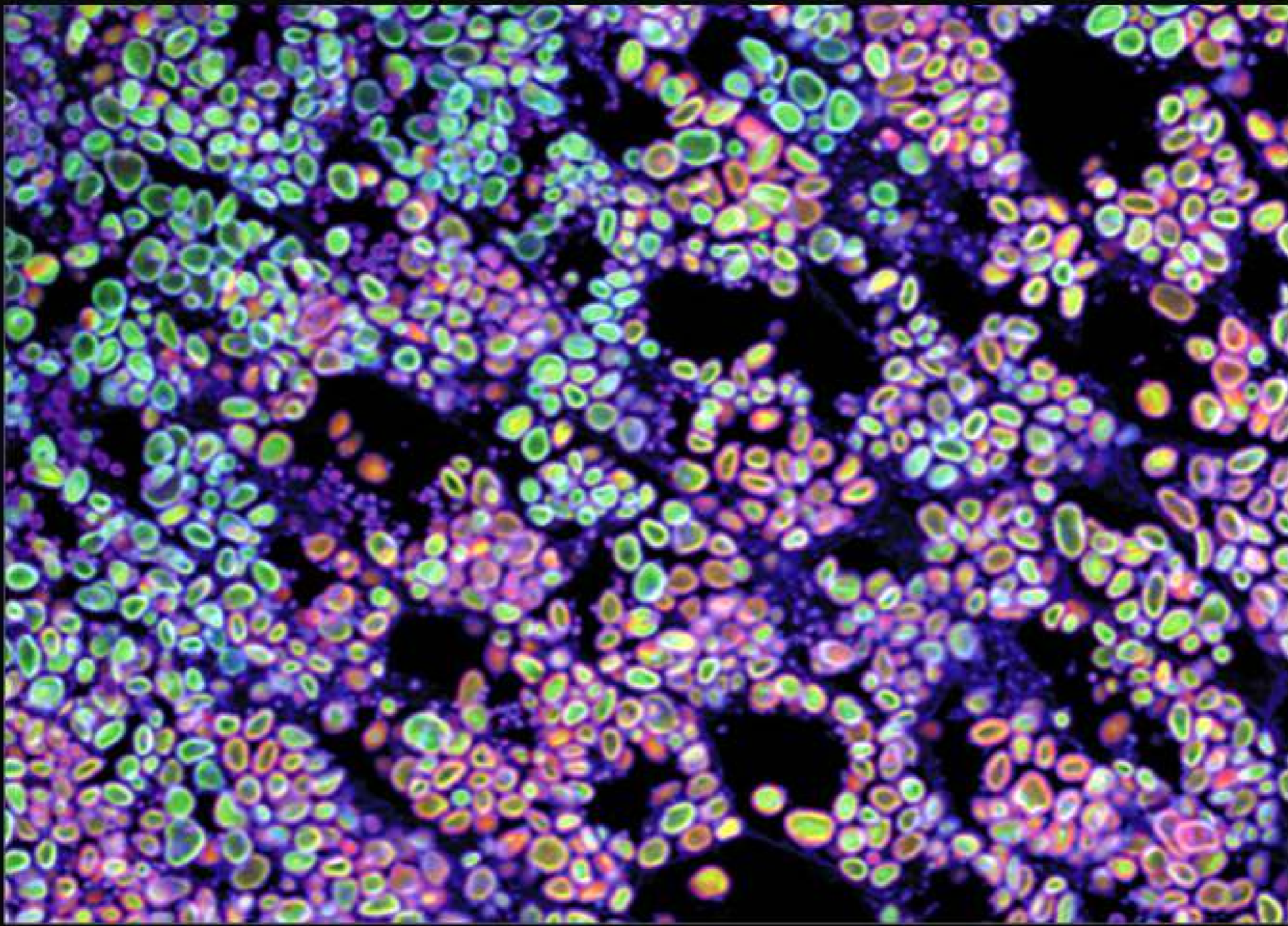
Ginkgo stem. (81)

Microscopic image Ginkgo leafstalk. Source: Botanical Garden in Berlin. (79)



Ginkgo root tip. (81)





Microscopic photos the Ginkgo embryo. Source: Scientific Equipment Group, Olympus America Inc., USA. (77)

Ginkgo in the Winter. Tokyo, Japan. Photo by Kawasaki Green Investigation, Japan. (92)

Landmark 500 year old *Ginkgo biloba* tree in Jeonju Hanok Village, North Jeolla Province, South Korea. Photos by Steven Grob (2007).

Beautiful Ginkgo trees in Germany (Berlin - big photo) & Hungary (Bakonyoszlop). Photo by Laszlo Orloci, Hungary. Photos left by Laszlo Orloci, Hungary (Ginkgo trees in Europe).

References

(correction approach to web sites 24-25/10/2010 and 07/02/2011)

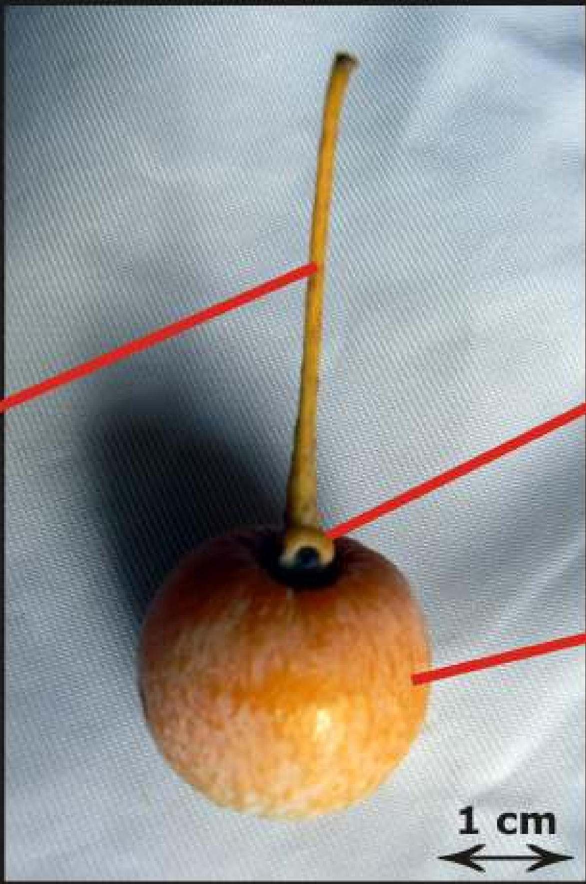
1. http://xs4all.nl/~kwanten (The Ginkgo Pages by Cor Kwant)
2. http://www.ucmp.berkeley.edu/seedplants/ginkgoales/ginkgo.html
3. http://www.conifers.org/gi/index.htm
4. http://en.wikipedia.org/wiki/Ginkgo_biloba, http://wapedia.mobi/de/Datei:GINKGOBAUM-2.jpg
5. http://ginkgo-biloba1771ginkgoeu.blogspot.com/
6. http://www.stevenfoster.com/education/monograph/ginkgo.html
7. http://www.stevenfoster.com/photography/imageviewsg/ginkgo/production/gbp5_071710/index.html
8. http://www.herbs.org/greenpapers/ginkgo.htm
9. http://www.ginko.cdfoto.net/ginkgo_tree.htm
10. http://www.theepochtimes.com/n2/content/view/18896/, http://epochtimes.com/gb/9/6/30/n2573911.htm
11. http://www.itmonline.org/arts/ginkgo.htm
12. http://www.planet-weimar.de/ginkgobiloba/ginkgo-und-seine-namen/index.html
13. http://kiskertesz.freeblog.hu/
14. http://foto-ginkgo.blogspot.com/
15. http://hort.ufl.edu/trees/GINBILA.pdf
16. http://davesgarden.com/guides/pf/go/337/
17. http://www.ibiblio.org/botnet/flora/gibiframe.html
18. http://www.plymouth.gov.uk/text/museumobjectmonth2?objid=200319
19. http://hua.huh.harvard.edu/china/mss/volume04/GINKGOACEAE.published.pdf
20. http://picasaweb.google.com/lh/photo/IQE4AYoM4KaMKH4DJPq2iA
21. http://www.lib.ncsu.edu/theses/available/etd-07062006-101949/unrestricted/etd.pdf
22. http://www.clevelandclinicmeded.com/medicalpubs/pharmacy/sepoct02/ginkgo.htm
23. http://apps.who.int/medicinedocs/en/d/Js2200e/18.html#Js2200e.18
24. http://www.kamprint.com/views/
25. http://thewip.net/contributors/2008/08/south_asias_oldest_tree_specie.html
26. http://www.lovett-pinetum.org/?page_id=977
27. http://de.academic.ru/dic.nsf/dewiki/523090
28. http://ulsanonline.com/Travel/
29. http://www.flickr.com/photos/limetom/
30. http://en.nicoga.in/link/?title=ginkgo
31. http://www.tripadvisor.com/Tourism-g58804-Vantage_Washington-Vacations.html
32. http://www.skyscrapercity.com/showthread.php?t=491800
33. http://commons.wikimedia.org/wiki/Category:Ginkgo_biloba
34. http://commons.wikimedia.org/wiki/Category:Ginkgo_biloba_%28Sch%C3%B6nbrunn_1781%29
35. http://www.plantsystematics.org/cgi-bin/dol/dol_terminal.pl?taxon_name=Ginkgo&rank=genus
36. http://www.antikasia.com/articles_detail.php?EventArg=2
37. http://hobbithouseinc.com/personal/woodpics/ginko.htm
38. http://tree-species.blogspot.com/2008/04/ginkgo-petrified-forest-vantage.html
39. http://www.pabigtrees.com/trees/species/ginkgo_maidenhair.htm
40. http://www.cityofsacramento.org/ccl/pdf/SHCC_MasterPlan.pdf
41. http://texastreeplanting.tamu.edu/Display_Onetree.aspx?tid=33
42. http://www.smithsonianeducation.org/educators/professional_development/conference /2009/climate_change/ginkgo/ginkgo_herbarium.html
43. http://cumuseum.colorado.edu/Research/Objects/dec07_ginkgo.html
44. http://inkyleaves.blogspot.com/2009_08_01_archive.html
45. http://tokyocinema.net/scienceE.htm
46. http://www.mobot.org/gardeninghelp/plantfinder/sshow.asp?ssid=28&slddtl=1
47. http://www.chemspider.com/Chemical-Structure
48. http://commons.wikimedia.org/wiki/File:GinkgolideB.png
49. http://www.minerals-witchcraft-store.com/feuilles-ginkgo-ginkgo-folium-100gr-pi-1798.html
50. http://www.innernet.net/galleryofwood/pricelist.htm
51. http://farm4.static.flickr.com/3227/3001905918_0d42c31732_b.jpg
52. http://www.worldagroforestrycentre.org/Sea/Products/AFDbases/AF/asp/SpeciesInfo.asp?SpID=17924
53. http://www.fao.org/docrep/x1022e/x1022e03.htm#12
54. http://www.nutsonline.com/cookingbaking/powders/ginkgo.html
55. http://purebulk.com/ginkgo-biloba-leaf-pe-24-6
56. http://ginkgowoodworks.com/our_process.html a) http://swanketyswank.com
57. http://dodol-mochi.blogspot.com/2009/12/jobs-tears-dried-beancurd-gingko-nut.html
58. http://www.notfarfromthetree.org/archives/809
59. http://blog.lib.umn.edu/michaels/tuesmorn/2009/09/
60. http://www.artfulhome.com/product/Stephen-LeBlanc/Ginkgo-Drop-Earrings/46861
61. http://www.alibaba.com/Ginkgo-Nuts_pid10407
62. http://www.oliverk.org/weblog/?paged=2
63. http://picasaweb.google.com/lh/photo/SqLR1tJOMVCuifKxjZuB2g
64. http://koreazy.com/category/new-york-times/
65. http://green-woodtrees.blogspot.com/2009_11_01_archive.html
66. http://www.kyoboku.com/47/nara/ohatsuki.html
67. http://www.nybg.org/wordpress/?p=969
68. http://www.horizonstudio.it/public/viewtopic.php?f=27&p=177
69. http://burgersonion.blogspot.com/2009/02/ginkgo-and-trouble-with-living-fossils.html

70. http://blog.dogu.shop-pro.jp/?eid=256920
71. http://www.geocities.jp/shinseimokuzai/gyoumu.htm
72. http://blogs.yahoo.co.jp/qucn9753/30493210.html
73. http://saitonoie.sagafan.jp/d2009-04.html
74. http://nowayout.blog.so-net.ne.jp/2009-12-06
75. http://visualsunlimited.photoshelter.com/search?I_DSC=ginkgo&I_DSC_AND=t&_ACT=search
76. http://waynesword.palomar.edu/plapr96.htm#ginkleaf
77. http://www.olympusfluoview.com/search/index.asp
78. http://www.microscopyu.com/staticgallery/dxm1200/ginkgoleaf20x.html
79. http://www.photomacrography.net/forum/viewtopic.php?t=8298&highlight=ginkgo
80. http://delta-intkey.com/gymno/www/ginkgo.htm
81. http://wordsdomination.com/lenticel.html
82. http://www.pbase.com/image/36606635
83. http://jschumacher.typepad.com/joe/2003/10/gathering_ginkg.html
84. http://outofmyface.com/
85. http://www.isa-arbor.com/publications/arbnews/jun01/figure2.aspx
86. http://www.dkimages.com/discover/Home/Gardening/Gardening-Basics/Pruning/Ornamental-Trees/Ornamental-Trees-041.html
87. http://www.kyoboku.com/itefu/enigatake.html
88. http://farm4.static.flickr.com/3157/2872910993_df4b7995a1_o.jpg
89. http://www.worldofstock.com/closeups/TAJ1212.php
90. http://d.hatena.ne.jp/CasparBartholin/20100310
91. http://www.yinxingjidi.com.cn/yinxingzaipei1.htm
92. http://kawasakimidori.main.jp/
93. http://www.absoluteastronomy.com/topics/Seed, http://www.answers.com/topic/seed
94. http://www.russianwolfwoodworks.com/Ginkgo.jpg
95. http://www.microscopyu.com/articles/fluorescence/filtercubes/yellow/y2ec/y2ecginkgolarge.html
96. Annals of Horticulture for 1848. London, 23-24.
97. Balz, J.-P., 1997. Agronomic aspects of Ginkgo biloba leaves production. In Proceedings of '97 International Seminar on Ginkgo, Nov. 10–12, Beijing, China, 101–104.
98. Beek, A. Van., 2000. Medicinal and Aromatic Plants—Industrial Profiles: Ginkgo biloba.
99. Begović, B., 2009. Svijet ginka, Croatia (manuscript).
100. Bell, P. R. & Hemsley, A. R., 2000. Green Plants. Their Origin and Diversity. Sec. Ed. Cambridge, 241-245.
101. Coder, K.D., 2003. Ginkgo: Eldest Tree Survivor. School of Forest Resources, University of Georgia. September 2003.
102. Critchfield, W.B., 1970. Shoot growth and heterophylly in Ginkgo biloba, Bot. Gaz. 131(2): 150-162.
103. Del Tredici, P., 1981. The Ginkgo in America. Arnoldia 41 (4): 150-161.
104. Del Tredici, P., 1983. Resurrecting Gardiner Greene's Ginkgo. Horticulture 61 (11): 112-117.
105. Del Tredici, P., 1989. Ginkgo biloba: Evolution and seed dispersal. In: P. Braquet (ed.): Ginkgolides—Chemistry, Biology, Pharmacology and Clinical Perspectives, Vol. 2: 1-13. J. R. Prous Science Publishers: Barcelona.
106. Del Tredici, P. 1991., The evolution and natural history of Ginkgo biloba L. Ph.D. thesis, Boston University.
107. Del Tredici, P. 1991., Ginkgos and people: a thousand years of interaction. Arnoldia 51(2): 2-15.
108. Del Tredici, P., 1991. The architecture of Ginkgo biloba L. In: C. Edelin (ed.) L'Arbre: Biologie et Developement. Naturalia Monspeliensia no h.s. A7: 155-168.
109. Del Tredici, P., 1992. Natural regeneration of Ginkgo biloba from downward growing cotyledonary buds (basal chichi). American Journal of Botany 79 (5): 522-530.
110. Del Tredici, P., 1992. Where the wild Ginkgos grow. Arnoldia 52 (4): 2-11.
111. Del Tredici, P., H. Ling, and G. Yang. 1992. The Ginkgos of Tian Mu Shan. Conservation Biology 6 (2): 202-209.
112. Del Tredici, P., 1993. Ginkgo chichi in nature, legend, and cultivation. International Bonsai 15 (4): 20-25.
113. Del Tredici, P., 1996. Ginkgo biloba. In: Enzyklopadie der Holzgewachse: Handbuch und atlas der dendrologie - 6. Erg. Lfg., 10. Ecomed Verlag, Landsberg.
114. Del Tredici, P., 1997. Lignotuber formation in Ginkgo biloba. In: T. Hori, R. W. Ridge, W. Tulecke, P. Del Tredici, J. Tremouillaux-Guiller and H. Tobe (eds.): Ginkgo biloba--A Global Treasure, 119-126. Springer-Verlag, Tokyo.
115. Del Tredici, P., 2000. The evolution, ecology, and cultivation of Ginkgo biloba. In: T. van Beek (ed.): Ginkgo biloba, 7-23. Harwood Academic Publishers, Amsterdam.
116. Del Tredici, P., 2007. The phenology of sexual reproduction in Ginkgo biloba: ecological and evolutionary implications. Botanical Review 73(4): 267-278.
117. Del Tredici, P., 2008. Wake up and smell the Ginkgos. Arnoldia 66 (2): 11-21.
118. Duke, J.A., 2001. Handbook of nuts: Herbal Reference Library.(1989) 163-166.
119. Friedman, W.E., 1987. Growth and development of the male gametophyte of Ginkgo biloba within the ovule (in vitro). Am. J. Bot., 74, 1797–1815.
120. Gifford, E.M. and Foster, A.S., 1987. Morphology and Evolution of Vascular Plants, W.H.Freeman and Company, New York.
121. Greenfield, J. & Davis, M.J., 2004. Medicinal Herb Production Guide. Ginkgo biloba. (http://www.naturalmedicinesofnc.org/mono-gg.html)
122. Gunkle, J.E., Thimann, K.V., and Wetmore, R.H., 1949. Studies of development in long shoots and short shoots of Ginkgo biloba L., part IV. Growth habit, shoot expression and the mechanism of its control. Am. J. Bot., 36, 309–316.
123. Handa, M., Iizuka, Y., and Fujiwara, N., 1997. Ginkgo landscapes. In T.Hori, R.W.Ridge,
124. Hori, T., R.W. Ridge, W. Tulecke, P. Del Tredici, J. Tremouillaux-Guiller and H. Tobe (editors): Ginkgo biloba—A Global Treasure. 1997. Springer-Verlag, Tokyo.
125. Hori Y, Fujisawa M, Shimada K, Oda A, Katsuyama S,Wada K., 2004. Rapid analysis of 4-Omethylpyridoxine in the serum of patients with Ginkgo biloba seed poisoning by ion-pair high-performance liquid chromatography. Biol Pharm Bull, 27:486–491.

126. Huh H, Staba EJ., 1992.The botany and chemistry of Ginkgo biloba L. Journal of herbs, spices and medicinal plants, 1:91–124.
127. Ion, S. & Cătălin George, S., 2008. The anatomic study of the Ginkgo biloba L. leaf. 44th Croatian & 4th International Symposium on Agriculture. 803-807.
128. Kajiyama, Y., Fujii, K., Takeuchi, H., Manabe, Y., 2002. Ginkgo seed poisoning. Pediatrics, 109:325–327.
129. Keys, J.D., 1976. Chinese herbs, their botany, chemistry and pharmacodynamics. Rutland, VT, CE Tuttle.
130. Lee, H. et al., 2008. Compound isolated from Ginkgo biloba bark, isolation method thereof and antiplatelet composition containing the same. United States Patent 7341750 (http://www.freepatentsonline.com/7341750.html)
131. Liang, L., 1993. The Contemporary Ginkgo Encyclopedia of China, Beijing Agric. Univ. Press (in Chinese).
132. Lin, J.-X., 1995. Old Ginkgo trees in China. International Dendrological Society Yearbook, 1995, 32–37.
133. Melzheimer, V., 1992. Ginkgo biloba L. aus Sicht der systematischen und angewandten Botanik. Pharmazie in unserer Zeit, 21:206–214.
134. Melzheimer, V. & Lichius, J.J., 2000, Ginkgo biloba L.: Aspect of the systematical and applied botany, in Ginkgo biloba (ed. Beek, T.A. van), 25-47
135. Miwa H, Iijima M, Tanaka S, Mizuno Y., 2001. Generalized convulsions after consuming a large amount of gingko nuts. Epilepsia, 42:280–281.
136. Nelson, S.L. et al., 2007. Handbook of Poisonous and Injurious Plants. 169-170.
137. Sasaki, K. et al., 2000. Bilobalide prevents reduction of gammaaminobutyric acid levels and glutamic acid decarboxylase activity induced by 4-Omethylpyridoxine in mouse hippocampus. Life Sci. 67:709–715.
138. Shepperd, W.D., 2008. In Bonner, F. T. & Karrfalt, R. P. The Woody Plant Seed Manual. Agric. Handbook No. 727. Washington, DC. U.S. Department of Agriculture, Forest Service. 559-561.
139. Shi-mei, L. et al. 2007. Morphological Development of Ovule-like Organ on the Leaf and Variation Characteristics of Ginkgo biloba var. epiphylla Mak. (Ohatsuki) Acta Horticulturae Sinica, 34 (1): 1-6.
140. Siebold, F. & Zuccarini, J., 1835 – 1870. Flora Japonica. Leiden. Tab.156.
141. Sprecher, A., 1907. Le Ginkgo biloba L. Geneve.
142. Tatić, B. & Blečić, V., 2002. Sistematika i filogenija viših biljaka. Beograd, 145-150.
143. The book-notes B. Begovic 2005-2010 (manuscript), Croatia.
144. Van Beek, T.A. & Lelyveld, G.P., 1993. Thin layer chromatography of bilobalide and ginkgolides A, B, C and J on sodium acetate impregnated silica gel. Phytochemical analysis, 4:109–114.
145. Vidaković, M., 1982. Četinjače, Zagreb.
146. Wang, C.W., 1961. The Forests of China, Maria Moors Cabot Found., publ. 5. Harvard Univ., Cambridge, Mass.
147. Watson, L. and Dallwitz, M.J., 2008. The Families of Gymnosperms (http://delta-intkey.com/gymno/www/ginkgo.htm)
148. WHO monographs on selected medicinal plants. 1999. Geneva, 1, 154-168.
149. Xiang, Z., Y. Xiang, B. Xiang and P. Del Tredici, P., 2009. The Li Jiawan grand Ginkgo king. Arnoldia 66(3): 26-30.

Pruned Ginkgo tree in Autumn, Kawasaki, Kanagawa, Japan. Photo by Kawasaki Green Investigation, Japan. (92)

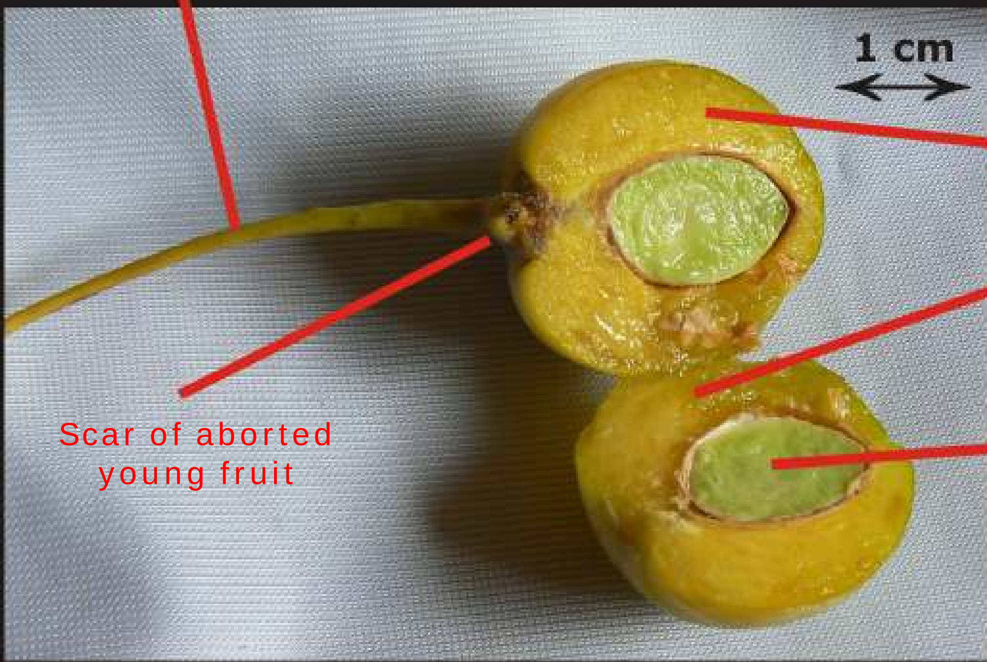
Ginkgo biloba fruit and seed - picturesque description



Scar of aborted young fruit

Fruit

Petiole fruits (fruitstalk)



Fleshy part

Scar of aborted young fruit

Immature seed (cca 01. October)

Seeds

Seed - three edge (male)

4

Cultivation and propagation of the plant *Ginkgo biloba*

Foreword

The greatest friend in the propagation of Ginkgo has undoubtedly been an still is the wind that blows pollen from the male tree for miles until the semen reaches a mature female egg. Just like in humans. However Ginkgo may be by human intervention replicated in many other ways.

Often asked question in Ginkgo's youth is: which gender is it? By certainty we can not know that foe almost 30 years. As if the plant deliberately wants to keep his long formulated secret.

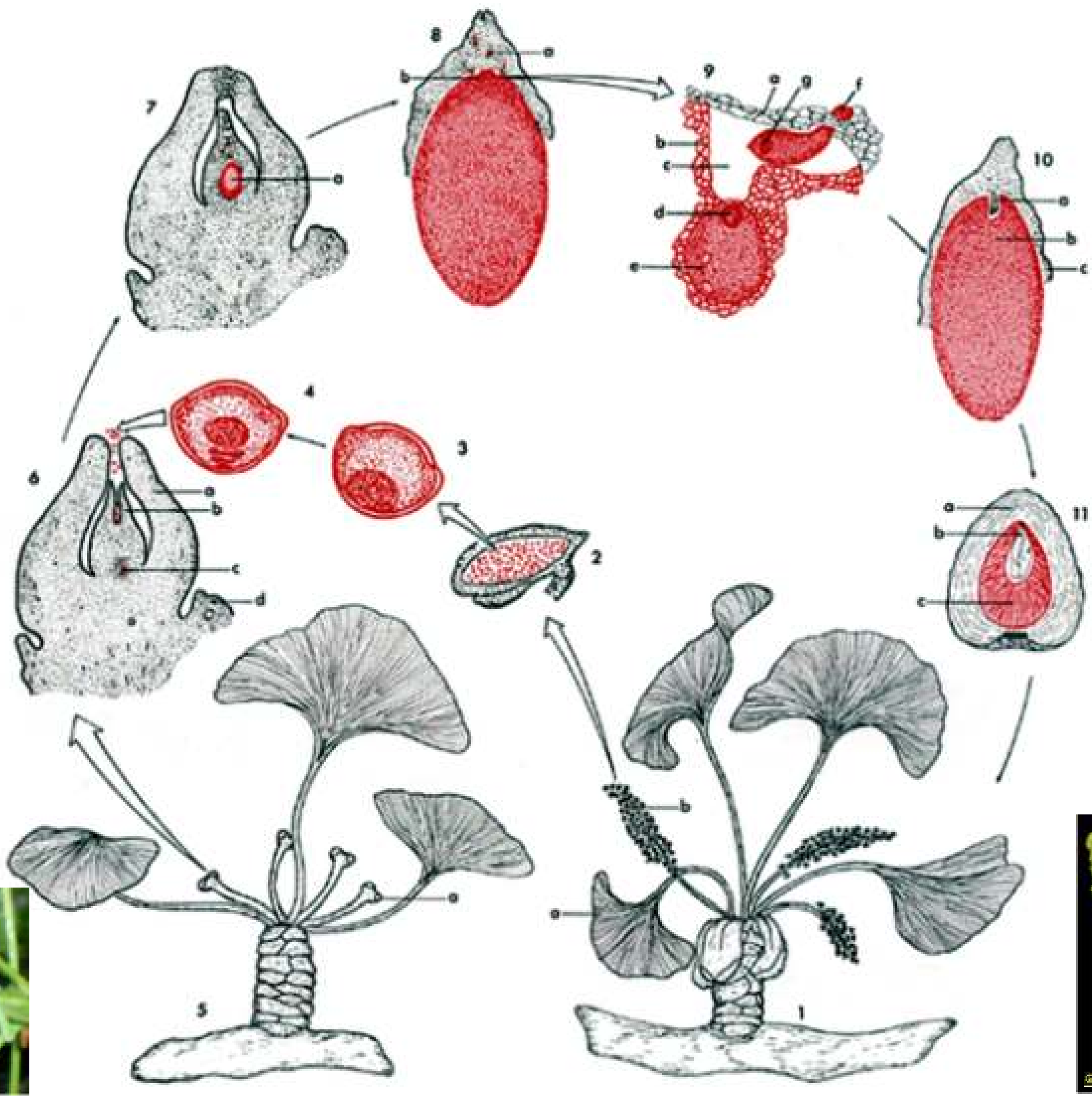
When the Ginkgo plant flourish and it happens in early spring when it gets his leaves, flowers are also characteristic in appearance. Some might think what kind of flower has no taste or smell? Ginkgo's flower as well as the leaf refuses insects and still looks marvelous. When flowers turn into the non smelly fruit then cleaned and dried seed becomes a real treat and a cure at the same time just as the whole leaf mass in autumn period. This is exactly the reason that Ginkgo is increasingly grown for the purpose of exploitation of the leaf from which medical Ginkgo's extract is being made. During the evolution Ginkgo's genetic codes have developed in a way that he must survive at any cost in any conditions and on any ground so growing Ginkgo is relatively undemanding. He quickly adapt to almost any climate and can handle very low and very high temperatures, plenty of sunshine, but also a lot of cold, may be long without the water etc.

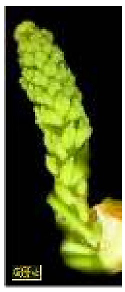
1
The process of fertilization - ovulation and fertilization

Process of budding and flowering of Ginkgo, ovulation (pollination) and the process of fertilization is one of the most important period connected to the natural propagation of the plant. This process has not changed for millennia apart from human intervention, collecting seeds, stratification and planting seeds and in fact has not changed since the natural ways to reproduce the plant when the seeds simply fall to the ground and with favorable conditions sprout by itself. Today we can see that Ginkgo in a natural way without the participation of humans may still proliferate throughout the world and this raises the question: why in fact has he died out? The response was confirmed primarily by climate changes in the past, etc.

When Ginkgo starts to bud in March flowers are formed in parallel. After about a month (or depending on the microclimate) flowers mature and the process of ovulation of the egg begins (pollination), and then mobilized sperm and fertilization, which takes approximately two months and more. After fertilization the plant inevitable reject (or abortion) part of embryos in May, and during continuing maturation of the fruit occasionally it can reject a part of a seeds. The process of ovulation and fertilization can be seen in the graphical view.

Maturation of the fruit happens a little before female specimens begins to drop off the leaves. By that time leaves from male specimens birds are mostly fallen and are already very yellow.





1) Shoot with male stamens a) Prominent stems leaf dichotomous b) Microstrobile 2) microsporophylls 3) Microspora 4) gametophyte (pollen) 5) Push females with eggs a) Ovule 6) Ovules at pollination a) Integument b) Megasporange c) Tetrad of megaspores d) Col (megasporophylle?) 7) Ovules a) megagametophyte 8) megagametophyte a) pollen tube b) archegonia 9) archegonium after fertilization a) Tissue megasporange b) megagametophyte c) House of the archegonium d) Nucleus of o (v) osphère e) archegonia f) pollen tube g) Nucleus of antherozoid 10) Embryo a) Embryo (new sporophyte) b) megagametophyte c) Megasporange 11) Seed a) Old sporophyte b) Embryo (new sporophyte) c) megagametophyte. Drawing by Athénée Fernand Blum, Belgium. (2)

Development of Ginkgo fruit. Top left: liquid droplets are visible to which pollen sticks. Bottom left: abnormally developed organs ovulating.

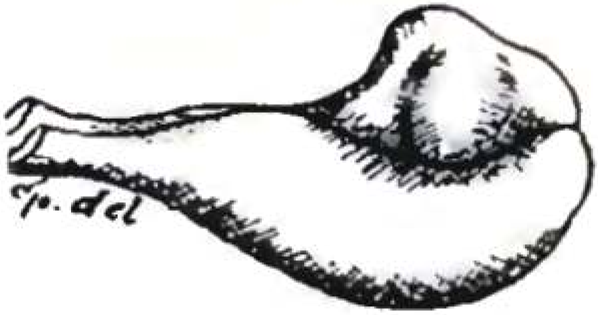
2
Germination and development of young plants

After harvesting seed preparation for planting can be done in many ways. About it you may see some basic sketches below. In early spring time seeds get enough moisture, and the ambient temperature is min. 15 degrees C or more, the seeds swells and on the blunt side of the seed germination begins. If the seed is deep in the ground germination will be. Sometimes it takes more than 50 days to germinate and if the conditions are excellent it will germinate after fifteen days. The seed has two cotyledons which remain in the ground after germination and holds on for the plant in the next two years.

When the plant germinates it is preferable not to touch her until next year, but if the seeding was conducted individually in separate containers then plants can be grafted into larger containers throughout the year. The most important thing is that plant develops properly and that by the end of vegetation period gets woody so that leaves would not weight her down. From the ground first will appear one shoot 1-2 cm long which consists from 2-3 shoots from which central axis will rise and which will, during the first year, have up to 10 es. leaves. In the first germination phase seeds will flush out on the opposite side of the shoot, stem with several small vessels, while the seed usually remain lying in a horizontal position all until it will rot next year.

Growing very young plants proved to be excellent if it is planted in a container in a lying position with fifty seeds or more at a distance of about 5-10 cm. In this case, after the outbreak of the germ and the formation of the leaf they will hold on together and stand upright until they become woody. It is best to wait until the end of the vegetation and leave falling and then separate the plants each for themselves in a larger container in which they will freely develop the root system in the following year or two.

It is difficult to speak about the quantity of germination. If conditions are good for



Drawing the cotyledon Ginkgo plant about 2 months old. (109)

Example: sowing and germination of seeds.

From sowing to germination of seeds Ginkgo. Left side: sowing and germination.
The left side of the above: drawing - seed > plant. (29)

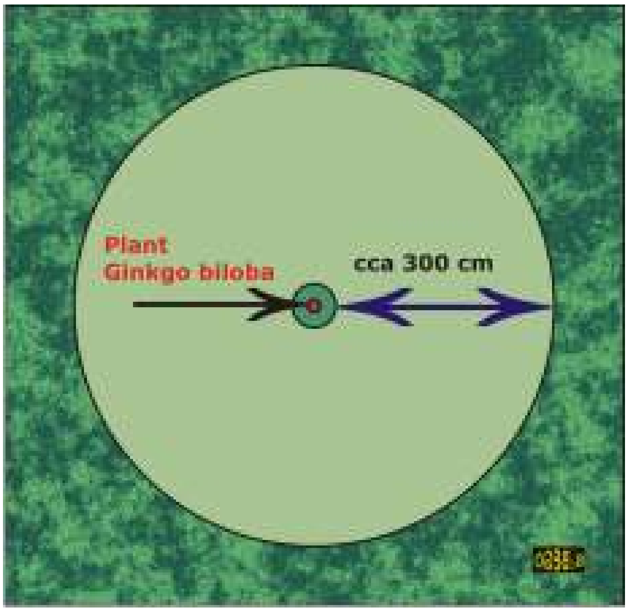
Seedlings under the Ginkgo tree. After transplantation in the container is only a few survived.

germination, and if good seed stratification has been made sometimes 90% of seed will germinate, and sometimes only 20-30%. By monitoring the germination of plants it has been observed that from the seeds fallen from the fruits germination will appear somewhat later than those sown by human intervention. In addition the young plant will appear in cases when during the winter fruit with seeds was covered with soil. From experience, we observed that almost all germinated plants was found on places where seeds fallen in the channels that was made by moles or voles.

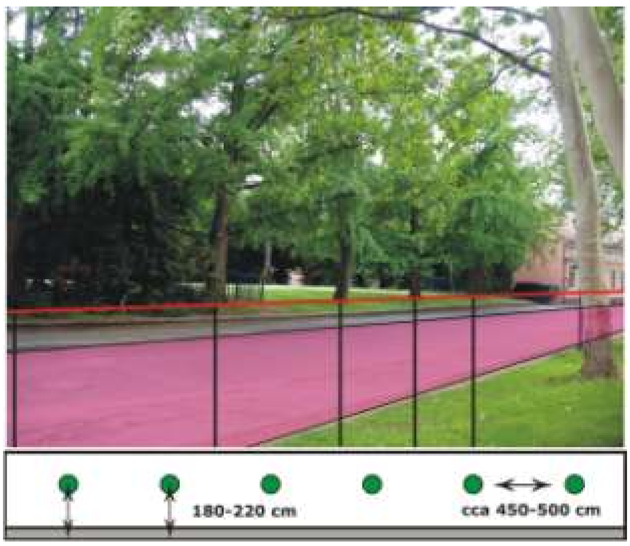
3
Grafting of young and other plants

Grafting plants in containers or somewhere else is a demanding job and requires certain rules. Young plants which were grown each in one container can be grafted throughout the year. From small to large container is good to enough moisten the earth with root systems, remove the container and transplant into a larger container with the addition of the required substrate. Plant can stay in the container for up to ten years and more, and in this way, with additional interventions, bonsai forms can be grown. If we want to grow bigger plant that will be grafted in the stage of growth then best practice is to put plants into the ground along with a container which must have sufficient openings to drain excess water out of the root system when the space becomes too small.

Ginkgo is known as a plant that tolerates grafting even at the time of vegetation, but in this



Up right: a rare example of giving nutrients (infusion) in old Ginkgo tree. Lengqi, China. About 1700 years old tree. Photo by Zhou Xiaolin from www.youduo.com in 2008.
Other: an example of a well dispersed plants alley Ginkgo (detail) in the center of a European city where they were planted in male and female plants together. Shortly before falling fruit grass properly maintained, and fallen fruit every morning to pick up the lawns and sidewalks. A well thought-out and a model example that even in cities growing and female plants and fruits that smell does not bother anyone.



Planting Ginkgo in a soil with a container; it is because of the possibility of safe transplantation in the vegetation (USA, UK, Czech Rep.). (86, 85, 8)

case it is necessary to take care that the plant has a multitude of tiny capillaries and it is necessary to dig a large amount of soil together with the roots. During vegetation rest grafting of any plant (no matter how old) will be successful if we take minimal care about minimal root damage and branches can not be cut. There are famous examples where older plants have been grafted, some even a thousand years old. I'll give an example from the first half of the 19th century, when in the honor of Dr. David Hosack about 40 years old tree in New York (where it was planted around 1800 by Hosack) was moved in Boston (USA), and there is also an interesting example from March 2010, when the wind blew down more than 1000 years old legendary tree in Kamakura, Japan. Experts have repaired it and re-planted it

Moving into the old Ginkgo Botanical Garden in Brooklyn (USA) 2008. (16, 17)

Right: three years old plant (detail).

and tree survived. Interesting migration occurred in 2008 in the Brooklyn Botanical Garden. On this occasion more than 200 tons tree was moved simply because it began to large and authorities decided to migrate it rather than demolition it.

4
Growing solitary Ginkgo plants

Growing Ginkgo as a solitary plant for decoration or collection leaves for medicinal purposes does not require a lot of things. Already we can see that ginkgo is not very demanding plant. For example I will describe what is basically required to grown a tree that will shine in its full glory, whether it is Ginkgo of typical species or Ginkgo cultivar.

Firstly we must bear in mind that over time, if it is a typical species, plant grow quite large, such as walnut or oak. So we must plant to plant at the site where it will have enough space. It is quite enough to be planted in a circle where at least in about 3 meters on each side there is no more plants or buildings. Most commonly planted are 2-5 years old plants which corresponds to the plant from 100 to 200 cm. Such plants are shipped

Up: Queen Elizabeth II planted Ginkgo tree at Kew Garden in 2006 on the occasion of his 80 birthday. Photos by Kew Gardens, UK.

Quality Ginkgo tree (2 years).

The leaves of this plant is completely turned white - for unknown reasons (?), USA. Photo by Tim Copeland, USA. Left & down: ibid. Photos by A. Novak, Croatia (2011). One year old plant.

Left: preparation of large Ginkgo trees for sale, China. (See 70, 71, 72)

Planting about 15 years old Ginkgo tree. Photo by Christine Mytko, California, USA.

Transplanting Ginkgo plant from container at the landscape.

Mandatory treatment for plants that are grown in a container. Transplantation of small into a larger container.

Left and down: example planting Ginkgo tree in Central Park Pasadena 2004, USA. Photos by Pasadena Beautiful Foundation, California, USA. (106)

Down right: planting early Ginkgo trees in China. (74)

in containers and almost always tied to a pillar such as bamboo or wooden stick and that is important because during strong winds, for example, damage of the branches and leaves could occur. If the plants are older than their roots are wrapped in a punctured natural fabrics mostly jute. Of course the prop is not required if the plant is already larger and well-formed. As ginkgo loves deep sandy soil it is good to dig a hole approximately 50x50 cm, depending on the size of a double root deeper. At the bottom it is a good to make the drainage layer from existing crushed up soil and difference to the root of plants supplement with substrate that can be purchased at almost any store that sells equipment and supplies for gardening. Position location in this case is not important since the plant will in any case have enough light. After planting we should take care that during first few months plant is regularly irrigated. Around the tree itself it is important to mulch (ground straw, sawdust, conifer, conifer bark, etc.) which will in any case retain moisture in the earth and the sun will not directly heat the land and root of the plant.

After planting we must take care to not damage or cut off any branches. It is not necessary to spray ginkgo against insects or common diseases, but it is good to protect young plants with the flawed net to protect it from an attack of birds or crickets who love to lay eggs on ginkgo and then larvae suck plant juices. At the first time it is not bad to put some protection against voles which prefer to attack the root of (especially) new plants in the environment. It is enough to do fertilize Ginkgo once or twice a year. It can be done foliar or through root.

Ginkgo plantation in China. After winter pruning, and in the spring. Tancheng, Shandong province, China. (Liyi Association For Science & Technology). Photos by Hong-Sheng Li, China.

(For example) Ginkgo Plantation in Guangxi Province (China).
Facts about our plantation
Total Area - about 13 hectares Elevation -220-300 metres Soil - red soil PH value - 5.5-6.5 Type of climate - sub-tropical monsoon type climate Annual temperature range - Average 18 degrees C. - Lowest 7 degrees C. - Highest 27 degrees C. Annual beam - Average 1602 hours Annual rainfall - Average 1900 mm Annual No.of days without frost - Average 300 days Major plants cultivated - *Ginkgo biloba* L. trees (52)

One interesting:
Ginkgo is a much needed sunlight. That is the reason that the plant absorbs significant amounts of temperature. Ginkgo tree canopy provides excellent cool-shade. For example: atmospheric temperature 40.2°C = below canopy Ginkgo = 35.3°C (temperature difference = 4.9°C), under the canopy of willow (*Salix*) = 37.9°C (temp. differ. = 2.3°C). (60)

Ginkgo plantation in Bordeaux. Harvesting leaves. (France). Photo by "Dr. Willmar Schwabe Pharmaceuticals", Karlsruhe, Germany. (3, 5, 6, 56)

Manual harvesting leaves in China (Changchun Ginkgo) Xuzhou, Jiangsu Province 2002. (59)

Eksperiment plantation Ginkgo tree. General inf.: Total area; 0,7 ha, Elevation; cca 120 m; Type of climate: continentale (HZ 7/8); pH value: 5-6; Soil: sand and a mixture (clay, marl, mold).

Left: the process of drying the leaves. Right: Packaging of dry leaves.Tancheng, Shandong province, China. (Liyi Association For Science & Technology). Photos by Hong-Sheng Li, China.

Right: harvesting Ginkgo leaves in Shandong, China. (Photos by Tancheng Xinsheng Ginkgo Co., Ltd , Locus of Xincun Government, www.ginkgo-hometown.com/).

Famous Chinese botanist Pang in Ginkgo garden. Thanks to him, in the 1970s began the organized production of leaves and seeds of Ginkgo on plantations. Especially after he perfected artificial pollination Ginkgo etc. (66)

Bundles dry leaves waiting for export. Tancheng, Shandong province, China. (Liyi Association For Science & Technology). Photos by Hong-Sheng Li.

5
Ginkgo plantation cultivation of plants

To solitary plant a tree whether one or more is generally done for the horticultural purposes and these plants are becoming part of landscape architecture. However, there is a planting and breeding exclusively for Ginkgo leaf or seed exploitation. As for plants from which seeds will be used it is understandable that they will be planted in order to grow and mature so that they can yield. Such plants should be planted in the aforementioned manner with the same spacing between the plants as in a city alley.

Ginkgo plants that are planted solely for the purpose of collection of the leaves can be planted in several ways. Two models are most common ones. Namely: to run a distance of about 100 cm plant from the plant or less, or also as a tree to larger spaces between plants from which will leaf will be picked up manually. Each plantation cultivation requires special plant treatment or certain pruning, mineral replenishment, etc.

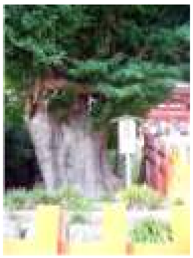
As data show for the other options where plants grown as a tree picking of a leaves can began when plant reaches about 5-6 meters in height.

Plantation mode where on the 1 ha is planted 20-25000 Ginkgo seedlings require special planting and breeding technology. In China and other countries of the East on the such plantations leaf is often harvested by hand, while on large plantations in South Carolina (USA) or France (Bourdeaux, since 1982) is being done with machines too (machinery for cotton harvesting). Except in those countries ginkgo is mostly grown on plantations in Japan and Korea but it is tried elsewhere too for example in Germany, Australia and New Zealand in recent times. Yield depends on the age of plants, microclimate, pruning, top dressing, soil type, etc.

The leaf is harvested in early autumn, for example in France, before the first frosts. It is the time just before leaf has not started to become yellow in color and contains the most active secondary ingredient. After harvest leaves are dried as quickly as possible and within 12 hours and this is done by mixing the leaves into a large gas-heated drum at temperatures of up to 1260 OC. It is important to preserve as much as leaf is possible with the most medicinal ingredients and the leaf is sufficiently dry for further processing when the stems of the leaf is dry. Fresh leaf contains about 75% of moisture, after drying the moisture content drops to 10%. Approximately 3.6 kg of green leaf goes for 1 kg of dried leaves that are baled in cardboard boxes and stored in a dark, dry and cool place. Apart from drying in drums in some parts of the world sheet is dried in the shade on the special bars and it is turned by hand. For example: 4-5 years old plantation after planting with 2-3 years old seedlings can give 12-16 tons of fresh leaf per hectare, which is about 4 tons of dry leaves/ha.

Estimates suggest that China annually produces about 20-30 000 tons of dry leaves and

Exceptional resistance Ginkgo is showed 2010 in Kamakura (Japan). 1200 years ago tree that knocked the wind - was again green. (39, 40, 41, 42, 43 & 90) Photos by Kawasaki Green Investigation, Japan.

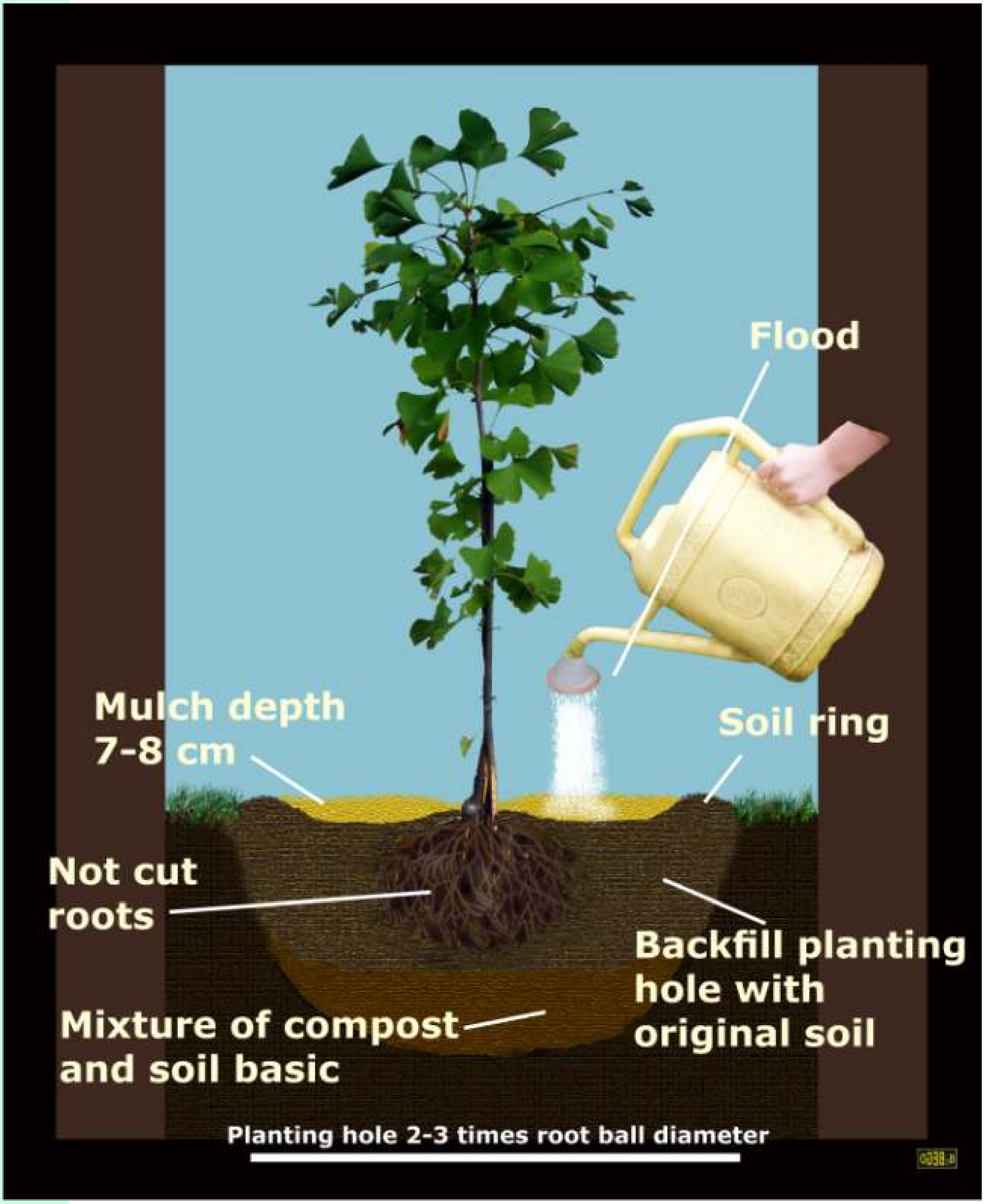


Correctly cutting thick branches.

Very low cut branches in a Ginkgo tree.

The mega cities of the smell of ripe fruit of Ginkgo causes problems. Somewhere trying to remove the smell by spraying chemicals. So it was in Washington in the winter 2008/09th This article says it all: “The bouquet of a ginkgo tree's fruit has strong notes of unwashed feet and Diaper Genie, with noticeable hints of spoiled butter.
For the District government this winter, it is the smell of defeat. This year, arborists working for the city tried a new solution for the stinky fruit, which has plagued residents for decades. They injected more than 1,000 ginkgo biloba trees with a chemical to stop them from producing the fruit. Whoops. The chemical didn't work, for reasons that scientists still don't understand. Now, instead of less Ginkgo stink, Washington has its worst case in years - a bumper crop of nastiness that is studding sidewalks and sliming dress shoes from Capitol Hill to Kalorama” An interesting illustration of this situation. By David Fahrenthold, Washington post, USA. (37)

Down: branches broken by strong winds. Japan. Location of Murata, Shibata District, Miyagi Prefecture (Shiratori-jinja shrine). Photo by Shouta Azumi, Japan.



Good planting Ginkgo tree in landscape.

other parts of the world about 14 000 tones. In many countries of the world there are numerous studies and experimental plantations of Ginkgo. As it is clear that the quantity and quality of valuable ingredients in ginkgo leaf depends on the general climate and microclimate studies in many countries show that in certain areas, for a sunny period, can be expected a larger coefficient of quality. For example, flavonoids in the region of the southern hemisphere (eg New Zealand and Australia).

6
Important factors for good Ginkgo growth

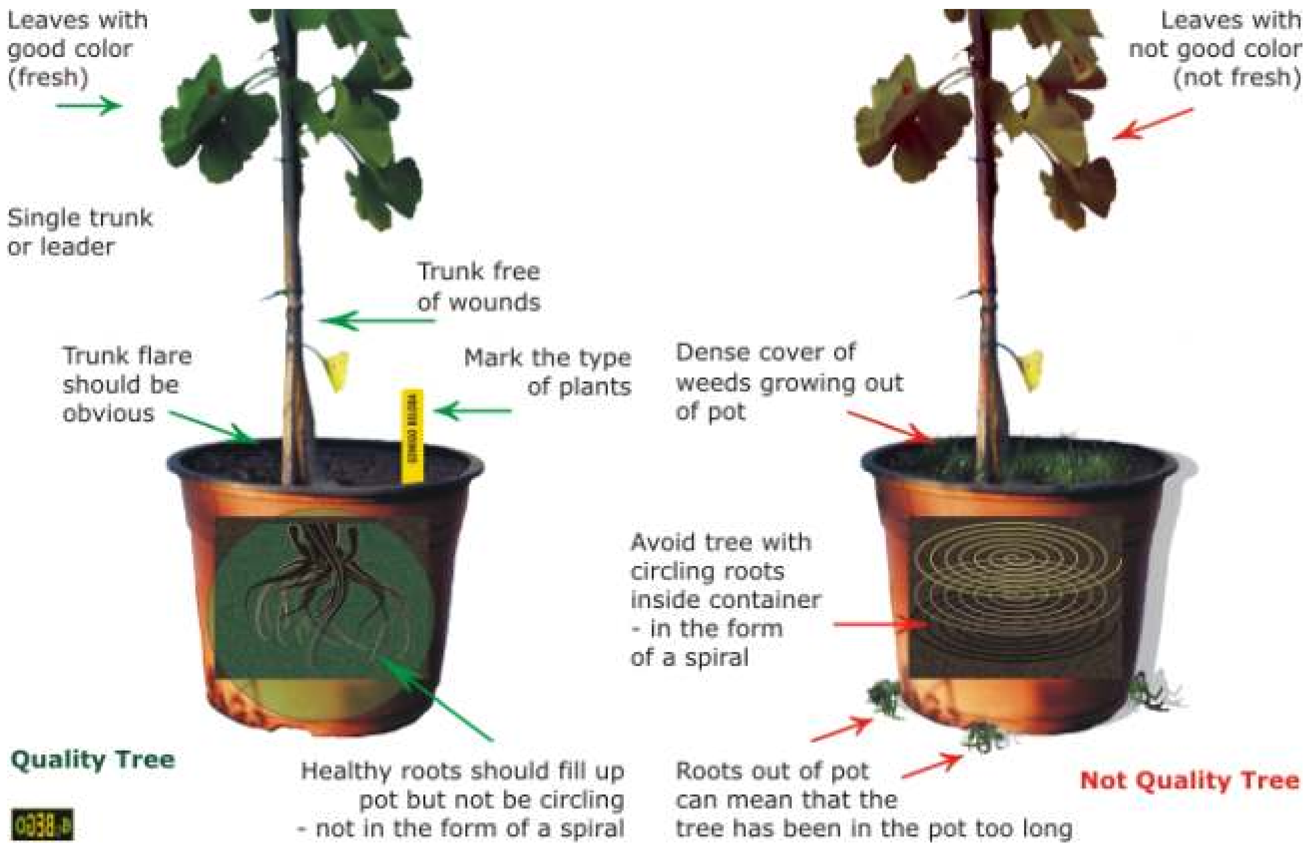
We have already said that ginkgo likes deep, sandy, sunny areas, without much moisture but will succeed better if the permeable soil flows down a certain amount of water, particularly downfall water. Ginkgo perfectly adapts to almost any climate even at pH soil acidity and thrives best at 4-8 climate zones. As regards the relief in which the plant grows we can say that they can determine the optimal value, however, ginkgo will grow on almost any angle to max. 1000 meters above sea level. Here are some basic facts about it.

Soil, substrate, fertilization, relief – for Ginkgos fertilization the best suited are organic fertilizers and various types of compost. Older plants (5-10 years) is enough to fertilize 1-2 times a year and a very old almost never. However, if necessary, which is dependent on local climatic conditions, we should do it. This can be easily seen by the progress of the plant over time, starting from May onwards. To be sure to use proper and necessary fertilizers you may test the ground and for that it is best to consult with the professional agricultural advisory service. But, if your Ginkgo looks good, growing, leaf has a fresh green color, tree, becoming thicker it is not necessary to do or change anything. We reiterate that we must when planting a ginkgo always bear in mind that ginkgo can not stand not prolific sand, gravel, rocky, marshy land and hidden with no sun and with lots of moisture. Everything else fits him. The soil must be "deep" at least the category "medium deep" (90 cm) or "very deep" (> 150 cm), which means that the potential value of the soil increases with depth of physiologically active profile.

According to the known and available data and experience Ginkgo fits almost every relief pitch or completely flat surface. It should be noted that for larger or large plantations (as well as for individual farming) is still the best pitch in relief around the 3-7O, for heavy storm water drainage system because Ginkgo does not tolerate prolonged wet terrain and tolerate drier periods. Ginkgo will grow better on the slope and relief to more than 40^{o} then on the relief of 0^{o}, especially if the climate is where it rains often (on this should take particular care during plantation farming). The same can be said in planting and growing in containers or flower beds. Each container must be at the bottom of the larger openings for the flow or downflow of excess water. When the stem breaks out from the holes it is necessary to graft a plant into a larger container.

When fertilization is concerned it should take into account that the plant receives sufficient amounts of nitrogen, phosphorus in the form of P_2O_5, K_2O in the form of potassium, copper, iron, manganese, boron, zinc, etc.. In solitary breeding if plant develops well supplemental fertilization is not necessary any more than it is costume at any other ornamental plants. In plantation farming there are usually teams of botanists who take care of fertilization of certain plants taking into account all the available elements.

Atmosphere - Ginkgo is not susceptible to modern atmospheric pollution (SO_2 and CO_2), but the clean air certainly fits him and we know that the composition of pure air is (in volume%): nitrogen (N_2) = 78.08, oxygen (O_2) = 20.95, helium (He) = 5.2, carbon dioxide (CO_2) = 3.3, methane (CH_4) = 2.2, neon (Ne) = 1.8, krypton (Kr) = 1.1 , argon (Ar) = 0.93, hydrogen (H_2) and nitrous oxide (N_20) = 0.5, Xenon (Xe) = 0.1 etc.



Above: below good maintained the area around the tree (the female) may find new plants: from the seeds, roots and stem. (82) Left: on an old stump or more years will pursue new plants. (77, 78)

Today the carbon and sulfur dioxide emission is very large and in the atmosphere we can find more and more traces of ammonia and other harmful compounds, depending on the position of the location (city, near the industrial zone, etc.). All that Ginkgo finds acceptable (even great) and is even resistant on it. Although the atmosphere contains the highest amount of nitrogen, which is essential for plant growth that amount is not sufficient for normal growth. Specifically elemental nitrogen from the atmosphere plant uses very little (depending on climate zone and the electrical activity of the atmosphere, because the electrical discharge gaseous nitrogen combines with oxygen to form oxides in which the rainfall transfers them into the ground - but it is insufficient amount of nitrogen) but it is very important because they bind the soil micro-organisms (nitrogen fixation). In the climate of continental climate from the atmosphere on average it is used 5-15 kg of fixed nitrogen per 1 ha which is little (in the subtropical regions efficiency is higher). It is also a small usability of other elements. Therefore plant needs a lot more than air offers. A large part of the necessary chemical compounds and elements so that plant does grow, survive and make proper photosynthesis (except light) plant gets from the soil. This quantity depends on the type of soil so it is necessary to artificially add or remove certain substances.

Let us mention once again that when we speak about resistance Ginkgo tree is very resistant to high temperatures, specifically on fire. Leaf itself when it is fresh is very difficult to mount and it is very difficult to ignite Ginkgo plant.

Good breeding (and cutting) can grow hedge of Ginkgo - Botanical gardens in Kumashiro, Japan. Photo by Kawasaki G. I., Japan. (79)

Left: hedge of Ginkgo, Tokyo, Japan. (90, 91)

Lal Mandi's (200 years) Ginkgo (Kashmir, India) struggles for survival; a section of its bark fell off after poor pruning. Dense suckers at the Ginkgo's base will be propagated into new trees. Example of propagation from the root. Photos by Afsana Rashid Bhat, India. (35)

Light & temperature – it is well known that without light there is no photosynthesis or chemosynthesis nor the production of chlorophyll. The need for the amount of light depends on the plant. Ginkgo requires relatively high amount of light and heat. Average optimum (for over 90% of the population of plant life) of major physiological processes is the temperature from 25 to 30° C, which is particularly important for photosynthetic carbon assimilation. The plant takes maximum of water at temperatures between 35 and 40° C, while the optimum for respiration is between 36 and 40° C. Photosynthesis stops at a temperature of 45° C, (then the chlorophyll begins to inactivate). Plant respiration ceases at temperatures higher than 50° C – and it comes to death. All these values are moving upwards in nature only and exclusively with indigenous plants (ie in the wild succulents are most resistant to high temperatures) and Ginkgo as a separate species that has morphologically developed a very long time and thus survived. Ginkgo does not stop breathing even at temperatures higher than 80° C and all other values in the case of Ginkgo are higher sometimes even doubled. The amount of light that is required for ginkgo in the phase of active physiological processes (photoperiod) is relatively high. In the broader average minimum amount of light needed for plants range from 1000 to 1300 lux. Ginkgo requires a minimum of 2000-2500 lux, and optimally about 3000-4000 lux. According to some surveys nearly 5000 lux or more would not hurt the plant significantly but just a little bit since it will significantly increase the influence of ultraviolet rays. How long will the plant in a habitat actually receive light depends on the value of light using that is calculated by dividing the intensity of light at the site with the intensity of full daylight. If you put it simply: plant is located in a container on a concrete surface exposed to 16 hours of bright sunlight at an average temperature of 30° C will not get as much light (lux) as a plant that is located in half shade (or the occasional shadow) surrounded by 16 hours of grass and a variety of higher plants at the average temperature of 30° C. Let us say also that ginkgo sustain both solutions. But very young plants do not. (96 etc.)

Similar as for high temperatures the same can be said for low ones. Ginkgo ranks high in durability. For thermopile plants transition in zone of negative temperatures mean physiological death. Breathing generally stops at about - 10° C but there are plants that withstand up to - 60° C. On this scale Ginkgo is quite high or low. Some cultivars including typical species can handle up to about - 40° C. Very young Ginkgo plants are less resistant to high and low temperatures. (96)

7
Propagation: vegetative and other

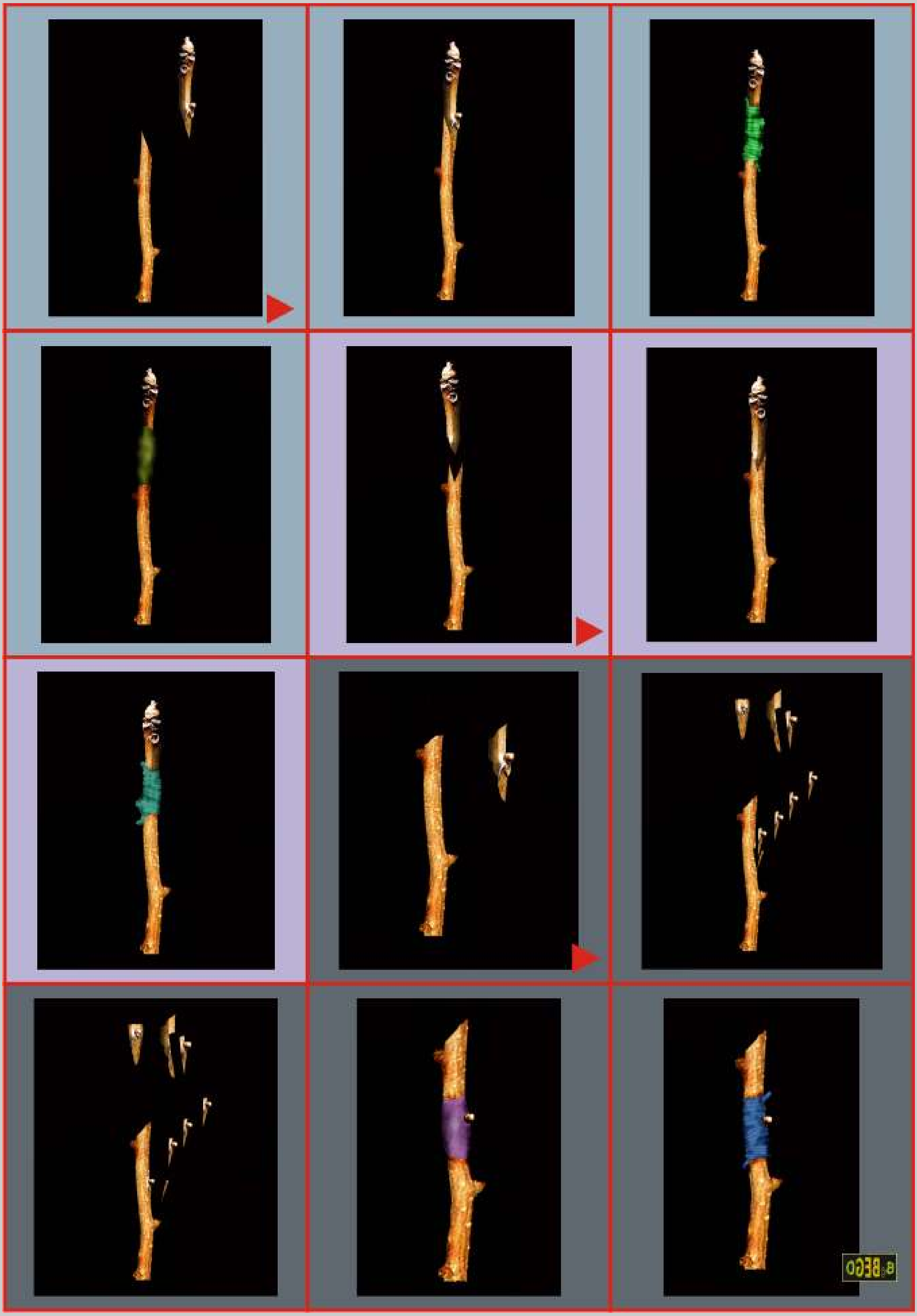
The natural way of Ginkgo reproduction is certainly sexually. Therefore the seed is a great way to breed but today other ways are also represented as well especially vegetative. Thus one can propagate from seed, cuttings, from vessels and from the stump, with margoting technique and with chi-chi root. Here we can add occultation, ie vaccination which is done primarily for the purpose of obtaining cultivars of a particular gender.

(Seed multiplication)

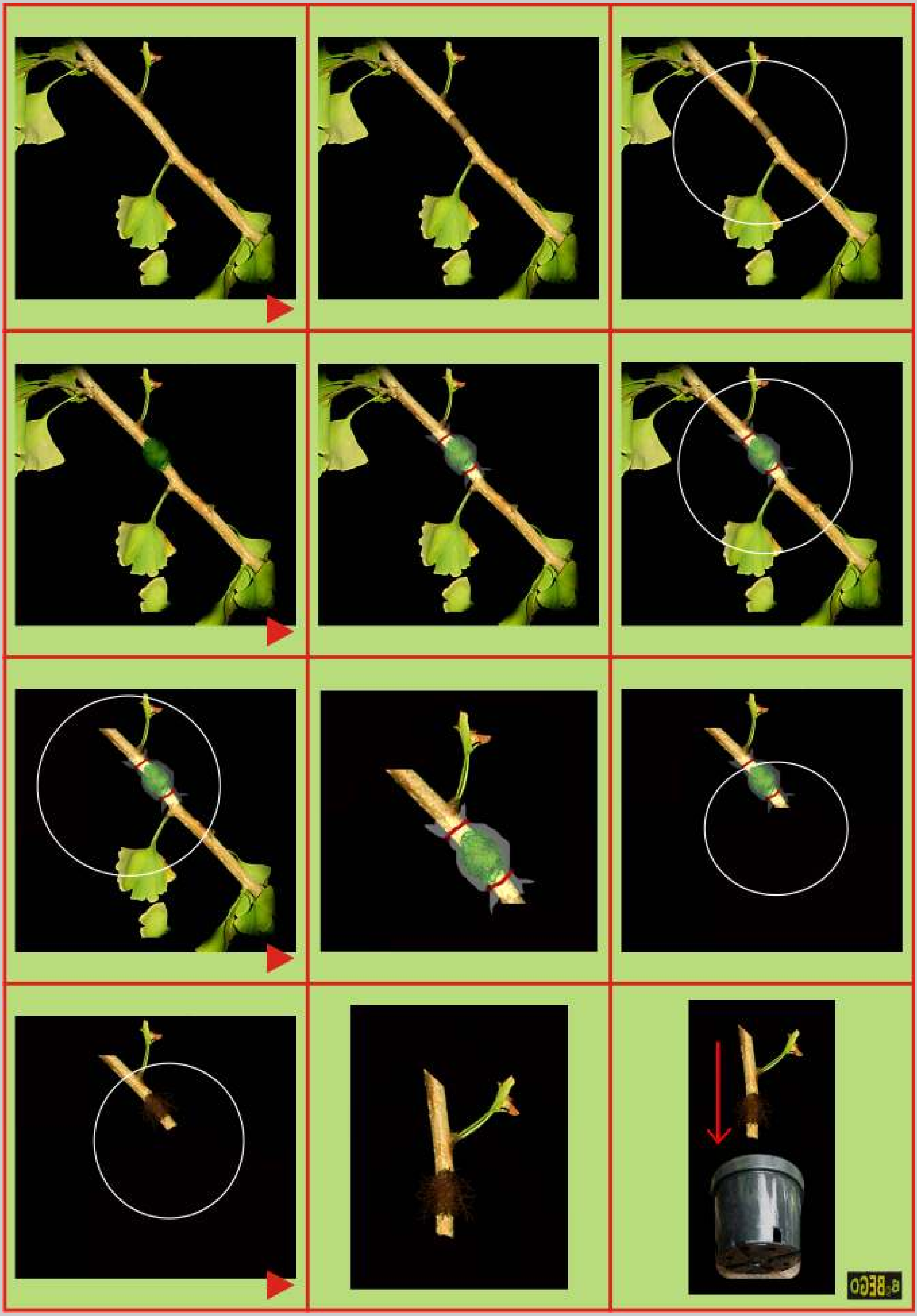
We have already said something about this type of reproduction. Basically Ginkgo is ready to reproduce from seed only after 25-35 years of tree age (depending on the micro-climate) and for other ways younger plants are more suitable. Seeds can be sown immediately after collecting or after stratification (kept at a temperature of about 1-8° C in the refrigerator or in a container buried in the soil) and sown in spring. Fresh fruits (seeds) must be dry before storing for the spring sowing. Just litter them in a thin layer, put on the jute bag or newspaper, and turn them daily until the seed dries like a hazelnut. It turned out that the temperature of -10° to -15° C or even much lower does not bother Ginkgo seeds.

Sowing ginkgo seeds has been tried out successfully (or unsuccessfully) in various ways. Here are some:

Sowing in the ground (compost + sand + clay) outside (naturally) immediately after collecting seeds gets mediocre results especially if the winter is cold with a hot spring. Such plants which have sprung up and they spring up in around 40-50% (some rot during the period from sowing to germination or gets eaten by animals, etc.) and which are regularly watered are progressing very quickly and the fastest of all these ways as Ginkgo initially has quite long



Grafting of Ginkgo can be done in many ways.
These are some.

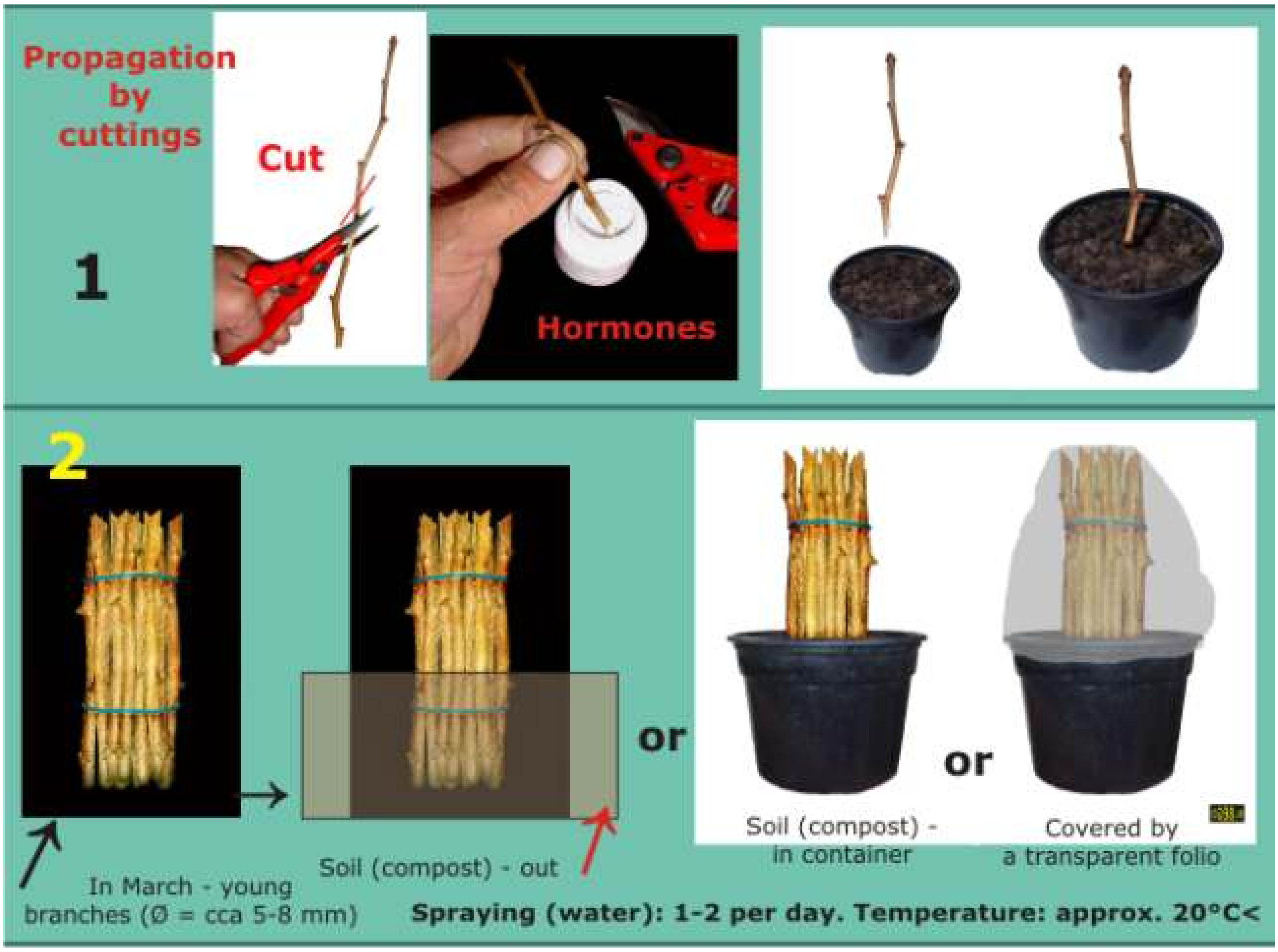


For example: “Air layering” (or marcotting) is a great way to propagate many types of plants - and Ginkgo.

central (or central) root vein and he needs a deep soil. The problem arises at the time of grafting since the root vein after several years really extend so the risk is greater. Under these conditions seedlings (which survives frost) grows in one year up to 50 cm. Of course they should be protected from spring frosts.

Sowing in the container (depth 10-20 cm) and placement at room temperature (about 18° C) immediately after collection (around the middle and the end of November) with controlled watering, the greenhouse way out of the natural cycle gave very poor results. The seed was sown in compost (mixed with white sand) to a depth of 2-5 centimeters in the lying position then turned downward and upward. Seed germination was registered within a month but over time began to gradually decline (decay or simply stop the continued growth). From 50 samples of seeds about 45 pieces germinated and by April alive was only 3 pcs which have grown to a height of about 10-15 cm. During the year until the autumn just two pcs survived which survived next year and start growing. (HZone 7)

Sowing after stratification between 1 and 8 March (HZone 7) regardless to weather conditions in the container (10-20 cm depth) and placement outside has shown excellent results. The most equale growth has been with plants where the seeds were placed horizontally at depths of about 2-3 cm (0.5-1 cm covered with white sand) at a distance of approximately 4-5 cm. Germination in this way was nearly 90%, and the largest number of plants about 80% has grown within the first year in the specified container usually around 20-35 cm. Some even more. The plants that were grafted in June/July (HZone 7) from this container into larger individual containers have grown a few inches more but in this way they were independent for further grafts. One part of the plant was left in hotbed after dropping leaves off (which was not taken but supplement with dried leaves of quince and juniper) was left to hibernate without protection. Precisely these plants which were grafted in early spring before budding were the most beautiful ones. We should mention that (as March and April was quite cold) it was necessary (because there was no intervention in the seeding), in addition to regular watering almost 60 days until the first seeds germinated. Sowing seeds almost side by side in a larger container also provides a good germination however the plants need grafting immediately after the exultation and the onset of the first leaf or do not graft until winter - until stems grow to up to 30 cm and gets woody. Namely because of the density of plants with large leave thin and weak stem plant cannot be replanted individually in the vegetation period. It would mainly from the force of gravity and leaves weigh bend down and gradually die. Therefore it is well to sow in small containers one seed in order to ensure plant safe and worry-free growth and avoid a graft in which plant will not experience shock. All such plant requires support slats.



The root of which were eaten by (species) *Thomomys* in (North) America or USA. The plant remains green until to the end. Similar damage would make the voles in Europe, China etc.! Photos by Carla Resnick, California, USA (2010).

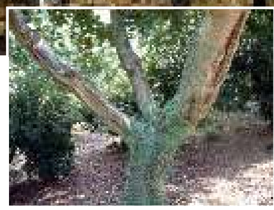
After collecting seeds were placed in PVC containers (with holes) and buried in shallow ground (soil). In late February dig up the seed and planted it in an ordinary garden land (without choosing) and put it into the open. Germination was quite good about 50-60%.

After collecting the seeds were placed in PVC containers and buried in shallow ground (soil). In the spring we removed the seeds from the earth and gently squeezed to make cracks and then placed it for several hours in the water and then planted it. Germination was even better (approximately 60-70%) and faster.

Seed was stratified after collecting in the refrigerator was gently squeezed to make cracks,

Dendrocopos major. Big woodpecker.

Holes made by woodpecker in the Ginkgo wood.



Protection against high game - the deer. Photo by Lex & Joan Lane, USA, 2009. (51) Right: damage to Ginkgo - the deer. Photo by Seesaa Inc., Japan, 2009. (75)

then placed for 5-6 hours in warm water (about 19-22° C) and in early March (HZone 7) placed in hotbed. Germination was quite good and germination started after around 40 days.

After stratify the seed in the fridge with the smooth sandpaper should be abrade to gain a small hole (to see the fleshy part of the kernel), placed in water for 24 hours and then after the 1st of March placed in the hotbed (compost) - climatic conditions were not taken into account. In this way the process of germination also speed up.

Seeds (after stratification to February, HZone 7) are being placed for 15 -24 hours in plenty of hot water (about 50-60° C). After that with sandpaper each abrades on the edges and then place on clean sand or compost. After that the seeds can be covered with several inches of sand or compost. Seed prepared on such a way is placed at a temperature of around 25-30 degrees C. Germination will begin very soon after even 2-3 weeks. Germinated plant should be grafted soon after germination in a larger container.

Sowing seeds in completely white sand gives excellent results. The seed is placed for 24 hours in lukewarm water. Then he should be placed in the lying position at a distance of 4 to 5 cm and pressed into the sand for about three quarters. This method of seed sowing is only for the greenhouses and requires a controlled temperature of 30 degrees C and high concentrations of moisture. Containers which are sown in this manner should be covered with PVC sheeting. After germination which is quite fast -around 20 days the plant should be grafted in separate containers.

By screening of seedlings or plants that have grown in the first year and have eight or more sheets of opposing ranks we can separate the plants especially beautiful or specific appearance.

Cicada is a rare enemy of Ginkgo (USA). Photo by K. Archer, USA. (49) A young Ginkgo tree is swathed in netting to keep female cicadas from laying eggs in it.

Since we mentioned that Ginkgo likes deep soils and as seedlings is older and unsuitable ground (soil) is it is harder to graft it safely. By performing several experiments we have seen that for planting in the space the most appropriate plants are with height of 30-35 to 100 cm in height, which corresponds to a plant age of about 2 to 3-4 years. Keeping the Ginkgo as ornamental plants in containers can last for several years and how the plant grows it will be necessary to graft her in the greater amount of soil. In this case it is required to be kept in the illuminated spot. In this way with regular treatment you can grow bonsai forms that spend a lifetime in the container. Do not forget that with proper handling and older Ginkgo can be successfully grafted in space (as a big building).

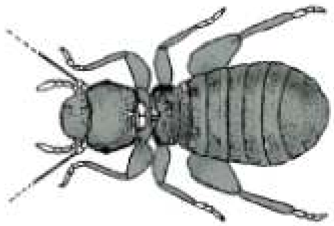
As ginkgo loves (as we have already mentioned) the sun and must be located in a sunny spot he should not be watered in the sun because of leaf damage because water droplets creates magnifying glass effect and burns the leaf on that place. Watering leafs is recommended in the evenings or in early mornings and during the day (during sunny weather) just land, ie the root or just around the tree.

Experiment with one-year seedlings (at rest phase) by placement at room temperature (about 20^{o} C and more) with regular watering and bright light in 12th January: after 20 days shows no signs of budding. Signs of budding and showing of the first leaf on the upper bud appeared only around 12 February and in only 5 days the young part increased for about 5 cm. In growth of about 30 cm (April) plants are still retained in the same conditions. By June plant grow more than sixty cm and have continued to grow. In late June they have been placed in natural conditions (the outdoor temperature and climate - Continental, HZone 7) where they were treated as if they germinated in natural conditions and there spent the following time. Later it was shown that the plants did not experience anything strange except that they exceeded the height of those that have been all this time under natural conditions. Length of the branches greatly increased.

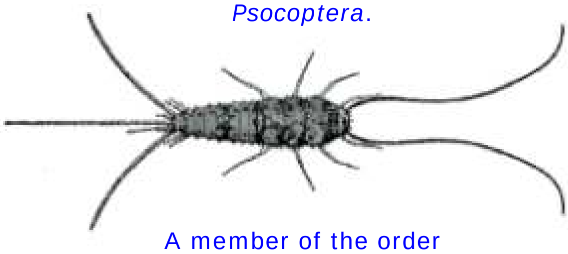
(Other ways of reproduction)

According to the literature Ginkgo is a species that is quite easy to reproduce. However, this is not true. To be multiplied by seed and get the most beautiful plants you have to wait thirty or more years old male and female trees, not too much distance from each other. Most ideal distance is up to one kilometer. However, using the propagation by cuttings no matter which gender is (but it will be the same sex as the plant from which cuttings were taken), plants initially grow more slowly and are rarely of the same beauty as as those from seed. The same can be said of the shoots from the stump of the vessel. Let us say that the cultivars are rarely reproduced from seed, since it is rarely to be found from the same cultivar (who does and have) sexually mature (male and female) of the plant, some cultivars do not even have female plants. Some men do not. Sexually mature female cultivars fertilized with the sperm of male cultivars obtained new cultivars and varieties.

The best time for propagation by cuttings is early spring, although cuttings will let the vessel at the bud time. In this case take up (July-August) semi-wooden cuttings and place them in cold “bed”. The best cuttings are young plants that are not yet ripe for reproduction and that is not the case with the shoots from the stump or vessels. The best cuttings are from last year's surge. It should be cut diagonally into about twenty centimeters long branches, tear the first few pages until the stem, to form sheets and put into a mixture of nutrient rich soil and sand. It is good to treat plant with artificially produced enzymes (hormone) for semi-wooden or mature cuttings, because the vessels will release prior. The first time you will be more frequently and with less water spray to water the cuttings until they release veins. It takes at least 6-7 weeks (from the movement of vegetation - if it's done in early



A member of the order *Psocoptera*.



A member of the order *Thysanura*.

spring), and sometimes much more - or less. Let us say: instead of artificially produced hormone it is good to keep cuttings the short time in sawdust of poplar and willow (*Salix*, *Populus nigra*, etc.) which naturally have a lot more hormones necessary for vessels.

Ginkgo is a plant that makes new ones from the stump near the ground and will pursue the new shoots from the vessel. Such shoots are rare and when it happens to should be excavated and cut off in part that released these vessels and replanted. This is done when plant rests.

Ginkgo can multiply with so called margotic technique. On selected tinier branch at the time of vegetation or notch a piece of bark. In this part put a brush or your fingers a bit of growth hormone after which it should be covered with moss. The moss should be moistened and opaque permeable PVC wrap film or thin skin. After a month or more plant will on this site let veins. Below edges and released vessels branch is cut and replanted in a separate container with compost.

The more complex way of propagation, but only cultivars or varieties, is a vegetative way, ie, grafting or transplantation. To do this you need: background and scion, and the knowledge and accurate arm. For seed propagation, however there is variability of plants, and vaccinations are carried all the properties of individuals, but later there will be variability. Most commonly used so-called. "peak" mode ("V" or hair cut) or oculation of the bud (eye). It is important that the plant goes into the vegetation before the scion. It should be inoculated during winter in a heated greenhouse or in early spring outside. Ginkgo is best to inoculate in one-or two-year basis. Newly preserved specimens have the qualities of the plant from which the scion was taken or about: growth rate, shape and color of the leaves, the shape of the canopy, spol. However, it is important to take care of that foundation and scion have similar characteristics.

8
Diseases and pests

Judging by experiences ginkgo plant is very resistant to diseases and parasites, fungi and other enemies of plants. The biggest enemy in her early age is the human factor; irregular watering, keeping the young plants in a very strong temperature (direct sunlight (30-40° C)) etc.. Strong sun can burn leaf, and the whole plant (leaf gets first whitish, then completely orange-brown color). Ginkgo specifically does not matter much for spraying per sheet during the day and sunny weather with warm water, but there are mentioned the danger of burning leaf parts (especially youth - to 6-7 years of age because the crown of the small and slow to absorb water) where the droplets (which often long stay on the list) of water because it creates well-known effect of "magnifying glass".

In the PVC tube is put poison for mice. A good way to combat *Arvicola terrestris* and *Microtus arvalis*.

Up: *Botrytis cinerea* the immature fruit of Ginkgo.

Arvicola terrestris and *Microtus arvalis*. Most destroys the bark on the ground above the ground, and sometimes up and climbs the plant. Since it does not collect food for the winter. They cause damage in the fall, winter and early spring. Especially for damages under the snow. During severe attacks per square meter is located in one or more active holes.

Symptoms: Newly planted Ginkgo tree died a few days after planting.

Diagnosis: Death resulted from lack of water.

Solutions: Transplanted trees should be closely watched for water stress. Replant with another Ginkgo tree. (80)

In middle.

Symptoms: Gradual drying of the leaves.

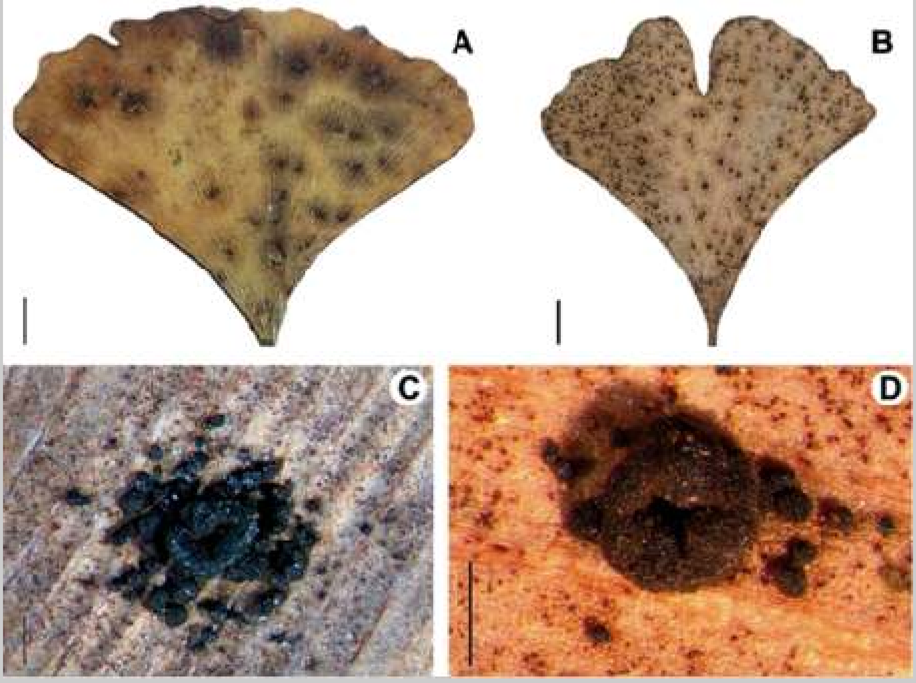
Diagnosis: Exposed to direct sunlight. Falling leaves, which does not mean death.

Solutions: To protect the plant from the direct sunlight.

Symptoms: Completely dry leaves.

Diagnosis: The root of plants at transplanting was left without water and soil. In the summer.

Solutions: Dead plant.



Resting spores are not only formed in the dark pustules on the leaf surface, but also inside the leaf tissue.

The most interesting fungal associate of Ginkgo is the basidiomycete *Bartheletia paradoxa*. Fallen Ginkgo leaves colonized by this fungus (A, B) usually show conspicuous dark sori (telia) of resting spores (C, D). Although *Barteletia* is apparently a saprotroph living on the soil surface, it is confined to Ginkgo leaf litter. (107). Reproduced with permission from Elsevier.

Plants do not need any spray preservative, but it is good to spray at least once a year (the ratio of 1:30-40) or watered with (ratio of 1:10-20) fluid obtained by soaking common Nettle (*Urtica dioica*). Plant creates a sort of immunity and gaining all important and necessary minerals, chemical elements and other vegetation.

In his youth enemies are mostly voles, field mice, sometimes snails, and later a very rare red spider or other insect species. According to some surveys and observations list even wood can possibly be under attack (not much) by *Psocoptera* species (wood or dusty nit-ulcer) and *Thysanura* but this is rare. This protection is attributed to the presence of oxalic and apple acid in the leaves of Ginkgo.

Young plants will be happily eaten in the countryside throughout the year (especially at rest) by wild animals (Rabbit, Big game, Birds, etc..), and mostly rodents. Let us say that the young plants often are habitation of Cicada (*Cicada*), which lay their eggs just to plant trees. When young animals hatch they suck the juice plant. Therefore, it is often placed on the plant a dense but translucent nets. Such networks are placed as protection against a variety of birds that prefer young shoots from ginkgo. In older plants, birds may be prejudicial, for example, by drilling holes for nests, as, for example Woodpecker (*Dendrocopos major*).

The biggest enemy of newly planted Ginkgo are still voles (regardless of plant age - if you plant more plants), which like the root - especially because it is a new culture. However, one should take into account the environment and the composition of the soil in which Ginkgo is planted because voles are significantly less on the soil where there is up to 40 percent sand and located some distance away from agricultural crops, forests and thickets. No matter what proved to be useful you should be doing systematic poisoning of voles and field mice during the whole year. Therefore, we must say that you if you loose some plants it is cheaper to replant with new smaller plants(!). Larger plants are more expensive - then the damage will be much higher. In an experimental plantation (continental climate, Hzone 7) of 1000 planted Ginkgo plants in soil that had no sand and no poisoning voles in one year destroyed 99% of plants. Planting a new trial to another location where the soil was more sand (unfavorable to voles)we managed to preserve more than half of the planted ginkgo.

The literature mentions numerous pests. However it has not been proven except in endemic cases (for example, on plantations in France, where the same culture long cultivated - Ginkgo) to an insect, viral or fungal diseases that would significantly harm the development of plants.

Scientists cite several insects dangerous (?) to plant (or leaves) Ginkgo: *Cacoecimorpha pronubana*, *Brachytrupes portentosus*, *Agrotis ypsilon* and *Gulcula panterinaria.* Roots, leaves and stems of Ginkgo are also toxic for insects. (101, 102, 114) Ginkgo (all plant) is an excellent insecticide.

Another interesting associate of Ginkgo is a fungus called *Bartheletia paradoxa*. It is a very small basidiomycete, almost not visible to the naked eye, except for blackish pustules of resting spores (teliospores) on the surface of fallen Ginkgo leaves. As far as we know by now, it survives as a saprotroph on the leaf litter. Other spores (basidiospores and conidia) are only produced when they are required to colonize newly fallen Ginkgo leaves in autumn. The extraordinary colonization rate observed in the field is confirmed by a remarkable growth rate in culture. However, after formation of resting spores on and in the newly colonized leaves, those resting spores wait in a dormant condition until the next autumn, for at least eleven months. This fungus does not cause any fungal disease of Ginkgo. However, in spite of its saprotrophic lifestyle, it is highly host specific, just like a biotrophic parasite. Any attempts to produce Bartheletia colonies with resting spores by inoculating the leaves of other plant species failed. Apparently this narrow specialization is the result of a long co-evolution of *Ginkgo biloba* (as well as its extinct relatives), and Bartheletia therefore another "living fossil". This interpretation was also supported by the first phylogenetic tree, where Bartheletia appeared in an unresolved position on a basal branching within the basidiomycetes. (107)

Valorization

Plants, whether for decoration (holding in flower garden or planting in the space) or for planting in the plantation it is best to buy (if you're not alone multiplied) in the winter or early spring, when plants are dormant. From then until around April at the beginning of vegetation (depending on local climatic conditions), plant has stabled by then root-capillary system for the new growing season and a new foundation. For several reasons it is best to buy a one-year seedlings (they are also the cheapest) and from seed, because they are beautiful (as opposed to other means of reproduction-for example. cuttings). If you want to own (amateur) attempt to replicate Ginkgo, then, well then educate with the appropriate literature.

Would you like to plant Ginkgo somewhere in space then perform it while plant is young. If you plant it separately in your garden or yard, or your collection then you will probably need only one or a few plants. Ginkgo can be kept as decoration in a nice container or any container. There you can cultivate the plant for several years easier than it is immediately planted on the place where it will stay permanently, and you thus learn from experience something about the Ginkgo – it will be easier when you put it into space. Ginkgo has not many insect enemies nor is it subject to some common plant diseases.

One year Ginkgo until first rest grows to 50 cm, and typically has 10-odd buds. Over the next year we do not know what will happen! Ginkgo is a plant-specific and unpredictable. It can happen that is planted or in space or in a container to grow even more, and it can happen to put on the upper stems and a few buds arise, by the end of vegetation, only increases the beautiful bunch of leaves, while the plant itself has grown only 10 cm or less . It is not surprising because in the literature there are often cited data showing that Ginkgo (in the same conditions, the same fertilization, in identical soil, seeds of the same plants etc..) can be from May to August and grow to 150 cm. But not one centimeter.

So if you want to plant a ginkgo plantation for harvesting leaves for commercial purposes or just because you want to grow many plants for future favorable sales of larger plants that are not in a container, make sure to analyze soil. Try to choose land that we know and see that there is a certain amount of sand (in China just to ginkgo saved a lot of sandy soil). Then tillage (standard preparation for planting grass), sow grass (if you want to grass row of - if not, do not do it), and immediately go into setting up the so-called. tube-bait with a poison for voles and mice. It is best to plant the young plants.

During the summer and warm or hot days do not water very young plants on the leaves. It is best to occasionally water each plant with the plenty of water, but strong sun and higher temperatures will not harm plant. It may happen that there is a partial drying of the leaf and lightweight stunting the plants, but it will not collapse until there had food and moisture. Several times a year, plant the top dressing over the leaf with artificial or organic fertilizers - how do you work with all other plants. Your Ginkgo in a few year will be an extraordinary fancy copy (exhibit), and if you have planted the orchard in order to expect a list from year to year, large quantities of leaves.

For each planting and growing large quantities of plants it is needed to consult with experts.

3 and 4 years old plant *Ginkgo biloba*.

A) Greenfield, J. & Davis, M.J., 2004. Medicinal Herb Production Guide. *Ginkgo biloba*.

(http://www.naturalmedicinesofnc.org/Growers%20Guides/ginkgo-gg.pdf)

Introduction

Botanical Information

Ginkgo biloba L., commonly called ginkgo or maidenhair tree, is a long-lived, deciduous, shade tree from China that can reach a mature height over one hundred feet and is the only genus and species of the Ginkgoaceae family existing today. Know for its three-inch wide, fan-shaped leaves that turn golden yellow in autumn, the ginkgo tree can be found all over the world and is one of oldest species of trees in existence today. Individual ginkgo trees have been known to live as long as 1,000 years. The trees, which are dioecious (bearing male flowers on one tree and female flowers on another), may not flower until they are twenty to thirty years old. The female trees produce a one to one-half-inch, plum-shaped, orange fruit. Male trees are more desirable for cultivation, as the female trees produce an unpleasant odor from the ripened outer coating of the seeds. It is the leaves that are harvested for medicinal purposes.

Bioactive Components

The main bioactive components of ginkgo leaves are flavonoids, biflavonoides, proanthocyanidins, and triactonic diterpenes, which include the ginkgolides A, B & C. Ginkgolide B has been shown to inhibit platelets in the blood from coagulating. The flavonoids in ginkgo have demonstrated very strong antioxidant effects.

Uses and Treatments

Ginkgo has been used for medicinal purposes for almost 5,000 years. In Chinese traditional medicine, it is used to treat asthma, bronchitis, and various brain disorders. In Asia, the seeds of the ginkgo tree are used to aid digestion and to reduce the intoxicating effects of alcohol. In Europe and North America, ginkgo extract is used for the treatment of circulatory problems, immune system dysfunction and cognitive disorders, including memory loss. There are currently no approved treatments involving the use of ginkgo extracts in North America. However, the FDA regards ginkgo extracts as "probably safe". Germany's Commission *E.* has approved ginkgo extract for the treatment of intermittent claudication, vascular vertigo, and vascular tinnitus. Some of the uses of ginkgo are listed in Table 1.

Table 1. Modern and traditional uses of Ginkgo biloba.

Modern Uses	*Traditional/Folk Uses*
- Loss of cognitive ability	- Brain disorders
- Poor circulation	- Asthma and bronchitis
- Vision and hearing problems	- Increase life span and sexual potency

Cultivation Practices

Site Selection

Ginkgo grows best in deep, moist, sandy soil and prefers full to partial sun in zones four to eight. It will tolerate poor and compacted soils except permanently wet soils. Ginkgo will grow in a wide range of soil pH and can tolerate heat and drought once the trees get established. For a tree crop, preparation of the soil is just as important as a field crop.

Planting

Propagation can be done by seed, cuttings, or grafting. Cuttings are the preferred method of propagating ginkgo to assure planting of only male flowering trees. Seeds can be planted in the spring or fall. Tim Blakley, co-author of *Medicinal Herbs in the Garden, Field, and Marketplace*, recommends stratifying the seed for four to six weeks if planting in the spring. Blakley sows his ginkgo seeds in one to five gallon pots, then transplants seedlings to the field, spacing them ten to twenty feet apart. Mulching the plants will keep weeds down. Ginkgo can grow twelve to eighteen inches a year. Blakley states the trees should reach a height of six to eight feet before beginning to harvest.

Insects and Diseases

Ginkgo trees have developed an amazing resistance to disease and pests. The *Index of Plant Diseases in the United States* lists the following diseases for *Ginkgo biloba*: leaf spots, *Glomerella cingulata* (anthracnose) and *Phyllosticta gingko*; sapwood or wound rot, *Fomes conatus*, *Oxyporus populinus*, and *Polyporus* spp. (sometimes found on living trees following injuries); root knot nematodes, *Heterodera marioni* and *Meloidogyne* sp.; root rot, *Phymatotrichum omnivorum*; and a seed rot, *Xylaria longeana*.

Harvesting, Cleaning, and Drying

The leaves from a ginkgo tree are harvested in fall, as the leaves are turning yellow.
Blakley's method of harvesting is to cut the branches with pruning shears, and then pull the leaves off of the branches. He recommends placing the leaves on racks in a dryer designed for herbs, and turning the leaves several times during the drying process to avoid matting. Ed Fletcher, Strategic Sourcing, Inc, suggests setting the dryer temperature at 105o-110oF. Drying time averages from twelve to fourteen hours but may increase or decrease depending on the humidity in the air. When adequately dried, the leaves should have a crinkly and crumbly feel. Fletcher states that there should be no flexibility in the leaf without breaking. When the midrib is dry, the leaf will also be dry. Package the dried leaves in woven poly bags that are light proof or in corrugated boxes, and store in a cool, dry, dark location.

Marketing and Economics

Annual Consumption and Dollar Value

In 2001, between 4.5 million pounds and 5.1 million pounds of dried ginkgo leaves were consumed. This was 34% higher than the amount in 1997 and about 5% higher than the amount in 2000. The dollar value in 2001 was about $25 million, which was 40% greater than the dollar value in 1997.

Supply and Demand

Historically, positive clinical support propels demand for this botanical. Clinical trials are being done on *Ginkgo biloba* as a treatment option for Alzheimer's disease. An aging population base in North America and Europe has increased demand, due to ginkgo's antiaging actions. European functional food manufacturers are also incorporating this material into more nutritional supplements and beverages.

Supply and demand for ginkgo has reached equilibrium with a very stable market. Supplies come almost exclusively from large-scale cultivation. Large-scale cultivation is occurring worldwide. A small number of growers produce over 95% of the world's supply. Large commercial plantations exist in South Carolina (US), Japan, Korea, France and China. Sumter County, South Carolina, is home to the largest ginkgo plantation in North America.

Since the supply of ginkgo comes exclusively from cultivated sources, little variation exists in bioactive components among individual harvests. Customers are primarily concerned with a lack of chemical residue on the material. Typical bioactive percentages are 24% ginkgo flavoglycosides and 6% terpene lactones.

Pricing

Ginkgo trades in a low, narrow, price band. In 2001, prices ranged from $4.00 to $6.00 per pound for dried leaf.

Distribution Channels

Distribution channels for ginkgo are highly structured. The maturity of this market has resulted in all material flowing through large, vertically integrated companies. Most organizations are located in Europe and draw on imported raw material sources from all over the world.

Commercial Visibility

Ginkgo enjoys a great deal of visibility around the world. It is the main ingredient in a number of herbal products, including "Tanakan", "Tebonin", and "Rokin". In 2001, the most well defined extract of ginkgo, Egb 761, was one of the top-five prescription medicines in Germany. It is available in the United Kingdom, the United States, and Canada as an overthe-counter food supplement. Of the top nutraceutical/botanical companies in North America and Europe, 51% offer ginkgo as a stand-alone product and 78% offer this material as a stand-alone product or as part of a multi-constituent supplement.

In 2001, a report came out on a study concluding that there was no validity to claims that ginkgo improves memory or related cognitive abilities. This question may finally be answered by a$15 million dollar financed by the National Institutes of Health. The results of this study are not expected until 2006.

This Medicinal Herb Production Guide includes excerpts from, Analysis of the economic viability of cultivating selected botanicals in North Carolina. Strategic Reports. 2002.

References

Dirr, Michael A. 1997. Dirr's Hardy Trees and Shrubs. Timber Press, Portland, Oregon. 493 pp.

Fernald, M. L. 1970. Gray's Manual of Botany. D. Van Nostrand Company, New York, NY. 1632 pp.

Fletcher, Edward J. 2004. Personal communication.

Leung, Albert Y., and Steven Foster. 1996. Encyclopedia of Common Natural Ingredients Used in Food, Drugs, and Cosmetics, second edition. John Wiley & Sons, Inc. New York, NY. 649 pp.

Michigan State University Extension. 1999.
http://www.msue.msu.edu/msue/imp/modzz/00000667.html

Ohio State University. http://www.hcs.ohio-state.edu/hcs/TMI/Plantlist/gi_iloba.html

Sturdivant, Lee, and Tim Blakley. 1999. Medicinal Herbs in the Garden, Field, and Marketplace. San Juan Naturals. Friday Harbor, Washington. 323 pp.

US Department of Agriculture, Crops Research Division Agricultural Research Service. 1960. Index of Plant Diseases in the United States, Agriculture Handbook No. 165. Washington, DC. 531pp.

Walters, Dirk R., and David J. Keil. 1996. Vascular Plant Taxonomy, 4th edition. Kendall/Hunt Publishing Co, Dubuque, Iowa.

(Sample of a series of publications on medicinal herbs available through North Carolina State University and can be accessed through http://ncherb.org)

Warning!

On young Ginkgo tree plants (1 to app. 7-8 years old) branches should not be cut under any circumstances during growth season.

Left: Prince Edward County Parks, Culture and recreation Commissioner Barry Braun, Tree Canada's Jim McCready, Picton BIA Executive Director Roni Summers Wickens, TD Friends of Environment's Golda Lafferty and PEC Mayor Peter Mertens ceremoniously 'plant' a Ginkgo tree - the oldest specimen in Canada. Up: A garden party followed the Green Streets announcement while Terra Vista employees completed the planting of the new Ginkgo tree.

Photos by www.countylive.ca, Canada, 2011.

About 25 years old Ginkgo in China. Photo by Zhou Xiaolin from www.youduo.com.

Harvesting Ginkgo leaves in Tancheng, China. (58) Tancheng, Shandong province, China. (Liyi Association For Science & Technology). Photos by Hong-Sheng Li, China (www.lyast.org.cn).

Preparation of Ginkgo plantation in Taiwan. Until a sufficient age Ginkgo plant is a variety of tea culture. The colorful harvest tea on the Ginkgo plantation. (Photo by Lu Lav, Taiwan, China).





Beautiful, about hundred years old male Ginkgo tree typical forms, East Europe. Photo by R. Oreški, Croatia.

References

(correction approach to web sites 2010/11/01 and 2011/2/8)

1. http://xs4all.nl/~kwanten ("The Ginkgo Pages")
2. http://www.afblum.be/bioafb/cyclgymn/cyclgymn.htm
3. http://www.schwabe.de/schwabe/Arzneimittel/Tebonin/Qualitat.php
4. http://www.xs4all.nl/~kwanten/usage.htm
5. http://www.schwabepharma.com/international/media-relations/images/production.php
6. http://www.schwabepharma.com/international/downloads/pdf/Imagebroschuere.pdf
7. http://www.shanwangping.cn/yxzz2-2.html
8. http://www.proginkgo.org/gallery.html
9. http://www.ginkgo.biloba.online.fr/
10. http://www.herbs2000.com/herbs/herbs_ginkgo.htm
11. http://www.palaeobotany.org/iop/living-fossils/24
12. http://www.treecrops.org.nz/knowl/archives/cairnse/ginkgoce.html
13. http://ginkgo-biloba1771ginkgoeu.blogspot.com/
14. http://www.hcs.ohio-state.edu/hcs/TMI/Plantlist/gi_iloba.html
15. http://coo.fieldofscience.com/2008/11/relict-fungus-on-relict-host.html
16. http://www.constructionequipmentguide.com/viewpicture.asp?id=4416
17. http://flatbushgardener.blogspot.com/2008/11/how-to-move-200-ton-ginkgo.html
18. http://www.lycaeum.org/leda/docs/16256.shtml?ID=16256
19. http://www.whitecanker.net/Ginkgo/Ginkgo.asp
20. http://www.palaeobotany.org/iop/living-fossils/24
21. http://tokyocinema.net/scienceE.htm
22. http://www.koronas.ro/anatomie_lamele_microscopice.html
23. http://www.answers.com/topic/seed
24. http://www.gymnosperms.org/imgs/kcn2/r/Ginkgoaceae_Ginkgo_biloba_3071.html
25. http://www.sbs.auckland.ac.nz/uoa/science/about/departments/sbs/newzealandplants/seed-plants-nonflowering/introduced-groups/ginkgo.cfm
26. http://img224.imageshack.us/img224/6104/ginkgo1vn3.jpg
27. http://www.aujardin.org/graines-ginkgo-biloba-t33927-15.html
28. http://www.treegrowersdiary.com/ginkgo_and_kentucky_coffeetree.html
29. http://www.ginkgo.lu/mmp/online/website/menuvert/ginkgo/index_FR.html
30. http://www.lewisginter.org/blog/
31. http://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook727/wo_AgricHandbook727_559_561.pdf
32. http://www.pacificbulbsociety.org/pbswiki/index.php/HardinessZoneMaps
33. http://www.aroid.org/horticulture/zonemap/
34. http://ginko-spg.org/
35. http://thewip.net/contributors/2008/08/south_asias_oldest_tree_specie.html
36. http://permacal.blogspot.com/
37. http://www.womenofmystery.net/2008_12_01_archive.html
38. http://ginkgoaustralia.com/main/page_photo_gallery.html
39. http://www.kamprint.com/views/
40. http://www.flickr.com/photos/limetom/
41. http://en.nicoga.in/link/?title=ginkgo
42. http://art20.photozou.jp/pub/6/161006/photo/34230180.jpg
43. http://news.kanaloco.jp/common/user/news/photo/1/100317/7_225756.jpeg, http://news.kanaloco.jp/common/user/news/photo/1/100318/7_230011.jpeg
44. http://www.ginkgo.lu/mmp/online/website/menuvert/ginkgo/index_FR.html
45. http://permacal.blogspot.com/
46. http://madarbarat.god.hu/images_bird/Dendrocopos_major.jpg
47. http://growinggreener.blogspot.com/2007_05_01_archive.html
48. http://www.gather.com/viewArticle.action?articleId=281474977014779
49. http://green-woodtrees.blogspot.com/2009_11_01_archive.html
50. http://coo.fieldofscience.com/2008/11/relict-fungus-on-relict-host.html & http://www.sciencedirect.com/
51. http://habitathome.blogspot.com/2009_10_01_archive.html
52. http://www.hydrosa.com.cn/Plantation.html
53. http://www.pijanitvor.com/showthread.php?t=3946&page=3&highlight=ginkgo (Photo: ali1)
54. http://kosugi-zohen.no-blog.jp/topics/cat5403764/index.html
55. http://www.sadotokusen.jp/products/detail.php?product_id=76
56. http://sakenotakarajima.blog101.fc2.com/blog-date-200705.html
57. http://tohtohshushop.blog54.fc2.com/blog-entry-3.html
58. http://www.lyast.org.cn/newAst/ShowArticle.aspx?ArticleID=27512
59. http://www.cn-ginkgo.com.cn, www.diytrade.com/china/3/products/279918/%E9%8A%80%E6%9D%8F%E8%91%89.html#normal_img
60. http://www.6651716.com/qhymdetail.asp?id=14
61. http://big5.made-in-china.com/showroom/ltstarting/product-detailYohmLFGrqRkt/%E9%93%B6%E6%9D%8F%E5%8F%B6+-+2.html
62. http://www.csyyc.com/docc/cpzs.php?cpzs_type=show_detail&id=241
63. http://www.yinxingv.com/news_type.asp?id=663
64. http://www.lets-go-aichi.jp/hourou/2009/000134.html
65. http://www.ctw.cn/article/article_15982.html
66. http://www.anlunews.cn/newsdetail.php?news_id=209

67. http://www.2-drying.com/tbtj/prod166.htm
68. http://www.zgycsc.com/sbinfo.php?sbid=93171
69. http://kimama.jp/diary/kudamono/nicky.cgi?DATE=200602?MODE=MONTH
70. http://www.539yx.cn/Show.asp?id=101
71. http://www.cjbd.com.cn/xiangzheng/2010-01/11/cms270404article.shtml
72. http://www.si-yuan.com.cn/productshow.asp-id=139.htm
73. http://oto-no-tanoshimi.seesaa.net/category/6120964-1.html
74. http://www.zysjjy.com/News_Cons.asp?id=182
75. http://nobeoka-brand.seesaa.net/article/133448006.html
76. http://houhouken.web.fc2.com/icyo.htm
77. http://kaze.biz-garden.com/?month=200909
78. http://www.nihon-isj.com/category/1305308.html
79. http://hedge.paslog.jp/category/102940.html
80. http://www.salinitymanagement.org/Salinity%20Management%20Guide/sp/sp_7c.html
81. http://www.pasadenabeautiful.org/central_park.htm
82. http://www.onnanoyokubou.com/?eid=244
83. http://www.yinxingjidi.com.cn/yinxingzaipei1.htm
84. http://can-park-bd.up.seesaa.net/town/21A5A4A5C1A5E7A5A6A4CEC0B8B3C0.jpg
85. http://www.johnbrown-nurseries.ltd.uk/prod01.htm
86. http://www.lovett-pinetum.org/?page_id=977
87. http://www.maths.cam.ac.uk/friends/newsletters/news18/
88. http://mytko.org/random/ginkgo2.JPG
89. http://sadart.ru/page297.html , http://rian.ru/ (Ria Novosti)
90. http://kawasakimidori.main.jp/ (Kawasaki Green Investigation)
91. http://kawasakimidori.main.jp/webzukan/zukan_gazou/ityou_jirei4.jpg
92. http://www.amentsoc.org/insects/fact-files/orders/psocoptera.html , http://www.nic.funet.fi/index/Tree_of_life/warp/album-Unidentified-11.html
93. http://www.entomology.uark.edu/, http://ftp.funet.fi/index/Tree_of_life/warp/album-Smirnov-19.html
94. http://www.herbos.hr/Default.aspx?art=212&sec=151, http://www.vinogradarstvo.com/index.php?s=708
95. Balz, J.-P., 1997. Agronomic aspects of Ginkgo biloba leaves production. In Proceedings of '97 International Seminar on Ginkgo, Nov. 10–12, Beijing, China, 101–104.
96. Begović, B., 2009. Svijet ginka. Croatia (manuscript).
97. Del Tredici, P., 2007. The phenology of sexual reproduction in Ginkgo biloba: ecological and evolutionary implications. Botanical Review 73(4): 267-278.
98. Greenfield, J. & Davis, M.J., 2004. Medicinal Herb Production Guide. Ginkgo biloba. (http://www.naturalmedicinesofnc.org/mono-gg.html)
99. Henderson, P., 1890. Henderson's Handbook of plants and general horticulture, New York.
100. Kuddus, R.H. et al., 2009, Isolation of medically important fungi from Ginkgo biloba leaves and crude Ginkgo supplements (http://www.ispub.com/journal/the_internet_journal_of_microbiology/volume_7_number_1_31/article/isolation-of-medically-important-fungi-from-ginkgo-biloba-leaves-and-crude-ginkgo-supplements.html)
101. Laurain, D., 2006. Cultivation of Ginkgo biloba on a large scale. In Ginkgo biloba (edit. Beek, T. A. Van) 63-79.
102. Major, R.T., 1967. The Ginkgo, the most ancient living tree. Science, 157, 1270–1273.
103. Martinez, M. and Chambon, J.P., 1987. Le point sur quelques ravageurs nouveaux, autochtones ou récemment introduits en France. In Conférence internationale sur les ravageurs en agriculture, T. 1, Paris, ANPP, 9.
104. Matsumoto, T. & Sei, T., 1987. Antifeedant activities of Ginkgo biloba L. components against the larva of Pieris rapae crucivora. Agric. Biol. Chem., 51, 249–250.
105. Mihalić, V., 1976. Opća proizvodnja bilja, Zagreb.
106. Pasadena Heritage, Vol XXIV, Num 4, photo by R. Finch (2004).
107. Scheuer, C., R. Bauer, M. Lutz, E. Stabentheiner, V. A. Mel'nik & M. Grube., 2008. Bartheletia paradoxa is a living fossil on Ginkgo leaf litter with a unique septal structure in the Basidiomycota. Mycological Research 112 (11): 1265-1279.
108. Shepperd, W.D., 2008. Ginkgo biloba L. The Woody Plant Seed Manual. Agric. Handbook No. 727. 559-561.
109. Sprecher, A., 1907. Le Ginkgo biloba L., Geneve.
110. Sturdivant, L. & Blakley, T., 1999. Medicinal Herbs in the Garden, Field & Marketplace. San Juan Naturals, Friday Harbor, Washington. 323.
111. The book-notes B. Begovic 2005-2010 (manuscript), Croatia.
112. Vidaković, M., 1982. Četinjače, Zagreb.
113. Young, N., 2001. Significance of Ginkgo biloba (Source: http://www.lycaeum.org/leda/docs/16256.shtml?ID=16256)
114. Zhiquan, Z., Dongrong, J., Guangquan, Z. and Yongmei L., 1991. A study on the causes of death of seedling of Ginkgo biloba. Guihaia, 11, 334–338.

Left:
lots of sunshine & low humidity.

Down left: high temperatures & plenty of moisture.

Fascinating changing colors in the Autumn: from green to yellow.

Page 186:
this is cultivar
Ginkgo biloba 'Pendula' (young plant in Autumn, detail). Photo by M. Šavorić, Croatia. It's hard to determine that it is variety and that.

5

Aerial & cadastre, Hardiness Zones etc.

Foreword

The total number of Ginkgo trees in the world will never be precisely known. One reason is that almost no country in the world does not do accurate cadastre of Ginkgo trees, broken, whether by gender, age or otherwise. In addition it is almost impossible to track the population of these plants since the last decade to almost the expansion of cultivation of Ginkgo. However, there are certain records in some countries for especially important and valuable trees. But that information will be collected in future successive and segmental in areas of many countries.

If we take into account the Ginkgo plantation in America, Europe, China, Japan and elsewhere and the existing plant we can say that the number of Ginkgo plants today is measured in millions. Single lists was best edited and introduced by Cor Kwant from the Netherlands (on the website "The Ginkgo Pages"), and there are a number of other websites around the world which state the views of individual plants, sometimes even the leaves. Besides we also have a somewhat older and more recent published literature in which one can reach the data on the approximate number of plants in a particular country or a region.

At the end of this section there is a list of literature from which we can learn more about the prevalence of Ginkgo in the world, and Hardiness Zone Maps in the World, from which you can see which areas in the world is suitable for growing Ginkgo.

1
Nature Reserve of *Ginkgo biloba* (Tian Mu Shan and Jinfo Shan)

Details of the famous National Nature Reserve Tian Mu Shan (Tianmu Mountain) in China. In the foreground is the Ginkgo, which is here the natural populations - the larger picture. “As a crystal and shining "green jade" casting in the middle of coastal China, Tianmu Mountain National Nature Reserve sits in the northwest of Tianmu mountain range of Zhejiang Province. It is within the municipality of Lin'an, with the latitude ranging 30°18'30" - 30°24'55" N and the longitude 119°23'47" - 119°28'27" E.” - the Chinese say that the beauty of these magnificent landscape.(B) (58, 91-95, 98, 132)

The Jinfo Shan Scenic Spot is located some 130 kms away from Chongqing city and within the boundaries of the Nanchuan city, the Dalou section vein branches suddenly into different mountain peak on the east. Jinfo Mountain means Golden Buddha Mountain in Chinese. The three mountains are composed by Jinfo Mountain, Baizhi Mountain and Jingba Mountain. The scenic area mountain peak level mountain fold ranges, the highest elevation of the group peak reaches 2,251 meters with a total area of 1,300 square kilometers. The virgin forest occupies 1/3 and the tour region is 264 square kilometers. There are much rare and precious zoology and botany on the mountain, the plant reaches 5,099 types; cathaya argrophylla, the Ginkgo, Daye tea etc. (B) (67-70, 73, 81, 82, 142)

Jinfo Shan (Szichuan)

Tian Mu Shan (Zhejiang)

Has not fully reached consensus with scientists: to which of these two areas of living the natural populations Ginkgo? Prefers the Tian Mu Shan area, although some analysis indicates the likelihood of the existence of natural populations in Jinfo Shan.

2 Asia

We could see that the Ginkgo has spread throughout the world exclusively from China. In places where it survived since before many millions of years ago still exists today natural populations of this species. This is an area of Tian Mu Shan (Zhejiang province) and Jinfu Shan (province Szichuan) - Southeast China. It would be quite unreasonable and unrealistic to claim that the surrounding area. Coming to Korea, Mongolia, Japan. Then, in Vietnam, Manchuria, etc. In Japan the plant during these few thousand years is so endemic that it has become almost a cult and sacred plant. In addition Japan has just been a place where the Ginkgo biloba has expanded outside the "Far East", to Europe and then America and beyond. But in Japan in 1945, the Board of Ginkgo showed his incredible ability of resistance even at the atomic bomb (radioactive). Explosion of an atomic bomb 6th August 1945 was survived by all the Ginkgo trees that are located in a radius of about 1000 meters from the explosion in Hiroshima. All trees were quickly regenerated, compared to many other species. In Europe, ginkgo comes from the city of Nagasaki and

Page 188 down & p. 189 up: Tianmu Mountain.

Tian Mu Shan (Tianmu Mountain) in Zhejiang, Nature Reserve of Ginkgo biloba, China. Photos by web site http://img1.zszs.cn/, China. (95)

Scientists are still with the uncertainty of state is the place where the natural population of Ginkgo

?

Two Hundred and Sixty-two old wild Gingkoes live in Mount Tian Mu World Biosphere Reserve, they are distributed from 300 meters to 1200 meters above sea level. Because Gingkoes grow slow, produce fruit late, and enjoy long lives, people call them. On one inscription is written: "Grandfather and Grandchildren Tree", which means the grandfather plants a gingko, only his grandchildren can enjoy the tree's fruit. These trees have derived from am old gingko stump; generation after generation, many „children and grandchildren trees" have sprouted out from the old trunk of their father or grandfather, formed a blissful and auspicious family, so people named them „Prosperous Children and Grandchildren".

was base for companies between Japan (East) and the Netherlands/United Kingdom (the West).

There are unanswered questions: how many survived and how many ginkgo trees lives in this area? In addition to the areas of these countries during the past one thousand years, Ginkgo is growing in all the other surrounding countries, just about all over China, the island of Taiwan, Vietnam, Burma, Laos. In the 11 th century Chinese poet Ou-Yang Xia says in a song "Ginkgo grows south of the Yangtze River, which is a name similar to his. The seeds are a delicacy that can carry the emperor's city ("Jewish " Kaifeng)..." So, it is the southeastern part of China. If we want to answer the question about the amount of trees, it is difficult to answer. Firstly this part of Asia is a huge space where even today tries there are inaccessible parts of China and surrounding countries to find even more thousands of years old specimens of *Ginkgo biloba*. We must mention that in China there are huge Ginkgo na,

Directions of the first expansion of the population Ginkgo from China. In Europe, Ginkgo is coming from artificial island Deshima in Nagasaki (Japan), and that for centuries had a monopoly on the Holland company Dutch East India Company (1602-1798).

Port of Nagasaki (Japan) today. Photo by Steve Grob (2005).

Thus look an artificial island Deshima (or Dejima) and Nagasaki (Japan) at the time (17 and 18th century) when it was brought Ginkgo and other plant products, from East to West.

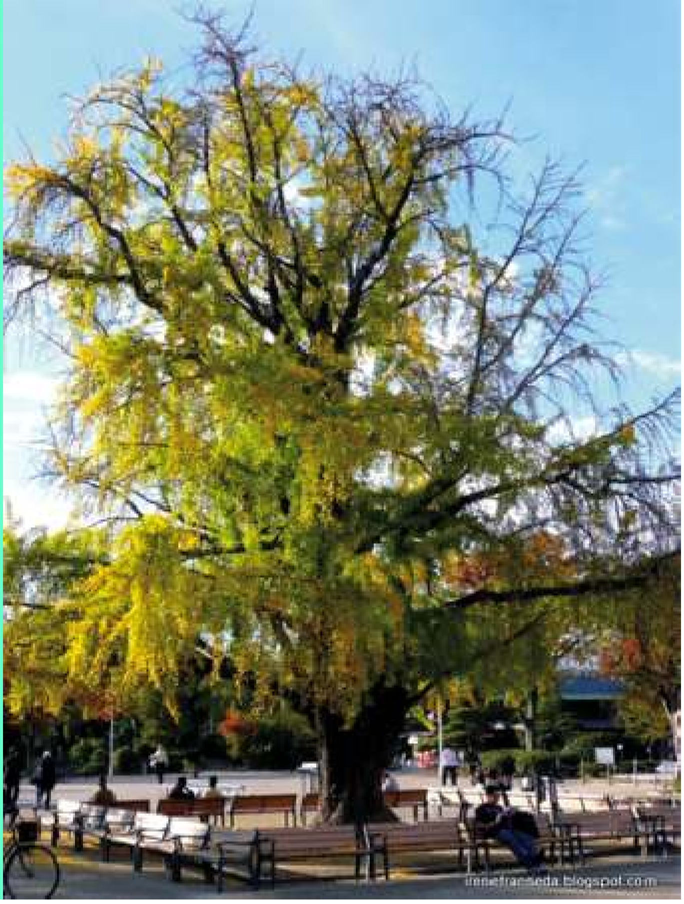
Female *Ginkgo biloba* in village Yang Tang, Zhejiang, China. Photo by P. Del Tredici. (132b)

Ancient Ginkgo tree bears 'Chi-chi' (Stalacites) in Huiji Temple, China, believed about 1400-1600 years old. Photo by Z. Zhou, China (2007).

plantation raised for picking leaves and seeds. The elderly and very old plants are especially kept under watch and special respect is given to them. There are some estimates that this area, the area of Asia, raised a total of several million plants. This number can now only be guessed at, and during this view can be set aside only a few hundred

Approximate number of sexually mature Ginkgo trees in the World (without plantation cultivation). (85 etc.)

U. S. A.	app. 30 000	Europa	app. 25 000
Canada	app. 200	Asia	app. 400 000?
Middle America	app. 160	Africa	app. 80
South America	app. 180	Australia & New Zealand	app. 320



Magical photo old *Ginkgo biloba* in Osaka, Japan. Photo by Irene Franseda, Singapure. (28)

University of Tokyo, Japan. Photo by Matt Opel, USA. (55)

Naganeupseong Folk Village - A five hundred year old Ginkgo tree in the village, South Korea. Photo by Steve Grob, USA. (60)

About 1100 years old Ginkgo tree in Yongmunsa (Yangpyeong, Gyeonggi-do), South Korea.

Height: 41 m. Photo by Chris Backe, Seoul, South Korea.

Ginkgo in Ono Hachiman Shrine (Agi Nakatsugawa City, Gifu Pref, Japan). Photo by Koiroha. (116)

plants from a range of well-known trees that grow all over China, Japan and Korea.

Some sources say that in South Korea in 2009 was recorded 12 ginkgo trees that are especially important, natural monuments, and another 813 protected individual plants. (19)

Best display on locations of ginkgo trees in Asia was presented by Mrs. Cor Kwant on “The Ginkgo Pages” (www.xs4all.nl/~kwanten).

The above web site fully represent the most recognized introduction of these plants in scientific circles.

Although Russia is a great Euro-Asian country todays climate of this territory does not suite for growing Ginkgo. In the past it was different. The climate was warmer and this is why we find just enough Ginkgo's fossils in Siberia and other parts of Russia.

In other countries in Asia, Ginkgo is grown, but not as in China, Japan or South Korea. A lot of trees in India, and we found them all over the Indian Ocean coastal belt and adjacent territory: Pakistan, Vietnam, Taiwan, Israel, Syria, Singapore, but there are no records of the approximate number of trees.

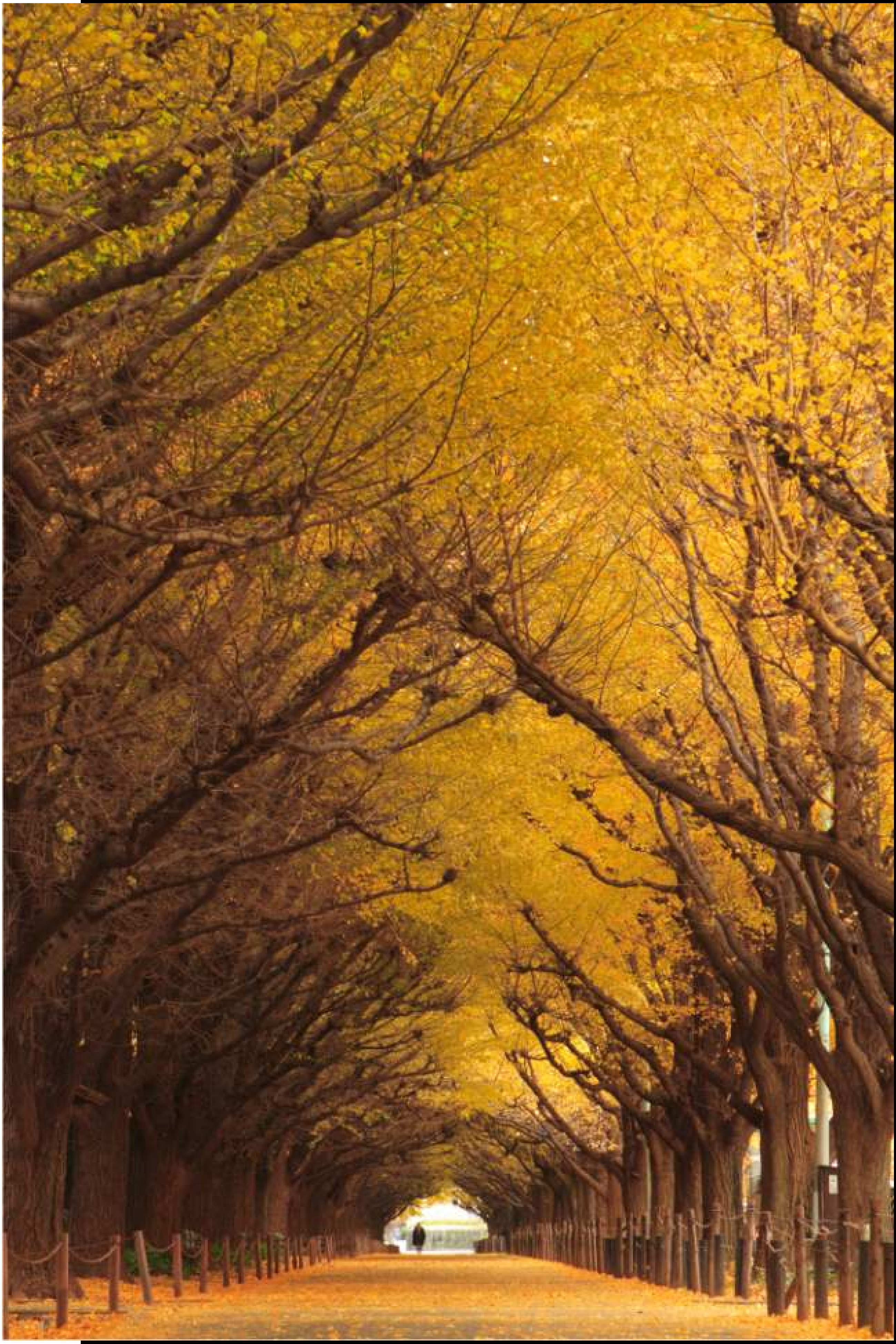
3
Europe

1692nd, with the arrival from Japan Engelbert Kaempfer certainly brought the seeds of Ginkgo, and probably occasional seedlings. Where they were planted it is not known. Subsequent expeditions have brought more ginkgo seedlings to

Ginkgo tree in Jingu Gaien Ginkgo Street Tokyo, Japan. Photo by Chris 73, 2004. (88)

Ginkgo biloba in Hyanggyo, South Korea. Photo by “Ginkgotree”. (87)

Page 194: Famous photo Ginkgo Avenue in Tokyo by Masahiro Hayata, Japan. (106)



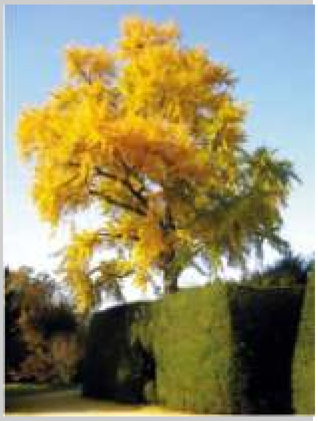
Ginkgo biloba in Geetbets (1750-1775), Belgium. “This is the oldest specimen of *Ginkgo biloba* in Belgium, and one of the oldest of western Europe. The species has been introduced in 1730 from eastern Asia. It is a beautiful tree, slightly younger than 1730 and still in very good condition. Another nice specimen (from +- 1830) can bee visited in the Town park of Tienen, 20km from Geetbets, alongside with many other rare trees.” Photo and data by Vincent Mauritz. (52, 53, 99-105)

Ginkgo tree in Tienen, Belgium. Photo by Vincent Mauritz. (99-105)

- Albania: 2?
- Andorra: 3 <
- Armenia: 2?
- Austria: 50 >
- Azerbaijan: ?
- Belarus: 3 <
- Belgium: 310 >
- Bosnia and Herzegovina: 40 >
- Bulgaria: 15 <
- Croatia: 160 >
- Cyprus: ?
- Czech Republic: 55 >
- Denmark: 30 >
- Estonia: 5 <
- Finland: 10 <
- France: 510 >
- Georgia: ?
- Germany: 800 >
- Greece: 25 <
- Holy See: ?
- Hungary: 80 >
- Iceland: 1-2?
- Ireland: 5 <
- Italy: 190 >
- Kosovo: 2?
- Latvia: 5 <
- Liechtenstein: ?
- Lithuania: 15 >
- Luxembourg: 40 <
- Macedonia: 2?
- Malta: 5 <
- Moldova:?
- Monaco: 5 <
- Montenegro: 2 <?
- Netherlands: 850 >
- Norway: 30 <
- Poland: 65 <
- Portugal: 60 <
- Romania: 35 >
- Russia (europ. part): 8 <
- San Marino: 10 <
- Serbia: 30 <
- Slovakia: 65 >
- Slovenia: 35 <
- Spain: 250 >
- Sweden: 60 >
- Switzerland: 120 >
- Turkey: 15 <
- Ukraine: 5 <
- UK (England): 360 <

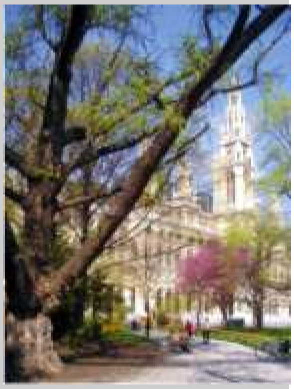
Ginkgo tree, from 1787 in Pisa, Italy. (121)

Ginkgo biloba in Riga (Latvia). (108)



Ginkgo in Lednice, Czech Republik. (119)

Ginkgo biloba in Vienna with City Hall in background, Austria. (120)



Ginkgo biloba in Tournai (Belgium) - "Parc de l'ancien château Dumon". Planted around the 1766. (79)

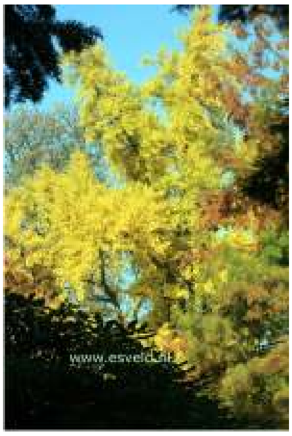
Fig. left: approximate number of sexually mature Ginkgo trees in Europe.

The oldest ginkgo tree in Europe.

Probably one of the oldest surviving Ginkgo trees in Europe, Utrecht, Netherlands. Planted in 1727 or 1730/1750? Photos by Vincent Mauritz.
(1, 50, 85, 128 etc.)

View pages 250 and 251.

Left: *Ginkgo biloba* in Palmengarten Frankfurt, Germany. Right: ginkgo trees in Botanican garden Gooilust in 's Graveland, Nederland. Photo by Nurseries PlantenTuin Esveld (by Dirk and Cor van Gelderen). (118)



Three ginkgo trees at the Eiffel Tower, Paris, France. Photos by Arboretum Žampach, Czech Republic. (www.uspza.cz) See page 249.

Ginkgo biloba in “Jardin Botanique de Tours”, France. Photo by “Liné1”. (78)

Europe, but it is certain that most of the seedlings was planted by the middle of the second half of the 18th century, undoubtedly brought from Japan, and some perhaps from China, while for the breeding ground for Europe there is no data at all through that century .

According to some statistics, the first seeds of Ginkgo has also been brought to Europe and planted in England in 1727 (in Kew Gardens) and adopted by French missionaries from Japan. According to other data, the first trees were planted around the 1730th in the places in Leiden and Utrecht (Netherlands), and mentioned place in Belgium, as Geetbets where today existing tree was probably planted in the 1730 (or 1734). Some believe that the tree currently in Utrecht is the oldest tree in Europe (outside Asia), and right behind him followed the one stated in Geetbetsu in Belgium. In later years, 18th century brought a trees in France, Germany, Austria and elsewhere. As already mentioned several times in Europe, Ginkgo, a typical kind of Ginkgo managed well. Quite responds to European climate that prevails from Scandinavia to the Mediterranean and from Britain to the Black Sea. Today, the oldest tree in Kew Gardens (UK) is considered to be planted in 1762 (called the "Old Lions"), while the older tree was injured in mid-19 century. 1770-ies in Kew Gardens more ginkgo trees were planted. The data for the planting of one tree dates from 1754. Until the early 19th century a lot of trees was planted across the UK.

The oldest trees in France is considered to be Ginkgo in Anduze from around the 1750th. There are four trees from 18 century. One was in Paris from about 1780, and two in Montpallieru, one from 1788 and another from 1795. The fourth is located in Nancy and dates to the 1758th. In Germany we have several trees from the 18 century and the oldest one is considered to be ginkgo planted in 1758 in Harbke. One of Europe's oldest tree is the ginkgo tree in Weimar planted around 1820. Although not a tree on which the Göethe wrote the song it is one of the trees that were planted during his lifetime.

Austria has relatively few trees from the 18 century although at that time was a powerful state. The oldest tree is located in Salzburg and planted about 1760. In 1781 in Central Europe over the UK arrived three ginkgo trees. One was planted in Schönbrunn. Some say that the tree in Germany (Harbke) is also planted 1781. According to some data on the area of whole Germany today we can enumerate about 800 Ginkgo trees (sexually mature)- trees planted in private and public parks, gardens and elsewhere, not counting the plantation cultivation for industrial purposes.

We must note that a lot of different aged trees is grown in Italy and Spain. From 18 century in Italy we have a tree in Padua (c. 1750), then Pisa and Rome. Apart from these trees, Ginkgo is planted during the first hundred years in Europe. Thus we have the older trees in Hungary (1801) (E), Slovakia, the Czech Republic and elsewhere, while in Scandinavia and the Baltic, trees are planted only in late 19 and early 20 th century. Ginkgo is much cultivated in Spain, although there is the relatively warm climate but there are many oases (such as Madrid etc.).

About 40 years after entering the ginkgo in Europe we have already planted a tree on the Croatian territory (Western Balkans). The trees from Daruvar originates from 1777 in Croatia where during 18th and 19 century many nobles of Austria, Hungary, Italy and Germany had their own castles, villas, estates and gardens on them, primarily for natural beauty, above the Adriatic coast and the beautiful mountainous and other natural beauty of this small country. Thus many are planted, and Ginkgo, which is why Croatia, although on the surface is a small country is rich in ancient Ginkgo trees more than 100 years old.

We must mention that most of Ginkgo trees are in those countries where he first arrived, but also in some others. Most trees are growing in the UK, the Netherlands, Belgium, Germany, France and Spain. In these figures we are counting trees older than 20-odd years and all mature.

Attractive ginkgo tree in the Czech Republic. Photo by Jan Samanek. (89)

Ginkgo biloba in autumn, USA. (114)

4
North, Middle and South America

First Ginkgo tree across the Atlantic ocean from Europe to America was brought by Williams Hamilton. To be precise in Philadelphia (USA) in 1784. This tree no longer exists, but a year later, 1785th The Frenchman Andre Michaux brought new Ginkgo tree and in 1787 founded a botanical garden near Charleston ("French Garden") in South Carolina (Sumpter), which will in time become the place where the largest Ginkgo plantation in the world are found. District of North America is particularly interesting as regards the cultivation of Ginkgo. It is completely understandable considering the immigration history of a large number of immigrants from around the world on the large areas.

Today it is difficult to answer in which state in USA or Canada there is the most ginkgo trees. In North America, ginkgo is planted everywhere except in desert areas. Not counting the plantations in South Carolina and other parts of the USA is estimated that the U.S. is growing more than 25 000 sexually mature trees that are planted mainly in horticulture. And in the U.S. and Canada, Ginkgo is being protected plant species and only in very rare cases is allowed the destruction of a tree. Mainly to the numerous landscaping projects throughout the U.S. and in many cases entire avenues are planted with these plants and is a very frequent guest at the cemeteries. In particular it is planted in cities because it is very resistant to the monoxide and other toxins found in urban areas. So we have a multitude of ginkgo avenues, as for example the one in New York, on Manhatann and elsewhere. Lots of Ginkgo trees have been planted over 19 centuries in the east and southern parts of the USA, and California, and today there is almost no property or yard in which does not grows at least one Ginkgo tree.

In Canada Ginkgo grows in warmer (southern) areas, such as the area of Montreal, Vancouver, Toronto, Niagara and British Columbia. It grows in areas around southern Ontario and elsewhere.

The space between North and South America is generally very hot and dry area that habitat adapted species. There are some territories where the climate is similar to the continental climate, however, in the Central American teritory endemic Ginkgo is grown. It is recorded some Ginkgo trees mainly in Mexico.

South America area mainly the southern part of the continent (Chile, Argentina, South Brazil) is where we find lots of Ginkgophyta fossils. It is therefore logical that the ginkgo is grown today. Most are grown in the coastal zone, and that is Chile, Brazil and Argentina. A lot of trees grows in the area of Buenos Aires.

5
Australia & others

Australia is a continent with a very dry and hot climate. That is why in Australia Ginkgo is not planted much. Most are grown in the southeastern and southern parts of the areas of Melbourne, Adelaide and Sydney. New Zealand plants small number of Ginkgo although agronomists and botanists in Australia and New Zealand are trying to resolve the issue of cultivation on plantations. It is interesting that gingko was brought here at late 19 th century by missionaries.

As for the rest of the world, where ginkgo is very well grown, we can cite the southern part of Africa (SAR). In Pretoria we have a big planted avenue of ginkgo. However, this does not mean that there are other, here not mentioned states and regions where it is grown Ginkgo. Yet this edition is of informative character

We may once again conclude that today, the number of Ginkgo trees can not be counted. Worldwide there are many millions of cultivated plants. Ginkgo is growing worldwide between 3?/4 - 8/9 climatic zones.

Ginkgo biloba in “Parque del Oeste”, Madrid, Spain. Photo by Luis Fernández García. (115)

Beautiful autumn color leaves *Ginkgo biloba* tree in Smithfield, USA. Photo by Les Park, USA. (123)

Kew *Ginkgo biloba*. Photo by Istvánka, Hungary. In Kew Gardens (England, UK) ginkgo has been planted 1762. This is known ginkgo "Old Lion”. (80, 85) Up right: Ginkgo in Kew Garden 1906. (134a)

See pages 252-253 this part.

Right down: *Ginkgo biloba* tree in Bojnice, Slovakia. Photo by Pavel Hrubík-Katarína Ražná, Nitra, Slovakia (4/2011).

Left: *Ginkgo biloba* in PAN Botanical Garden in Warsaw, Poland. Photo by “Crusier”. (124)

When asked how many trees, for example in 2010 is growing in the world can be answered generally, and is limited to plants older than 5 or 10 years, or for plants that are sexually mature. The answers to this question will be very different and imprecise. Yet a certain number can be displayed. That we will

Measurement of 4000 years old Ginkgo in Tiantan. Photo by Qin Gang, China (Changshun, Guizhou), 2009.

try. Today be sufficient information about a plant should look something like this:

Species: *Ginkgo biloba* L. 1771
Location: Park Street, Thomas Masaryk 11, Čakovec, Croatia, Europe
GPS: 46.391007, 16.43885
Description:
The thickness of the trunk: 50 cm
Height: about 16 m, small tree
Years old: about 40
Date: 05 March 2010

Where the ginkgo grows today can best be seen through the Plant Hardiness Zones. If on the maps that we see climate is favorable then surely we'll find a ginkgo there. This is why at the end of the book we present Hardiness Maps Zones.

Ginkgo tree in the palace garden of Harbke. The tree was plant in 1758 and in this case probably the oldest one in Germany. Photo by Times (July 2007).
(7. See Refer. 8).

About 750 years old Ginkgo tree in South Korea. Goheung Hyanggyo (Confucian Shrine and School) in Goheung, South Jeolla Province, South Korea. Photos by Steve Grob, USA.

Showa Memorial Park to enjoy the yellow leaves of Ginkgo trees, Japan. Photo by Daniel Wieczorek. (125)

Young ginkgo trees in (Ginkgo-Park) “Vilshofen an der Donau”, Germany. Photo by “High Contrast”. (117)

Autumn color in Botanical Garden Montreal, Quebec, Canada.
Photo by Hugh Siegel. (113)

Ginkgo biloba tree in autumn. Photo by “Ginkgotree”. (83)

Additional photos Ginkgo tree in the World, see the previous and the next parts of this book.

Details from Hiroshima (Japan) in 1945 and today. After the A-bombed 6 Aug. 1945 Ginkgo trees is survivors. Survivors Ginkgo trees in Hiroshima - choice photos. Photos from Petersen, D., & Conti, M. 2008. "Survivors: The A-bombed Trees of Hiroshima". Lulu Press.

6
The oldest Ginkgo trees in the World

The largest and oldest trees quite understandably are located in China. Although we have a large and a few thousand years old trees in Japan and North and South Korea, several of them, which are located in China's unmatched as a kind of curio and relic, and some are listed in Guinness Book of Records. It is not possible to fully demonstrate that natural populations of ginkgo, although they are very old, since the cultivation of Ginkgo by man is over 4000 years old. As DNA analysis showed that the greatest genetic diversity was confirmed in plants in Guizhou province, it is likely that a population of plants which are directly related to the natural population from the time of glaciation, and thus is an ancient, now extinct species of ginkgo. (71, 72, 132, 142, etc.)

Today we have survived ginkgo trees that are much older than a thousand years. Number of them moves over the numbers 200, but exact number is not yet known. However, only for a few trees that grow in China can be said that they are indeed the oldest.

Two are located in Guizhou province in south China. One tree is in Li Jiawan (A), and is estimated to be about 4500 years, and the other is located in the village of Tiantan in the same province and is estimated to be about 4000 years. It is worth mentioning that the last one did not became widely known until 2009.

Public was informed: “On June 28, ancient *Ginkgo biloba* trees were discovered in Tiantan village of Changshun County, Guizhou Province. There were two “ancestor” Ginkgo trees which were tightly surrounded by numerous “grandchildren” trees that vary greatly in thickness and height. The locals say that this “living fossil” is full of vitality in the summer and can produce over 4,000 pounds of seeds each year. Home for many species of birds, these trees are regarded as sacred by villagers. Villagers from near and far travel to the trees to make wishes, give worship, and pray for favorable weather conditions.

The ancient Ginkgo is 16.8 meters (55.1 feet) in circumference, requiring the arm spans of 13 adults to encircle it. It is 50 meters (164 feet) tall, and the crown of the tree covers half an acre. According to forestry experts, the tree is over

4,000 years old and is nicknamed “Chinese Ginkgo King.” (29, 30)

As above area is in the county Guizhou, as well as all surrounding counties and this part of China's vast and often inaccessible it is hard that for a long time to we will be able to know the true state of the old Ginkgo trees. There are fact that the reserve area in Tianmu Mountain has a total of 167 old trees. (132)

Apart from these two states there is another old Ginkgo tree - about 4000 years old and it is located in the eastern Chinese province of Shandong Province, next to one of the oldest monastery in the eastern Chinese Jin. Hight is 26.7 m, and the extent of the tree is 15.7 m. Treetop covers 900 square meters. (66)

Apart from these trees we have a lot of old trees preserved in the west Sichuan, then something in the north Zhejiang province , then in the mountainous valleys between the Zhejiang province and Anhui province.

As for the other surrounding countries most of the old trees (over 1000 years old) we have all over Japan and South Korea, and probably a lot of them can be found in North Korea and Mongolia but Ginkgo in those countries is not explored.

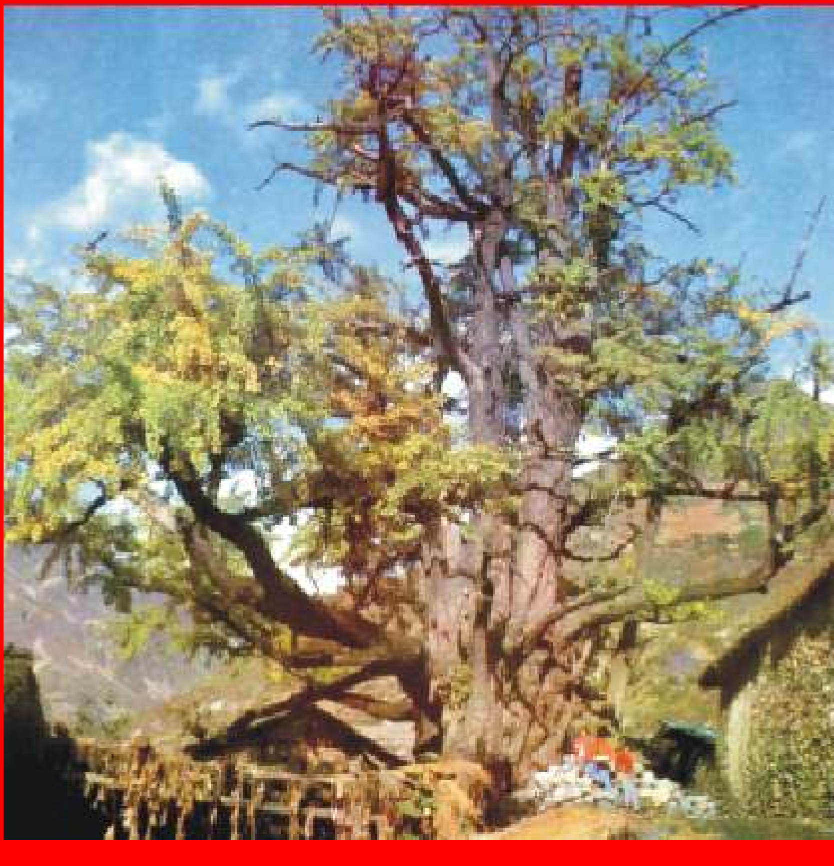
“Ginkgo biloba, a famous living fossil, is the sole survivor of the genus Ginkgo. To make inferences about the glacial refugia that harbored G. biloba, we examined the genetic structure of eight potential refugial populations and plantations using chloroplast DNA (cpDNA) with eight size variants in the trnK1-trnK2 fragment. The data consist of haplotypes from 158 trees collected from eight localities. The majority of the cpDNA haplotypes are restricted to minor portions of the geographical range. Our results suggest that refugia of G. biloba were located in southwestern China. This area is a current biodiversity hotspot of global importance, and may have been protected from the extremes of climatic fluctuations during the Pleistocene. The Ginkgos on West Tianmu Mountain, which were previously considered to be wild by many researchers, may, instead, have been introduced by Buddhist monks.”

(L Shen, et al., 2004, Genetic variation of Ginkgo biloba L. (Ginkgoaceae) based on cpDNA PCR-RFLPs: inference of glacial refugia (Heredity (2005) 94, 396–40).

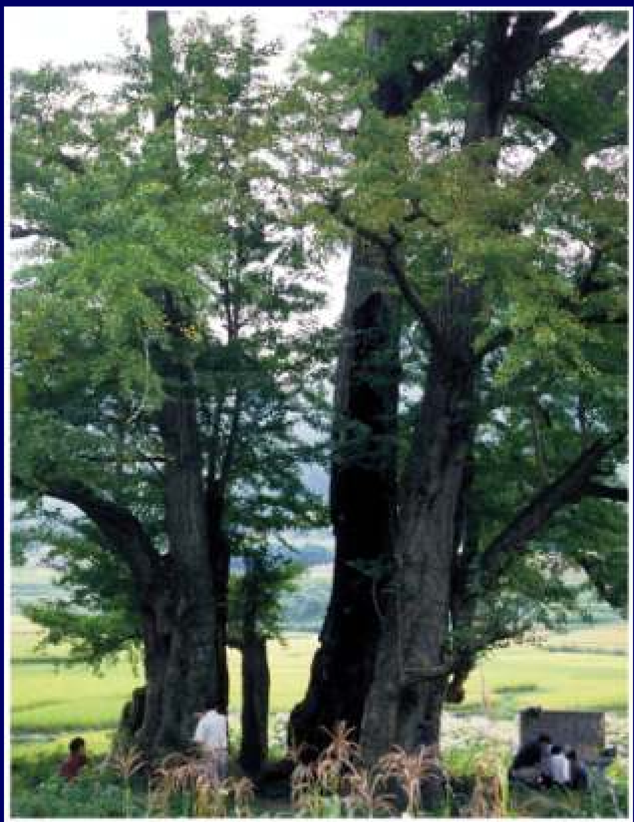
On June 2009 ancient *Ginkgo biloba* trees were discovered in Tiantan village of Changshun County, Guizhou Province (China). New trees that grow around the central trunk; is rejuvenation of the tree typical for Ginkgo.
Photo by Qin Gang, China (2009).

Tian Mu Shan (Tianmu Mountain), China. Artist-photo by Marcin Krakowiak, Poland (2006).

One of the most exposed Ginkgo tree is the *Ginkgo biloba* in Lengqi (Western Sichuan), China. Age: about 1700 years. Height is about 30 and girth about 12.5 m. Up: 2008 (Photo by Zhou Xiaolin from www.youduo.com). Right: 1983 (Photo by Yin Kaipu in Ma Shitu, 1985. The Rare Plants and Flowers of Western Sichuan). Down: 1908 (Photo by Ernest H. Wilson). See pages: 237, 250-251.



Peter Del Tredici & friends
(in Li Jiawan, China).



One of the last old Ginkgo trees natural populations (?) in World. The age of these plants is estimated to be about 4500 years. For more, see below. (A)
(Photo by P. Del Tredici)

(A) Xiang, Z. et al. 2009. The Li Jiawan Grand Ginkgo King,

(Reprinted from Arnoldia vol. 66, no. 3, copyright 2009, by permission of the Arnold Arboretum of Harvard University.)

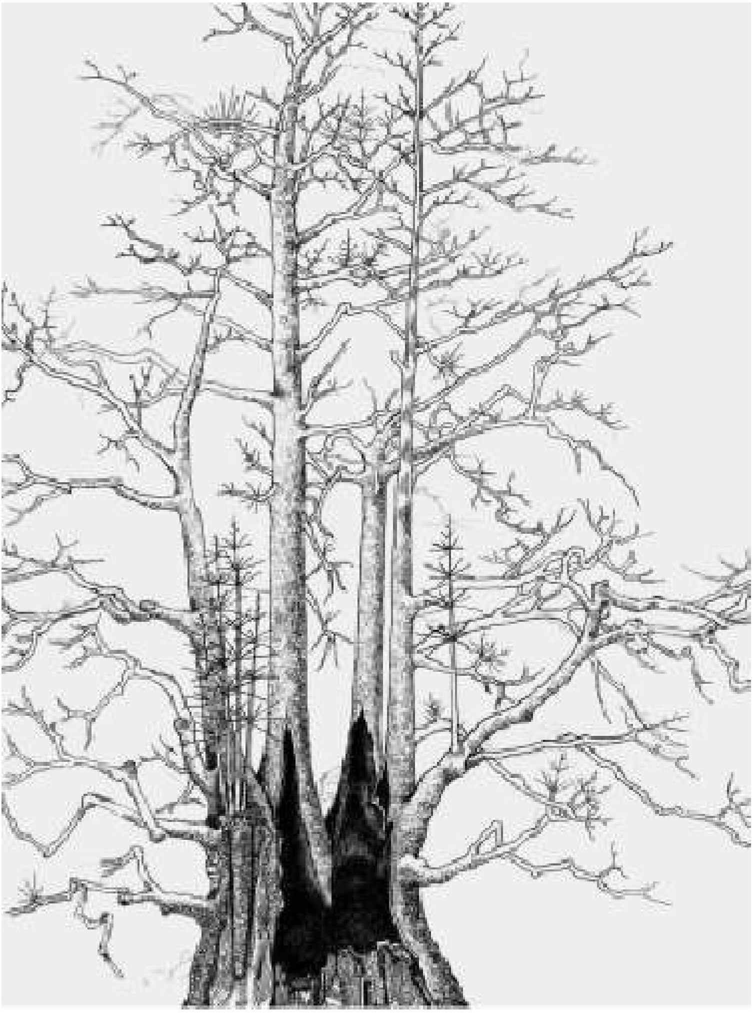
"The largest Ginkgo biloba tree in the world, the Li Jiawan Grand Ginkgo King, is located about a hundred kilometers west of Guiyang, the capital of Guizhou Province, China. The tiny hamlet of Li Jiawan (26°39' N and 107°25' E) is too small to appear on any maps. Administratively, Li Jiawan is part of Lebang Village, which is part of Huangsi Town in Fuquan County. The Grand Ginkgo King is growing at an altitude of 1,300 meters (4,265 feet) in a narrow valley where it towers over the surrounding bottomland vegetation, which consists mainly of cultivated crops (Figure 1). It is a male tree, about 30 meters (98 feet) tall, with a ground level trunk diameter of 460 centimeters (181 inches) in the east–west orientation and 580 centimeters (228 inches) in the north–south direction. Its circumference at breast height is 15.6 meters (51 feet) and its canopy shades an area of roughly 1,200 square meters (13,000 square feet). The primary "trunk" is completely hollow and encloses an area of 10 to 12 square meters (108 to 130 square feet), more than enough for seating a dinner party of ten people. Indeed, during the 1970s, an old man by the name of Pan Shexiang, accompanied by his cattle, lived in this natural tree cave for two years. The inside of the trunk—up to a height of about 5 meters (16 feet)—is charred black from lightning-ignited fires (Figure 2). The outside of the trunk shows no signs of fire, but has a ragged appearance caused by the excessive amount of callus tissue that has formed between the new branches and old trunks. In addition, large hanging chichi (downward growing shoots that look something like stalactites) have developed in response to various wounds and breaks, adding more confusion to the convoluted woody excrescences that cover the trunk. As battered as the outside of the tree appears, however, it maintains a vigorous hold on life, as attested to by the presence of numerous young shoots sprouting out all over the tree (Figures 2 and 3). Chinese investigators have determined that the Grand Ginkgo King is a "five-generationsin-one-tree" complex. In other words, the first generation was a normal seedling which—as a result of repeated sprouting from the base over the course of several millennia—produced four succeeding generations of trunks, each of which has continued the tree's growth and development after the preceding generation was damaged or died (Figure 4). The tree, as we know it today, is the result of at least five generations of stems produced over the course of thousands of years. There are five distinct trunk sectors which are separate at ground level but are partially merged at the height of about a meter (3.3 feet) above the ground, and new branches often sprout from the tissue between trunk sectors. While each trunk section seems to be physiologically independent, the secondary fusion creates the appearance of a single tree (Figures 2 and 3).

Age Estimation

Extensive field work has shown that the Li Jiawan Grand Ginkgo King is the biggest (in terms of trunk diameter) ginkgo tree in the world, a fact what was recognized by the Guinness Book of World Records in 1998. The question of how old the tree might be is unclear given that its internal tissues—with all their growth rings—are totally gone. What we do know, however, is that ginkgo trees of different ages have very different appearances and growth

Figure 1. The Li Jiawan Grand Ginkgo King as it appeared in September 2002. (Photo: P. Del Tredici)

Figure 3. The multi-generational trunk of the Li Jiawan Grand Ginkgo King.
(Page 210 this book - Photo: P. Del Tredici) - p. 210.



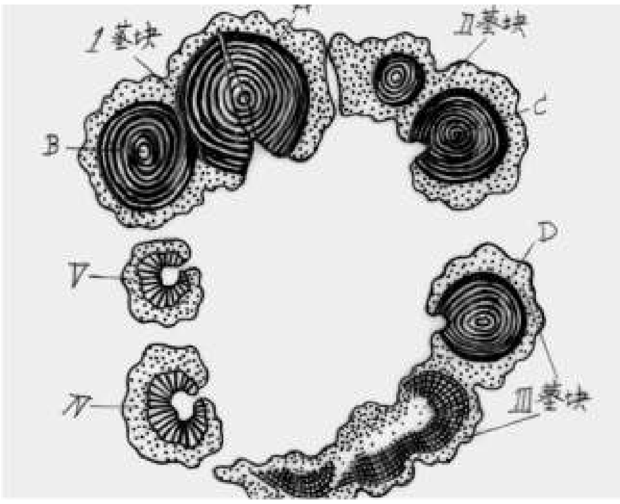


Figure 4. A cross-section of the Li Jiawan Grand Ginkgo King at ground level: Part 1 has two trunks: A, 30 meters (98 feet) tall, 110 centimeters (43 inches) diameter; B, 20 meters (66 feet) tall, 90 centimeters (35 inches) diameter; Part 2 has produced trunk C with a height of 28 meters (92 feet) and diameter of 80 centimeters (31 inches); Part 3 has trunk D of height of 28 meters (92 feet) and diameter of 60 centimeters (24 inches). The smallest and youngest trunks, Parts 4 and 5, have produced many small, weak stems, only a few meters tall, which seem to have lost their capacity to grow into upright trunks. (Drawing by Yinghai Xiang).

Figure 2. The Li Jiawan Grand Ginkgo King. (Drawing by Yinghai Xiang).

characteristics, and that different generations of ginkgo trunks typically have different growth rates and different longevities. We have come up with a rough estimate of the Grand Ginkgo King's age based on what we know about the ages of other ancient ginkgo trees in China with a similarly complex developmental history: the first generation stem(s) can typically reach up to 1,200 years of age, the second generation stems live for about 1,000 years, the third 800 years, the fourth 600 years, and the fifth about 400 years. According to this highly theoretical formula, the Li Jiawan Grand Ginkgo King has a maximum estimated age of around 4,000 to 4,500 years.

Legends and Romance

The Grand Ginkgo King has been living for thousands of years without an official record in the history books of the local government. However, there are many folk legends surrounding this tree. Writer Shixian Xu described one of these legends: During the Tang dynasty there was a scholar named Bai who had recently gained a governor's position by winning a national competition. At some point after taking office, Bai had a fight with a treacherous court official who had done a lot of bad things to the ordinary people. Given that bad officials typically protect each other, the scholar Bai was punished for his actions and sent off to an isolated army camp. On the way there, he was severely beaten and eventually died from his wounds. His body was buried at Li Jiawan by the local people, who deeply loved this scholar who tried to help ordinary people. Soon afterwards, a huge tree grew out from the tomb. This tree was considered the avatar of scholar Bai and given the name “bai guo tree” (one of the Chinese names for Ginkgo biloba). Another story about the origin of the tree dates from the Ming dynasty and holds that the Li Jiawan Grand Ginkgo tree transformed itself into a scholar and entered a national competition. The tree-scholar won the championship and was appointed to be a high official by the king. When the tree-scholar failed to show up for the position, the king sent two messengers to find him, both of whom were killed when they came back empty handed. The third messenger that the king sent was worried about his own safety since he too could find no trace of the mysterious scholar. During his disturbed sleep one night, he had a dream in which a person appeared calling himself “Bai.” At this point the messenger woke up and saw an official's hat hanging on the top of a nearby ginkgo tree and immediately understood that the scholar and the tree were one and the same. This story—that the ginkgo tree had changed to a spirit—is an astonishing, age-old story, and there are lots of “big tree changed to spirit” stories in the south of China. Luckily, people usually worship such “spirit trees” and don't dare to damage them. Many of these trees grow in temple courtyards or on sacred mountains and are preserved out of respect for the spirits that inhabit them but, unfortunately, this kind of conservation is not good enough to protect trees in the modern world.

What the Future Holds

The Li Jiawan Grand Ginkgo King was seriously damaged and its overall appearance dramatically changed by a storm in July, 1991, in which the biggest trunk on part 2 was broken off (Figure 4). The stem was pruned off below the break, but the resulting scar still looks fresh with no sign of callus growth to cover it over. It is also worth noting that for eighteen years there have been no new sprouts from part 3. Such a loss of normal regenerative function suggests that the Li Jiawan Grand Ginkgo may be losing its vigor. Based on what we have seen of other multigenerational trees, it is predictable that the Li Jiawan Grand Ginkgo will get smaller over time rather than bigger and that in 50 to 100 years or so it will be dead.

References

Xiang, B., Z. Xiang, and Y. Xiang. 2007. Report on wild Ginkgo biloba in Qianzhong altiplano. Guizhou Science 25(4): 47–55.
Xiang, B., Z. Xiang, and Y. Xiang. 2006. Investigation of wild Ginkgo biloba in Wuchuan County of Guizhou, China. Guizhou Science 24(2): 56–67.
Xiang, Y. and B. Xiang. 1997. Primary report on ancient Ginkgo biloba remnant community in Wuchuan county of Guizhou Province. Guizhou Science 15(4): 239–244.
Xiang, Y., X. Lu, and B. Xiang. 1998. Ancient Ginkgo biloba report 2: data of ancient Ginkgo biloba remnant communities in Luping village and Fengle town of Wuchuan county Guizhou Province. Guizhou Science 16(4): 241–252.
Xiang, Y. and Z. Xiang. 1999. Ancient Ginkgo biloba report 3: investigation on ancient Ginkgo biloba remnant population in Guiyang. Guizhou Science 17(3): 221–230.
Xiang, Z. and Y. Xiang. 2001. Ancient Ginkgo biloba report 4: investigation of ancient Ginkgo biloba remnant population from Changming to Jingyang along 320 national highway in Guizhou province. Guizhou Science 19(1): 48–58.
Xiang, Y., B. Xiang, M. Zhao, and Z. Wang. 2000. A report on the natural forest with Ginkgo biloba population in West Tianmu Mountains, Zhejiang Province. Guizhou Science 18(1-2): 77–92.
Xiang, Z., Z. Zhang, and Y. Xiang. 2001. Investigation of natural Ginkgo biloba population on the Golden Buddha Mountains of Nanchuan, Chongqing. Guizhou Science 19(2): 37–52.
Xiang, Z., Chenglong Tu, and Yinghai Xiang. 2003. A report on Ginkgo resources in Panxian county, Guizhou province. Guizhou Science 21(1-2): 159–174.

(Zhun Xiang is Research Assistant at Guizhou Academy of Science in Guizhou and Graduate Student at South China Agriculture University in Guangzhou. Yinghai Xiang is Professor of Ecology at Guizhou Academy of Science in Guizhou. Bixia Xiang is Assisstant Professor of Genetics at the University of Miami. Peter Del Tredici is a Senior Research Scientist at the Arnold Arboretum.)"

(B) Del Tredici, P., Ling, H., Guang, Y., 1992. The Ginkgos of Tian Mu Shan

(Conserv. Biol. 6, 2: p. 202–210) (Choice quotes).

"The question of whether or not Ginkgo biloba still exists in the wild has been debated by botanists, without resolution, for almost a hundred years. Most of the controversy has focused on a single population of trees located on Tian Mu Shan (Tian Mu Mountain) in Zhejiang Province, China, a site of human activities for approximately 1500 years. Regardless of its origin, the Tian Mu Shan Ginkgo population is biologically significant by virtue of its long survival in a semi-natural state under conditions of intense interspecific competition. A total of 167 Ginkgos were counted and measured in the 1018 ha Tian Mu Shan Reserve. Many of the trees were growing on disturbance-generated microsites, such as stream banks, steep rocky slopes, and the edges of exposed cliffs. Forty percent of the censused individuals were multitrunked, consisting of at least two trunks greater than 10 cm in diameter at breast height. Most of these secondary trunks originated from root-like "basal chichi," that are produced at the base of trees that have experienced damage from soil erosion or other factors. No Ginkgos less than 5 cm in basal diameter were found in the mature forests of Tian Mu Shan. This lack of seedling reproduction is caused by several factors: the lack of sunny microsites suitable for seedling growth, seed collection by people, and seed predation by animals. In the absence of successful seedling establishment, secondary trunk formation from basal chichi is the single most important factor in explaining the long term persistence of Ginkgo on Tian Mu Shan."

(C) Kim D. Coder, 2003. Ginkgo: Eldest Tree Survivor

(School of Forest Resources, University of Georgia, USA. Source: http://www.urbanforestrysouth.org/resources/library/ginkgo-eldest-tree-survivor/file_name)

There is one family of trees which saw the rise and fall of dinosaurs. This same family of trees barely survived the last ice-age. Ginkgo has become a tree without a home -- an exotic wanderer scattered across the globe. Every botanical garden and arboretum worthy of its title has at least one ginkgo tree. Cited as a living fossil, a cultural icon of the orient, and a tree both bizarre and fascinating, ginkgo shares our world today due solely to human cultivation. Its botanical uniqueness, food content, and medicinal values assure people will continue to cultivate this most ancient of trees.

This publication will outline the curiosity surrounding ginkgo from its name to its wood. Appreciating a living ginkgo standing in the sun can be enhanced by understanding its ecological history, biology and structure. Here myths will be discarded and rumors quenched regarding the ginkgo tree, in order for you to grasp the priceless and timeless genetic qualities of Ginkgo biloba.

The Ginkgo Age

The ginkgo family line stretches back beyond 200 million years. The fossil record places one or two species of ginkgo at this beginning. Over time there has been at least 20 species of ginkgo, possibly as many as 50 species, in at least four genera. The ginkgo family reached the height of its ecological success about 150 million years ago when there were approximately five common and widespread species. The ginkgo family covered many parts of what we now call the Northern Hemisphere of Earth. Catastrophe struck 65 million years ago.

The same global changes which initiated the loss of dinosaurs and allowed for the rise of mammals, also decimated the ginkgo forests. Only one ginkgo species survived. Surrounded with more effective competitors and seed predation, ginkgo began a long decline into extinction. Ginkgo disappeared from North America around 7 millions years ago, Europe around 3 million years ago, and its last few refuges in Asia evaporated across the last million years. The successive waves of global cooling snuffed out almost all the scattered remnants of ginkgo. Petrified wood and leaf fossils of ginkgoes were the only remains to be found at sites across the United States.

Genetic Relationships

Ginkgo biloba is unique among trees in occupying its own taxonomic division, class, order, family, and genus. It has outlived its relatives by large genetic distances. Seed plants (Spermatophytes) can be subdivided into two groups, Angiosperms and Gymnosperms. Ginkgo is one of four primary subdivisions of the Gymnosperms which include: cycads (9 genera and ~100 species); conifers (48 genera and ~500 species); Gnetales (3 genera and ~64 species); and, ginkgo (1 genera with 1 species).

In the Gymnosperms, Gnetales are considered developmentally advanced and cycads are considered primitive. Conifers are considered a main-line and dominant group defining Gymnosperms. Ginkgoes share traits intermediate between the cycads (similar reproductive traits) and the conifers (similar growth and structural traits). Ginkgoes are an advanced cycad or a primitive conifer. Ginkgo represents a genetic way-station on the road to modern trees.

By Any Other Name?

The given scientific name for this tree is Ginkgo biloba. The meaning of the scientific name is a “twolobed leaved, silver apricot.” The word *ginkgo* is derived from Chinese and Japanese terms *ginkyo* meaning silver apricot. The common name is greatly confused by translation and cultural differences. The most used common name follows the scientific name -- *ginkgo* (*ginkgo* being singular and *ginkgoes* being plural.) Other common names used are: ginkyo, gingkyo, ginko, maidenhair tree, duck-foot leaf tree, duck-foot tree, icho, silver apricot, nut apricot, white fruit, white eye, spirited eye, temple tree, grandfather-to-grandson tree, Ginkgobaum, and noyer du Japon.

In the beginning of determining ginkgo taxonomy, the common term ginkyo was mis-translated / mis-spelled by Latin-based taxonomists as ginkgo. Ginkgo biloba was the designated name established for the tree in 1771. Renaming and reorganizing the tree's taxonomic position occurred at least twice with the scientific names Salisburia adiantifolia (1797) and Pterophyllus salisburiensis (1866) being proposed. The oldest name (Ginkgo biloba) remains the proper scientific name.

Native Land?

Ginkgo was first known by modern humans in China. Mature ginkgoes grow in low density, disturbed, and mixed forests. Ecologically, ginkgo is an early successional species which colonizes sunny, open soil areas without much competition. Cut stream banks, soil slide areas, and large forest gaps with little litter are prime seed germination and seedling establishment areas. Mid-slope positions in heavily flooding river valleys, and well-drained, non-saturated mineral soil sites are ideal. Ginkgo seed production is a strategy for distribution and new site colonization. Ginkgo vegetative reproduction is a strategy for holding onto a site for hundreds of years.

Ginkgo can be found in naturalized stands within the mixed species forests concentrated on the lower mountainsides of the Western Tien Mu Shan in Southern Anhui province and in adjacent Western Zhejiang province, West of Shanghai, China. It is unclear if any of the remaining old stands of ginkgo in China are true natives to their sites, or were naturalized and cultivated by man over the last two millennia. Ginkgo was first recognized as a food and medicine source. Ginkgo was conserved for the royal household. Information about the tree slowly escaped the palaces, and ginkgo trees were cultivated within protected gardens and monasteries. The reverence and veneration of ginkgo occurred not because of religious or spiritual reasons, but because of its uniqueness, food cash value, and perceived medicinal properties.

World Travels

As more seeds became available, and as more trees were planted to supply the royal court, the more seedlings escaped and were cultivated by merchants. Around 800 years ago ginkgo trees were first recorded as part of trade to Japan and Korea. Europeans first saw the tree in Japan in 1691 and noted its unique qualities. Upon further searching through the middle 1700's, Europeans found ginkgo growing in China, Japan, and Korea. Ginkgo was first described botanically in continental Europe in 1712. The Dutch introduced the tree to continental Europe in 1727 near Utrecht. Cultivation in England began in 1754.
A botanist and collector named Hamilton planted the first two trees in the United States near Philadelphia in 1784. Both these trees are now gone. The oldest living ginkgo tree in the United States was planted in 1785 or shortly thereafter by the Bartram brothers (famous botanical explorers), also near Philadelphia. A planting fad erupted among upper middle class and wealthy households in the northeastern part of the

United States in the early 1800's and again in the 1890's until the first world war. A curiosity and strangeness factor still propels planting ginkgoes around the world – in yards, schools, streets and parks.

Size, Reach, & Extent

Ginkgoes come with many variations in growth. There are ginkgo cultivars with many sizes and shapes. Some of these can be accessed by name in the publication by Coder, 2003, Selected Ginkgo Forms & Cultivars, University of Georgia, School of Forest Resources, Publication FOR03-20, pp.5. The "normal" ginkgo traits will be reviewed here. Ginkgoes are large, tall trees. Many people have mistakenly used ginkgo for street-side plantings and around buildings where there is little below or above ground space for the tree to colonize. Ginkgoes are considered too large for narrow street or tree lawn plantings. Crown spread is highly variable and has been selected for in various cultivars. Ginkgo trees can reach 50-90 feet in height with a 30 to 60 feet wide crown spread over a trunk 2-3 feet in diameter. The largest ginkgoes occur in China and reach maximum confirmed sizes of approximately 140 feet tall and 16 feet in trunk diameter. Note that true heights and trunk diameters are estimates due to mountainous terrain exposing root collars and root base areas, and to adventitious roots and special aerial root growths clouding where to take measurements.

Life-form & Life-span

Ginkgoes can reach large sizes on good sites away from site disturbance, tissue injury, and highly competitive plants. Juvenile trees have regularly spaced but sparse branches forming an upright and open crown. As trees mature, crowns become more spreading with branches colonizing more resource space and crowns becoming more dense. With age, branches fill-in the open crown areas of youth. The noticeable, single-leader-dominate young tree crown is overtaken by other branches resulting in a multileader tree with age. The final mature form is an elongated wide oval crown shape. There is a trend difference in crown shape between a more upright and narrow crown shape in male trees and a more spreading and shorter female tree. Reliable sources cite maximum existing tree age to be 1,200 years old. Unsubstantiated reports cite 3,000 years of age maximum.

In the species Ginkgo biloba there are five primary crown or leaf forms (besides "normal" or "typical") which humans have cultivated: a weeping or pendulous form; a highly upright or fastigiate form; a dwarf type; a branch type with aerial root bulges; and, three foliage variations -- rolled tubular leaves, variegated leaves, and leaf and seed-stem fused foliage. Beyond these standard variations, the rest of ginkgo variability is considered "normal."

Growth Rate

There are many highly variable citations for growth rate. Many measures are confused by cultivar traits, sex, biological age, and site resources available. Without isolating each factor, a simple growth rate value means little. As a general rule, ginkgo has a moderate growth rate compared with other specimen trees in an established landscape. An establishment period of 2-5 years is usually a time of extremely slow growth. After establishment until approximately 40 years of age, growth rate can be rapid. As active sexual reproduction accelerates, growth rates decline 40-140 years. As female trees reach sexual maturity (20-40 years of age), elongation and crown expansion rates decline as more resources are dedicated to seed production. After 150 years growth rates are usually slow, although ancient ginkgoes on sites with great resources can sustain rapid growth for centuries. The fastest, long-term growth occurs in males on the best resource-available and stress-reduced sites, and where roots are infected with mycorrhizae fungi (endo -- VAM type – Glomus spp.).

Figure 1 (see page 86) provides an extremely rough estimate of mortality and normal expected lifespan for ginkgo based only upon information cited in scientific and popular literature. Note established ginkgoes should grow for at least 45 years and should be expected to live to be 110 years of age. Figure 2 (see page 86) provides an extremely rough estimate of ginkgo diameter growth over time. Note that a ginkgo at 110 years of age should have a diameter of 2.1 feet. The height data presented across the literature is confounded much more than diameter and age due to storms and site constraints. In general, a 110 year old ginkgo, 2.1 feet in diameter would be roughly 62 feet tall.

Tree Health Issues

Ginkgoes are easy to transplant and establish if a large root ball with healthy roots are planted. Because of the mess of seed production, plant only males for shade and street tree uses. Approximately 0.5% of male ginkgoes will generate some isolated female flowers and seeds (monoecious). Females should be planted as specimens away from walking trails and public areas, if at all. Tree health care is minimal except for providing good moisture in a well-aerated, well-drained soil.

Ginkgo has few primary pests and shares key stresses with all other trees – water availability in the growing season. Ginkgo is tolerant of air pollutants at low to moderate levels. Seeds are susceptible to fungal attack. Many different parts of the tree contain a variety of anti-biological compounds targeted primarily at animal systems. One major concern in ginkgo is a failure to effectively deal with wounds. Ginkgo does not react quickly in compartmentalizing injuries. This is especially noticeable in wall four (next year's increment) problems.

Ginkgo should not be green-wood pruned when young. Allow the tree to grow naturally until it is larger, and then do not use crown cleaning or thinning. Use crown raising and terminal subordination to control crown spread. Light nitrogen fertilization, once the tree is established will be essential for good tree performance. Beware of nitrogen fertilizer over-dose, especially when soils are compacted or drainage is poor.

Site Preference

Ginkgo is an early successional pioneer onto open mineral soils in full sun. They establish and grow on disturbed sites within mixed temperate forests. Ginkgo does well where conditions lean toward warm and moist conditions and perform poorly where sites concentrate low temperatures and wind / ice storms. As with most trees, temperature and water availability regimes override most other site constraints. Ginkgo is considered summer drought tolerant. In general, ginkgo requires 90% to 100% sun, moist but well-drained soils, and neutral to acidic soils. Ginkgo requires North American winter hardiness zones of 4 - 8 and North American heat zones of 4 - 8.5. Altitudinal limits are below 6,000 feet above sea-level. Ginkgo is cited as being urban site and air pollution tolerant, but are salt sensitive. Tolerance is a relative concept and growth rate is significantly sacrificed for any resource poisoning or availability constraints.

Conclusions

Ginkgo is worth planting and enjoying if only for it rarity of form and ancient lineage. Imagine a tree which was both one of the only living survivors of Hiroshima's atomic blast (from root sprouts), and one of the few trees descended from the age of reptiles virtually unchanged. Plant a piece of ancient history which teetered on the edge of the extinction abyss. Plant a ginkgo.

(D) Henderson, P., 1910. Handbook of Plants and genera Horticulture, New York (p. 390-391).

Salisbu'ria. Maiden-hair Tree.
In honor of *Richard A. Salisbury*, a distinguished English botanist. Nat. Ord. *Coniferae*.

This very remarkable tree was formerly called *Ginkgo biloba*, Ginkgo being its name in Japan. The only species that has been described, and is to be found in collections of ornamental trees, is *S. adiantifolia*, the leaves resembling in form those of the Maiden-hair Fern, the botanical name of which is *Adiantum*. This is one of the most beautiful and peculiar of all hardy exotic trees, and one so entirely difi"erent in habit and foliage from all others belonging to this order, that, were it not for the flowers and fruit, it would have been difficult to find its proper position in the vegetable kingdom. Without regard to its botanical position, it is beyond question one of the most beautiful trees under cultivation. It attains a height of eighty feet, and has a straight trunk with a pyramidal head. This tree is a native of China and Japan, and was introduced into England in 1754. It is not yet as common in this country as it should be, on account of its price and scarcity, but is now being more largely propagated and planted. There is a fine specimen on Mr. Manice's place at Queens, L. I., fully fifty feet high, with a full, symmetrical head. There is also a noble specimen on the old Downing place at Newburgh, supposed to be the lai-gest in the States. It is propagated in this country by layers, or by imported seeds. The fruit is common in Japan, and is highly esteemed for its astringent properties and for the reputation it has of promoting digestion.

From an interesting notice of this remarkable tree in the "Philadelphia Ledger," August 29, 1889, remarking on its fruiting for the first time in that city, in the grounds of Mr. Charles J. Wister, Germantown, and communicated to us by Mr. A. Garman, of Philadelphia, we make the following extracts:

The tree itself has a very remarkable history. It is asserted by eminent horticulturists that it has been found wild nowhere on the earth, but is cultivated largely both in China and Japan, where it is usually found near the temples and similar religious structures.

The first specimen received in this country was presented by William Hamilton, the former owner of the beautiful grounds—in which the celebrated explorer, Pursh,was gardener — which is now known as Woodlands Cemetery. This particular tree is still regarded as one of Philadelphia's arboreal treasures, and tree lovers from distant parts of the globe, when in this city, journey to the cemetery expressly to see this magnificent specimen." When the original tree that was imported from Japan flowered it was found to have male flowers only, and consequently all trees propagated by cuttings were male also. The tree in Woodlands is a male tree. It has only been comparativelj' a few years since seeds have been introduced from China or Japan, and among these young seedlings, plants with female flowers were found. This tree of Mr. Wister's happens to be female, and now that it has come of age it produces fruit. Numerous seedling trees have been distributed over different parts of the United States, and it is expected that others will reach the fruiting stage before many years. There is a magnificent avenue of Ginkgo trees on the grounds of the Agricultural Department at Washington, the trees having been sent there from Pennsylvania nurseries. It is not known, however, that even the National Government has been favored with fruit ahead of Mr. Charles J. Wister.

The fruit itself is about the size of a large cherry, and is of a greenish-yellow color when ripe. Like the cherry, it has a fleshy pulp with a single stone or seed in the interior. To most persons the odor of the fruit is very disagreeable, but the fruit plaj-s a very important part in Chinese gastronomic ai-t. The grand dinners of the Chinese usually last all day, and every help to digestion is needed in order that the guests may experience the fullest enjoyment. The fruit of the Ginkgo is the chief element in promoting this desirable result. They are first slightly roasted, and then placed in small plates by the side of the guests, who every now and then lake one between courses, as an American or an Englishman would an olive. Mr. Wister states that the odor of the fruit of his tree is very disagreeable, and those who have handled the fruit can scarcely credit its use as described by the Celestials.

The palaeontologists and evolutionists are also much interested in the Ginkgo. Although, as already stated, no wild localities are known where the trees grow, it has been discovered by its fossil remains to have been once widely scattered over the face of the globe. It is probable that it is only through its having commended itself by its beauty and other good qualities to the Chinese and Japanese gardeners, that it has been able to survive those geological cataclysms under which the old race has been cleared away from the surface of the earth. It is classed with the coniferous trees, notwithstanding its fern-like foliage, its closest relation being the yew family; but as there is nothing very closely resembling it, the palseontologists believe that an immense number of what have come to be called missing links must have been wholly swept away.

(E) Orlóci László, 2011. The first Ginkgo in Hungary.

(2011/02/23)

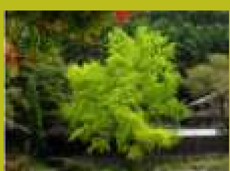
“The planting of the first Ginkgo in Hungary is an interesting story. The count lineage of the famous Festetics family for the purpose of building a hunting mansion purchased the country house with 10 hectares of land of the Szeleczky family, on the periphery of Pest, in the early 1800's. A classical Empire style mansion was built in 1801 by the alteration of the original Baroque building, on the south side of which they planted three saplings, which can be seen now days as two male and one female tree. The family took interest in the science of Botany and has funded it for a long time, the proof of which can also be seen by the planting of these trees. They had good relations with the Habsburg family, so the saplings or their propagating material probably came from the famous tree of the imperial botanical garden of Vienna. For not only these facts alone our garden, the ELTE Botanical Garden regards as one of its duties the study of Ginkgo. During the past years we have conducted anatomical, biochemical and morphological studies. We have also inventoried the oldest Ginkgo trees in Hungary; during the course of which we have documented that one specimen the tree in Acsád is capable of changing its gender, which is a proof of the incredible survivability of the species. We also carry out breeding and introduction of cultivars in the experimental plant introduction station in Tordas. Here continuous observations are made on over 40 cultivars.
I am convinced that the „forever survivor” is a perspective medicinal and ornamental plant of the future.

• The gender changer of Acsád • The largest and most beautiful of Somogysárd • The young one with Chi-Chi-s of Kőszeg • The cultivar trial in Tordas • 'Wiener Walzer' and 'Hetych' • Ginkgo Days at ELTE Botanical Gardens • Topophysis, old cutting and the survivor all suppressing tree”

Around the temples in China, Japan, South Korea has traditionally been planted ginkgo trees - as a protection against fire and other disasters. This is one Temple in South Korea. Photo by Steve Grob, USA, 2006.

Beautiful Summer and Autumn color Ginkgo tree & (red) Japanese Maples (in Chichibu-Tama-Kai National Park, Japan). Photo by Daniel Wieczorek, Japan (2010). (127)

Summer 2010.



Autumn 2010.

Old *Ginkgo biloba* tree at Kuroki Suwa-jinja shrine, Japan. Photos by Shouta Azumi, Japan.

•

Plant & tree Hardiness Zones – World and parts maps (Continents)

We have already mentioned that Ginkgo thrives on all continents. But its cultivation is mainly caused by climatic features. The climate is divided by the zones, and Ginkgo's best suit the conditions of 3/4 to 8/9 zone. If you look at the map, then clearly we can see why Ginkgo somewhere thrive well, and sometime not. It is therefore very important to keep in mind which time zone works - if you want to plant a Ginkgo. Today, the climate and climatic zones can be quite easily monitored via the Internet, and there are several types of zones. Listing Hardiness Zone are the most important when it comes to cultivating plants - in general.

Here are a number of Hardiness Zone Maps that all use the same USDA methodology and numbering system (for easy comparison among the regions). Note that many large urban areas carry a warmer zone designation than the surrounding countryside. The map-contains as much detail as possible, considering the vast amount of data on which it is based and its size.

In addition to the USDA methodology presented here are from APHIS-PPQ-CPHST-PERAL methodology and numering sistems.

These are currently (2010) valid data (if not stated otherwise).

Legend:

Favourable climate for Ginkgo

Unfavourable climate

Depending on the microclimate (danger)

Zone	°F	°C	Full
3a	-40 to -35 F	-40 to -37 C	-40°C/-34°C -40°F/-30°F
3b	-35 to -30 F	-37 to -34 C	
4a	-30 to -25 F	-34 to -31 C	-34°C/-29°C -30°F/-20°F
4b	-25 to -20 F	-31 to -28 C	
5a	-20 to -15 F	-28 to -26 C	-29°C/-23°C -20°F/-10°F
5b	-15 to -10 F	-26 to -23 C	
6a	-10 to -5 F	-23 to -20 C	-23°C/-18°C -10°F/0°F
6b	-5 to 0 F	-20 to -18 C	
7a	0 to 5 F	-18 to -15 C	-18°C/-12°C 0°F/+10°F
7b	5 to 10 F	-15 to -12 C	
8a	10 to 15 F	-12 to -9 C	-12°C/-7°C +10°F/+20°F
8b	15 to 20 F	-9 to -7 C	
9a	20 to 25 F	-7 to -4 C	-7°C/-1°C +20°F/+30°F
9b	25 to 30 F	-4 to -1 C	

Zone	Celsius [°C]	Fahrenheit [°F]	Example Cities
0	Below -50 C	Below -60 F	Verkhoyansk, Russia
1	-45 to -50 C	-50 to -60 F	Fairbanks, Alaska, USA; Yakutsk, Russia
2a	-43 to -45 C	-50 to -45 F	Prudhoe Bay, Alaska, USA; Irkutsk, Russia
2b	-40 to -43 C	-45 to -40 F	Novosibirsk, Russia; Pinecreek, Minnesota, USA
3a	-37 to -40 C	-40 to -35 F	Omsk, Russia; St. Michael, Alaska, USA
3b	-34 to -37 C	-35 to -30 F	Yekatarinburg, Russia; Tomahawk, Wisconsin, USA
4a	-32 to -34 C	-30 to -25 F	Kazan, Russia; Minneapolis/St.Paul, Minnesota, USA
4b	-29 to -32 C	-25 to -20 F	Moscow, Russia; Northwood, Iowa, USA
5a	-26 to -29 C	-20 to -15 F	St Peterburg, Russia; Des Moines, Iowa, Chicago, USA
5b	-23 to -26 C	-15 to -10 F	Helsinki, Finland; Columbia, Missouri, USA
6a	-20 to -23 C	-10 to -5 F	Stockholm, Sweden; Boston, St. Louis, Missouri, USA
6b	-18 to -20 C	-5 to 0 F	Berlin, Germany; New York, Branson, USA; Beijing, China
7a	-15 to -18 C	0 to 5 F	København, Denmark; South Boston, Virginia; Xi'an, China
7b	-12 to -15 C	5 to 10 F	Amsterdam, Netherlands; Griffin, USA
8a	-9 to -12 C	10 to 15 F	Peking, China; Paris, France; Dallas, Texas, USA
8b	-7 to -9 C	15 to 20 F	Istanbul, Turkey; Gainesville, Florida, USA; Tokyo, Japan
9a	-4 to -7 C	20 to 25 F	London, England; St. Augustine, Florida, USA; Shanghai, China
9b	-1 to -4 C	25 to 30 F	Madrid, Spain; Rome, Italy; Brownsville, Texas; Osaka, Tokio, Japan
10a	2 to -1 C	30 to 35 F	Lisbon, Portugal; Victorville, California, USA; Melbourne, Australia
10b	4 to 2 C	35 to 40 F	Auckland, New Zealand; Coral Gables, Florida, USA; Guangzhou, China
11	above 4 C	above 40 F	Santa Cruz, Tenerife; Mazatlan, Mexico; Brisbane, Australia
12	above 10 C	above 50 F	

Primary references and Special Thanks
(Plant & tree Hardiness Zones Maps)

Special Thanks for this part:

- Mr. Roger D. Magarey, Ph.D. (Senior Researcher, North Carolina State University and Cooperator with USDA-APHIS-PPQ-CPHST-PERAL 1730 Varsity Drive, Suite 300, Raleigh, NC, 27606, USA).
- Natural Resources Canada (Canadian Forest Service) and Agriculture and Agri-Food Canada. Reproduced with the permission of Natural Resources Canada, Canadian Forest Service." The image of the map will include the following: © Her Majesty the Queen in Right of Canada, 2007.
- Mrs. Tatyana Shulkina, Ph.D., Associate Curator, Former Soviet Union (the Caucasus) Projects Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166-0299, USA.
- Mr Mark P. Widrlechner, Ph.D. USDA-ARS Horticulturist, North Central Regional Plant Introduction Station, Iowa State University, Ames, Iowa 50011-1170, USA.
- Shane Kelley/Kelley Graphics (Kelley Graphics, 14902 Kamputa Dr., Centreville, VA 20120, USA).
- Mr. Lester Kallus, the president of The International Aroid Society, PO BOX 43-1853, South Miami, FL 33143, USA.
- Mr. Mark P. Derowitsch, Ph.D., The Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410, USA.
- http://www.backyardgardener.com, WA, USA.

- Anonymous 2003: The 2003 US National Arboretum "Web Version" of the USDA Plant Hardiness Zone Map USDA Miscellaneous Publication No. 1475, Issued January 1990.
- Brasier, C. M.; Robredo, F.; Ferraz, J. F. P., 1993: Evidence for *Phytophthora cinnamomi* involvement in Iberian oak decline. Plant Pathol. 42, 140-5.
- Erwin C.D.; Ribeiro O.K., 1996: Phytophthora diseases world-wide. St. Paul, Minnesota USA, American Phytopathological Society.
- Crandall, B. S., Gravatt, G. F., and Ryan, M. M. 1945. Root disease of *Castanea* species and some coniferous and broadleaf nursery stocks, caused by Phytophthora cinnamomi. Phytopathology 35, 162-180.
- Garbelotto, M., and Huberli, D. 2006. First report on an infestation of Phytophthora cinnamomi in natural oak woodlands of California and its different impact on two native oak species. Plant Dis. 90, 685.
- Gelderen, D.M. van., Jong, P.S. de., Oterdoom, H.J., 1994. Maples of the World. Timber Press, Portland, Oregon.
- Mirchetich, S. M., Campbell, R. N., and Matheron, M. E. 1977. Phytophthora trunk canker of coast live oak and cork oak trees in California. Plant Dis. Rep. 61, 66-70.
- Robin, C., Desprez-Loustau, M. L., Capron, G., and Delatour, C. 1998. First record of Phytophthora cinnamomi on cork and holm oaks in France and evidence of pathogenicity. Ann. For. Sci. 55, 869-883.
- Tainter, E.; O'Brien, G.J.; Hernandez, A.; Orozco, F.; Rebolledo, O., 2000: *Phytophthora cinnamomi* as a cause of oak mortality in the State of Colima, Mexico. Plant Dis. 84, 394-8.
- Wood, A. K., and Tainter, F. H. 2002. First report of *Phytophthora cinnamomi* on *Quercus laurifolia*. Plant Dis. 86,441.
- Zentmyer, G.A., 1980. *Phytophthora cinnamomi* and the diseases it causes. Phytopathological monograph 10. The American Phytopathological Society St Paul, MN, 96 pp.

- USDA. 1990. USDA plant hardiness zone map. USDA- Agricultural Research Service (ARS).

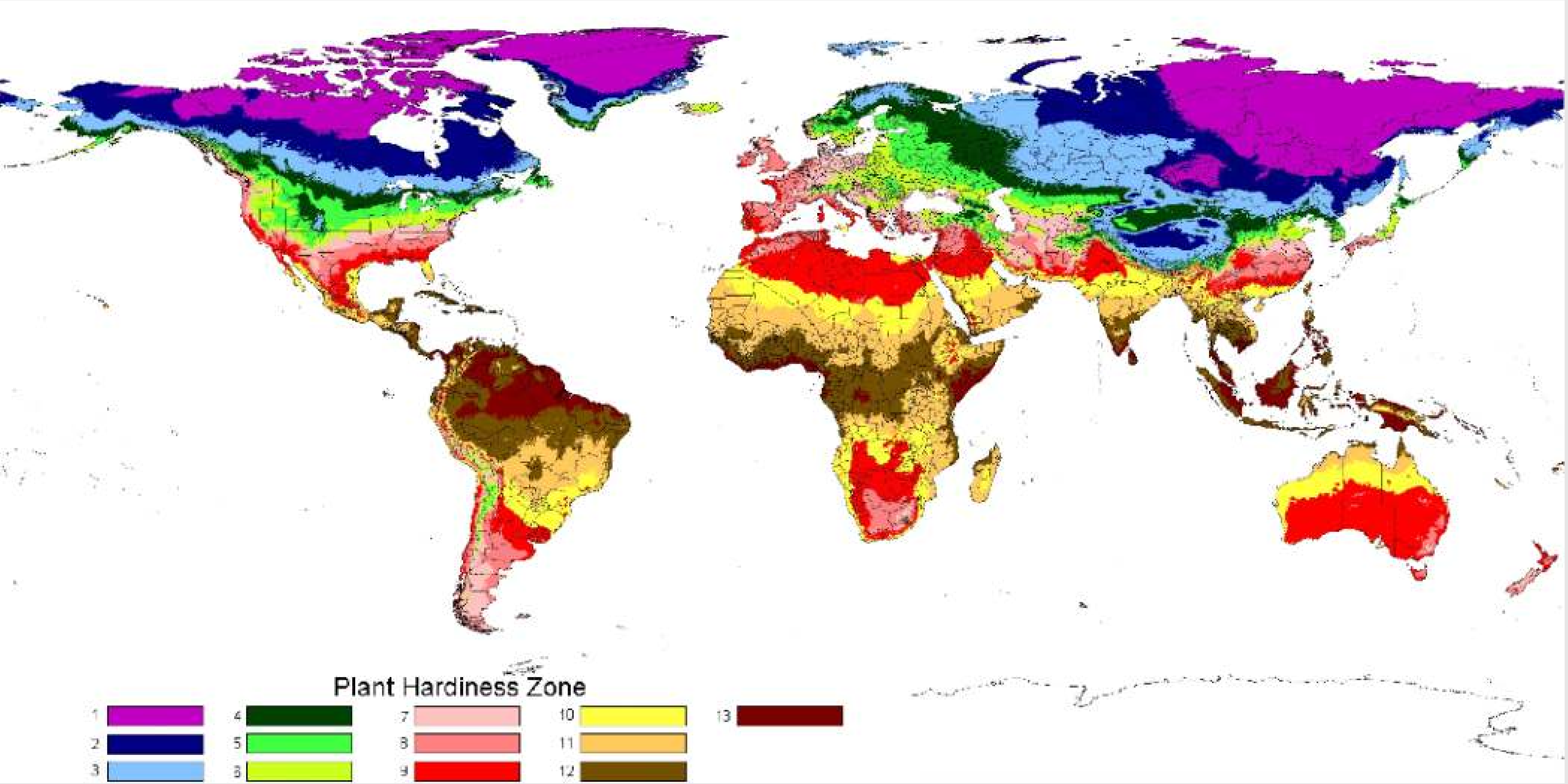
- Miscellaneous Publication Number 1475. USDA-ARS, Washington, DC 2002.

- The 2003 US National Arboretum "Web Version" of the USDA Plant Hardiness Zone Map USDA Miscellaneous Publication No. 1475, Issued January 1990.

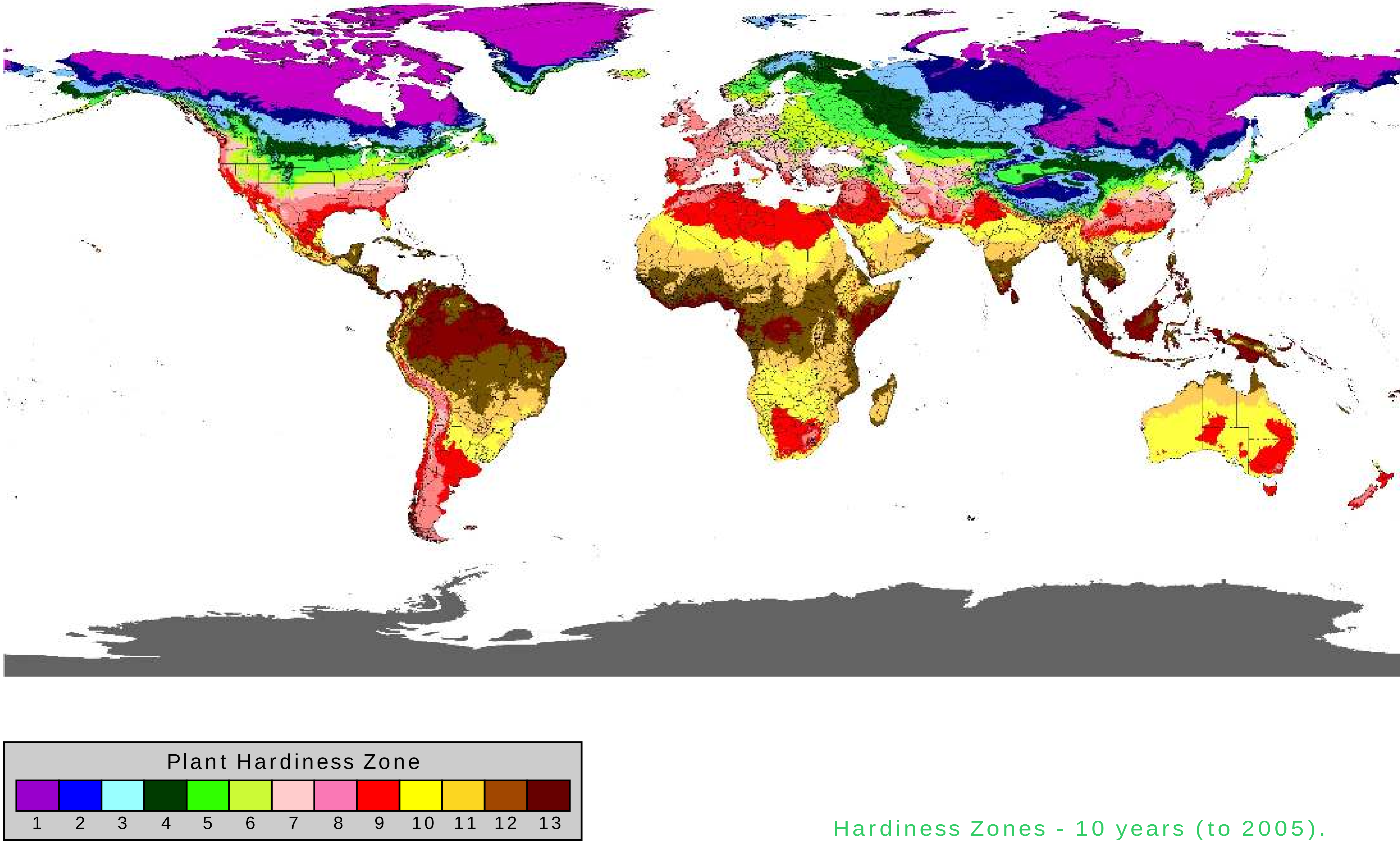
(Last access control: 2010/12/23-24/)

http://sis.agr.gc.ca/cansis/nsdb/climate/hardiness/plant_poster.zip
http://www.pacificbulbsociety.org/pbswiki/files/Maps/CanadaHZMap.pdf
http://www.planthardiness.gc.ca/images/cfs11x8E.jpg
http://www.arborday.org/media/graphics/2006_zones.zip
http://www.backyardgardener.com/zone/europe1zone.html
http://www.mobot.org/MOBOT/research/russia/images/Fig_02.jpg
http://www.ars.usda.gov/Main/docs.htm?docid=9815&page=3
http://www.jelitto.com/english/japan.htm
http://www.diggers.com.au/images/HCOLDZ01Large.jpg
http://www.liddlewonder.co.nz/zones.php
http://www.uk.gardenweb.com/forums/zones/hze.html
http://www.usna.usda.gov/Hardzone/ushzmap.html
http://www.ars.usda.gov/Main/docs.htm?docid=9815&page=2
http://www.aroid.org/horticulture/zonemap/
http://www.nappfast.org/Plant_hardiness/ph_index.htm

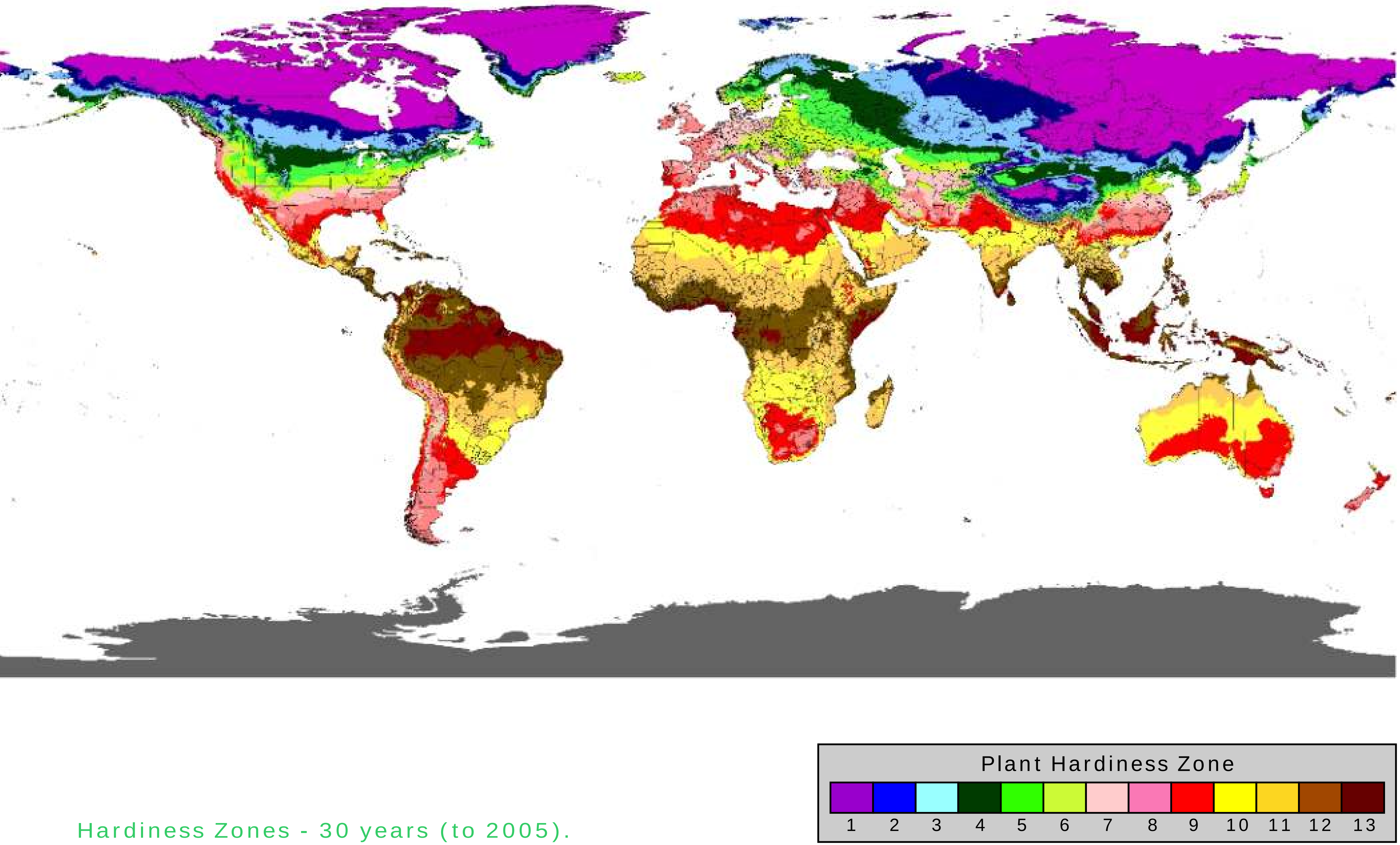
(More additional literature and source see “References” this part book.)



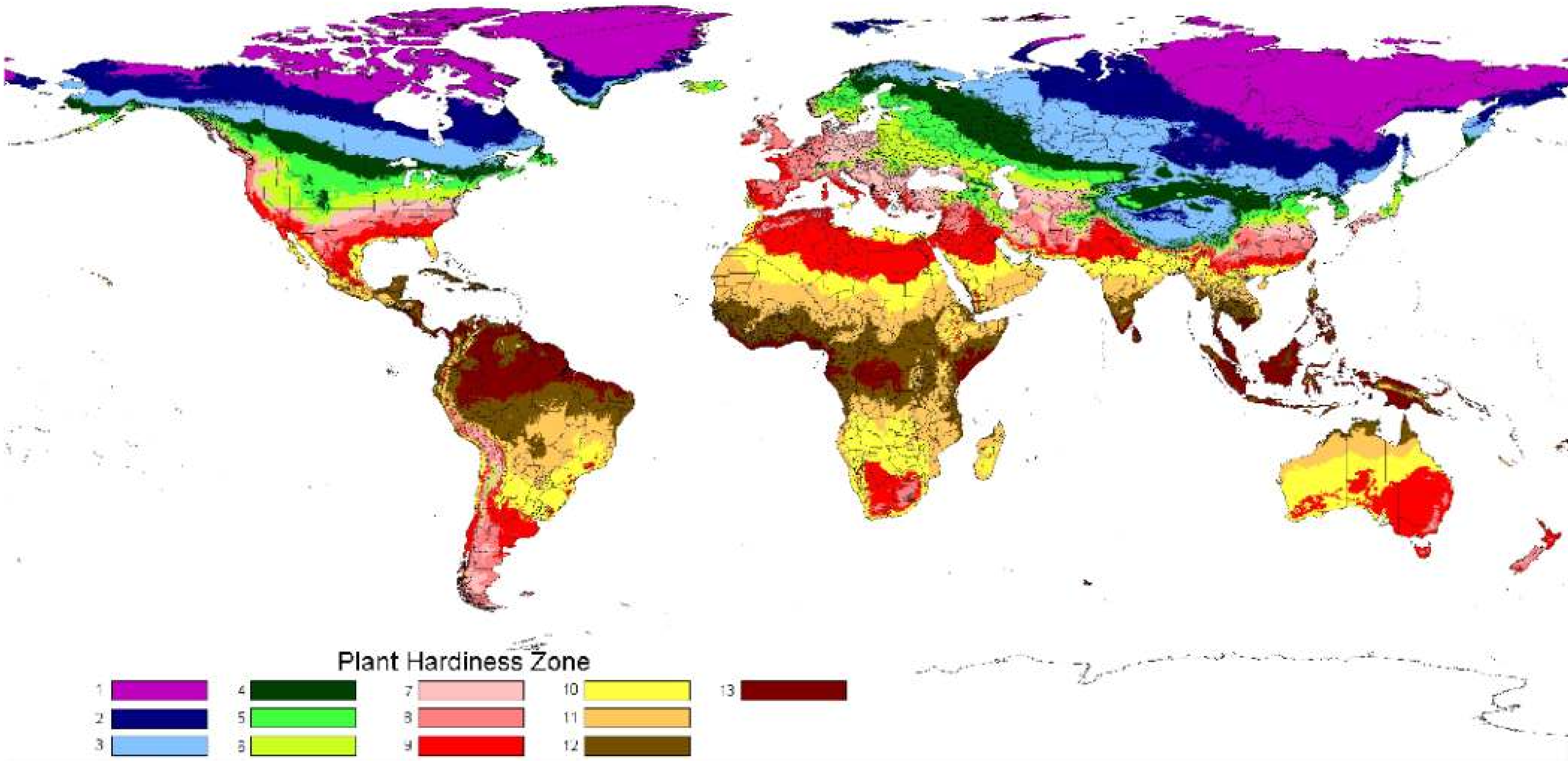
Hardiness Zones 1961-1990. (110)



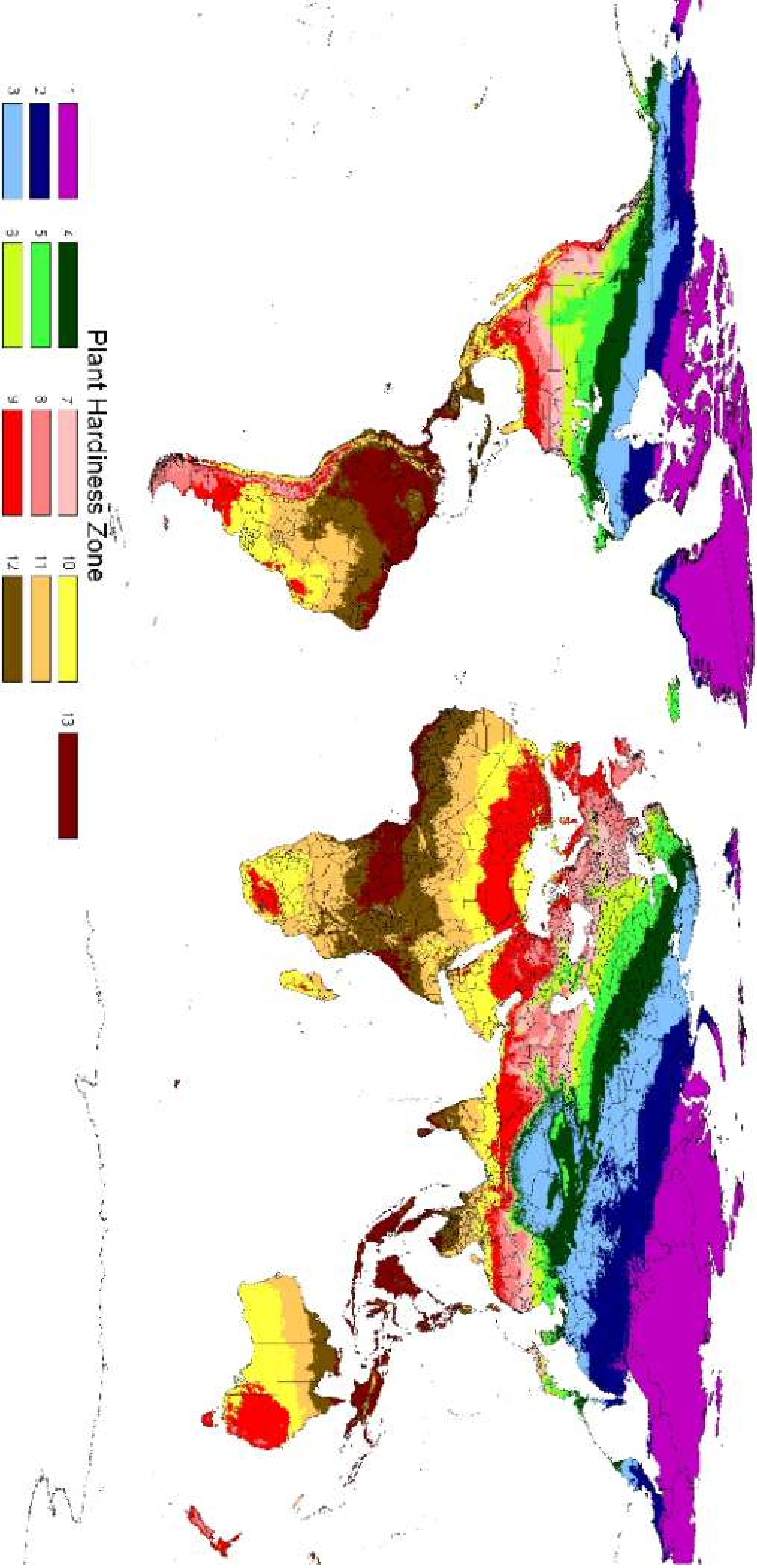
Hardiness Zones - 10 years (to 2005).



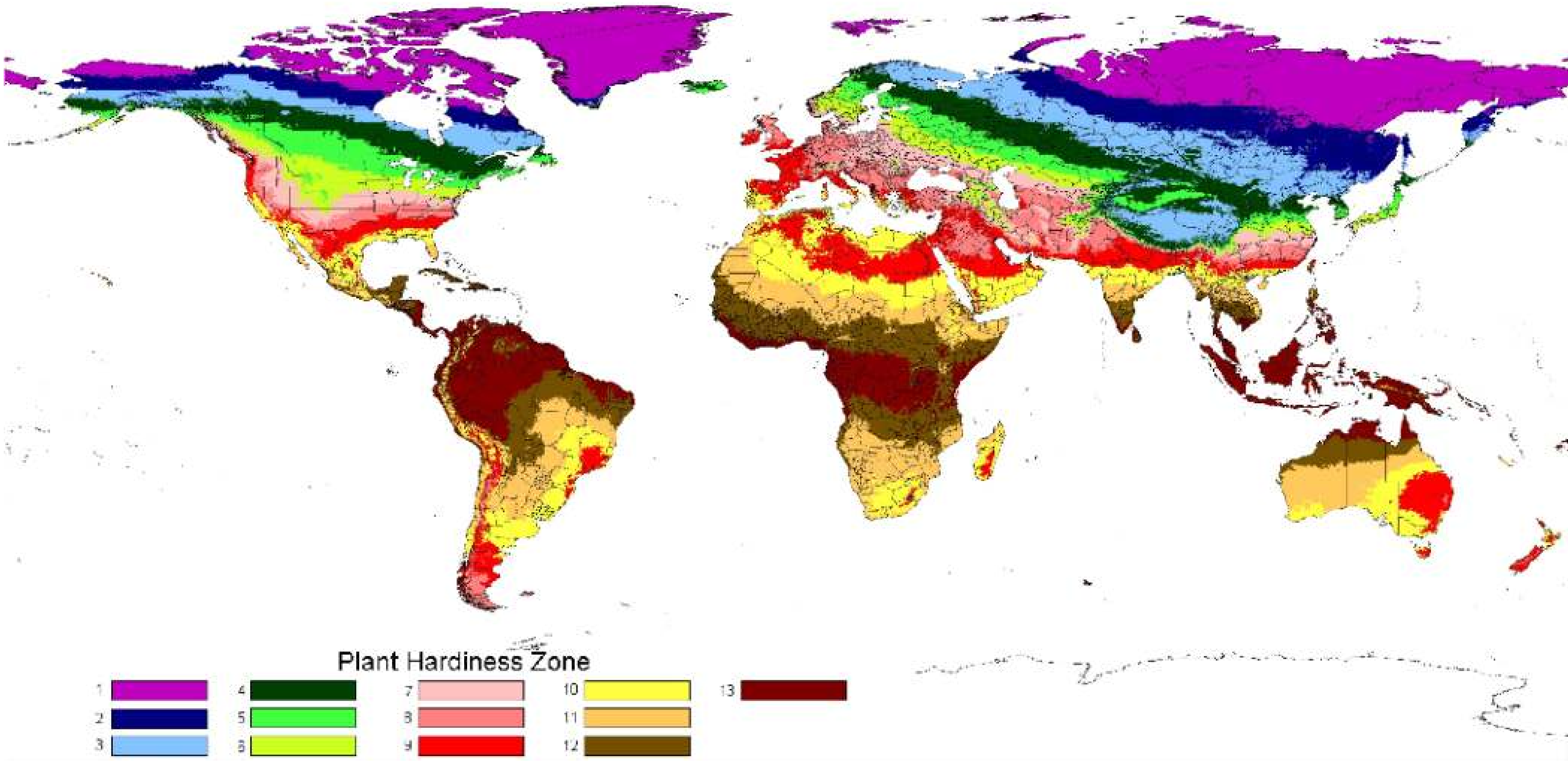
Hardiness Zones - 30 years (to 2005).



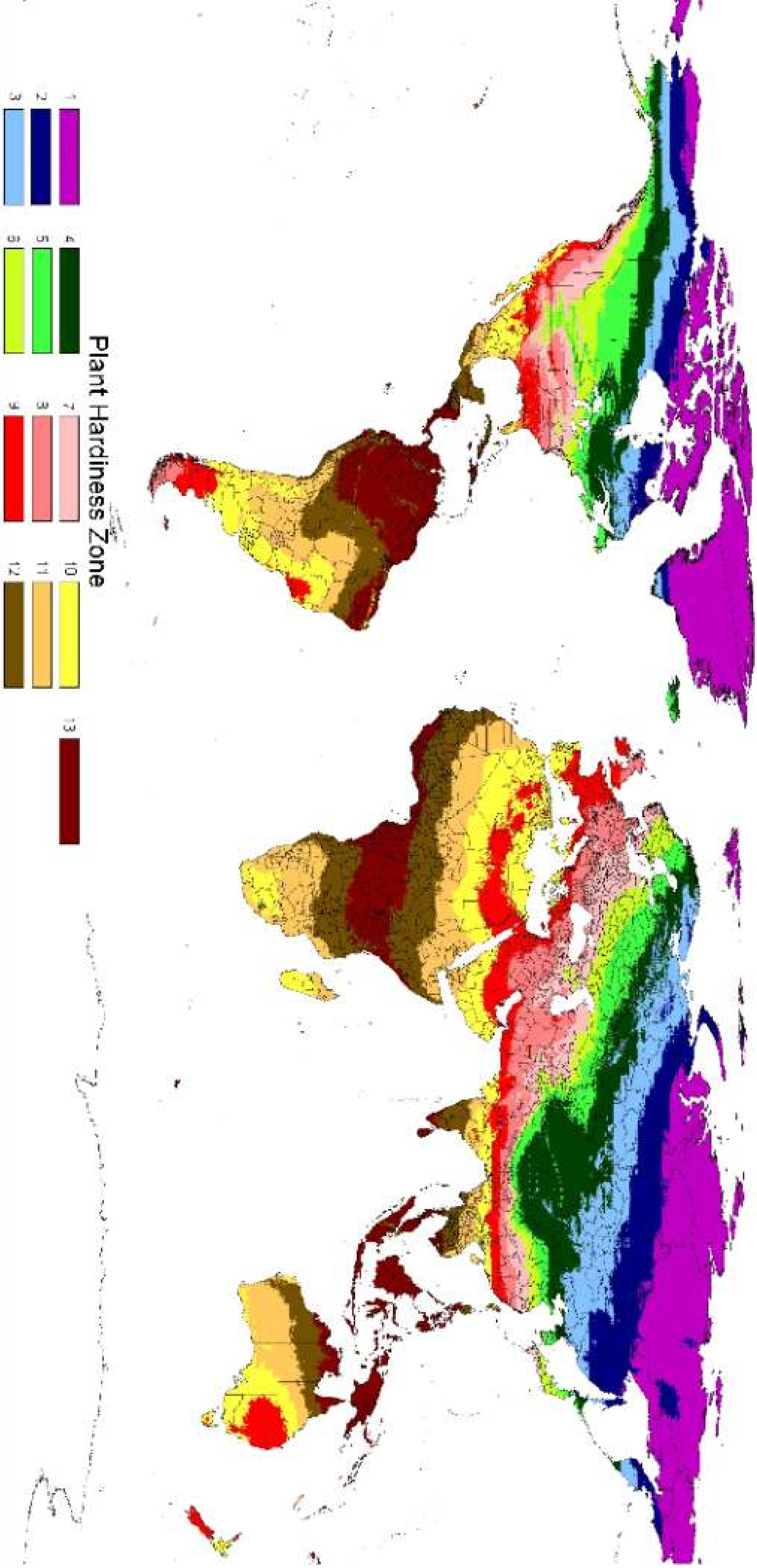
Hardiness Zones 2019.



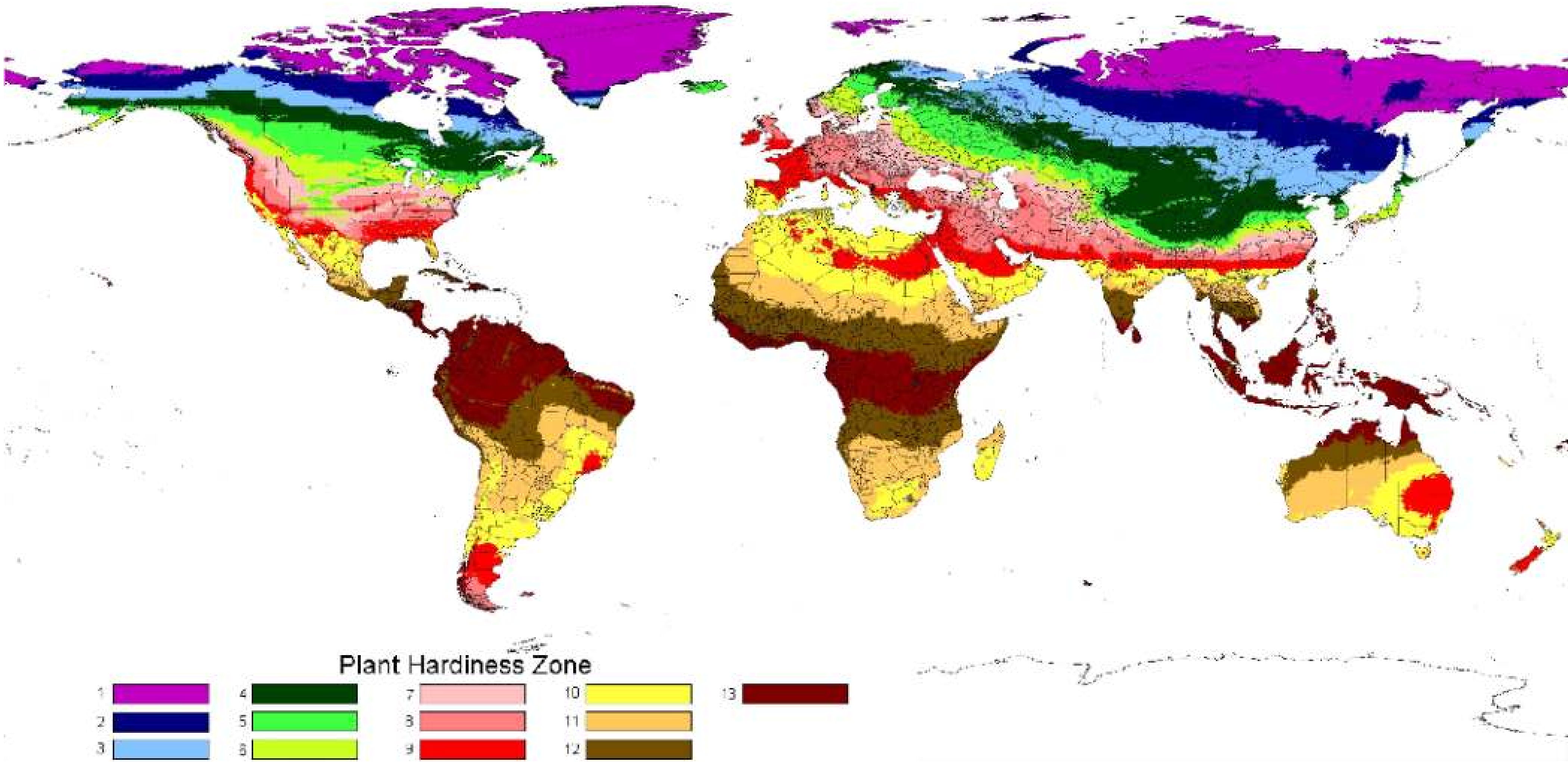
Hardiness Zones 2029.



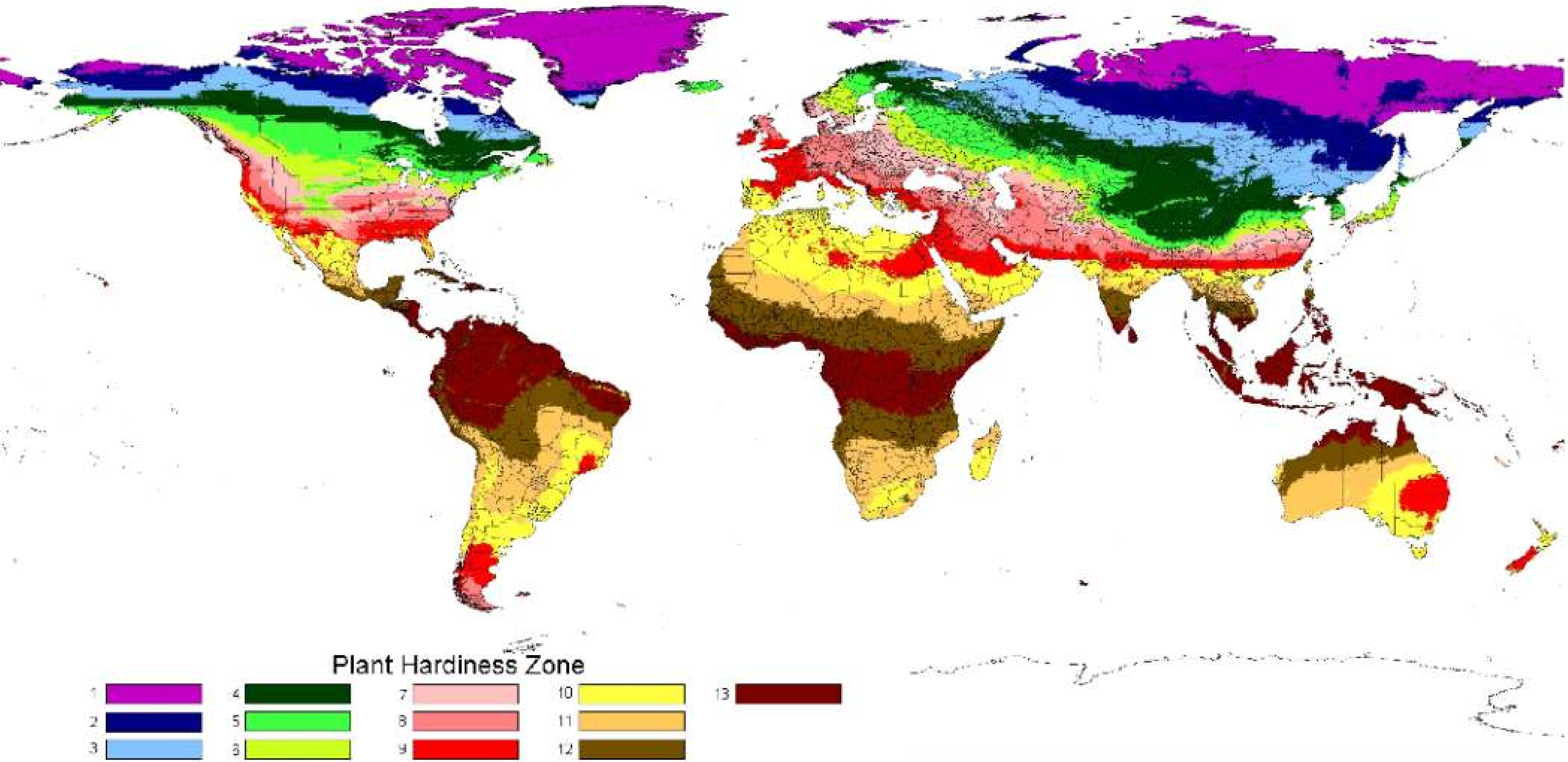
Hardiness Zones 2039.



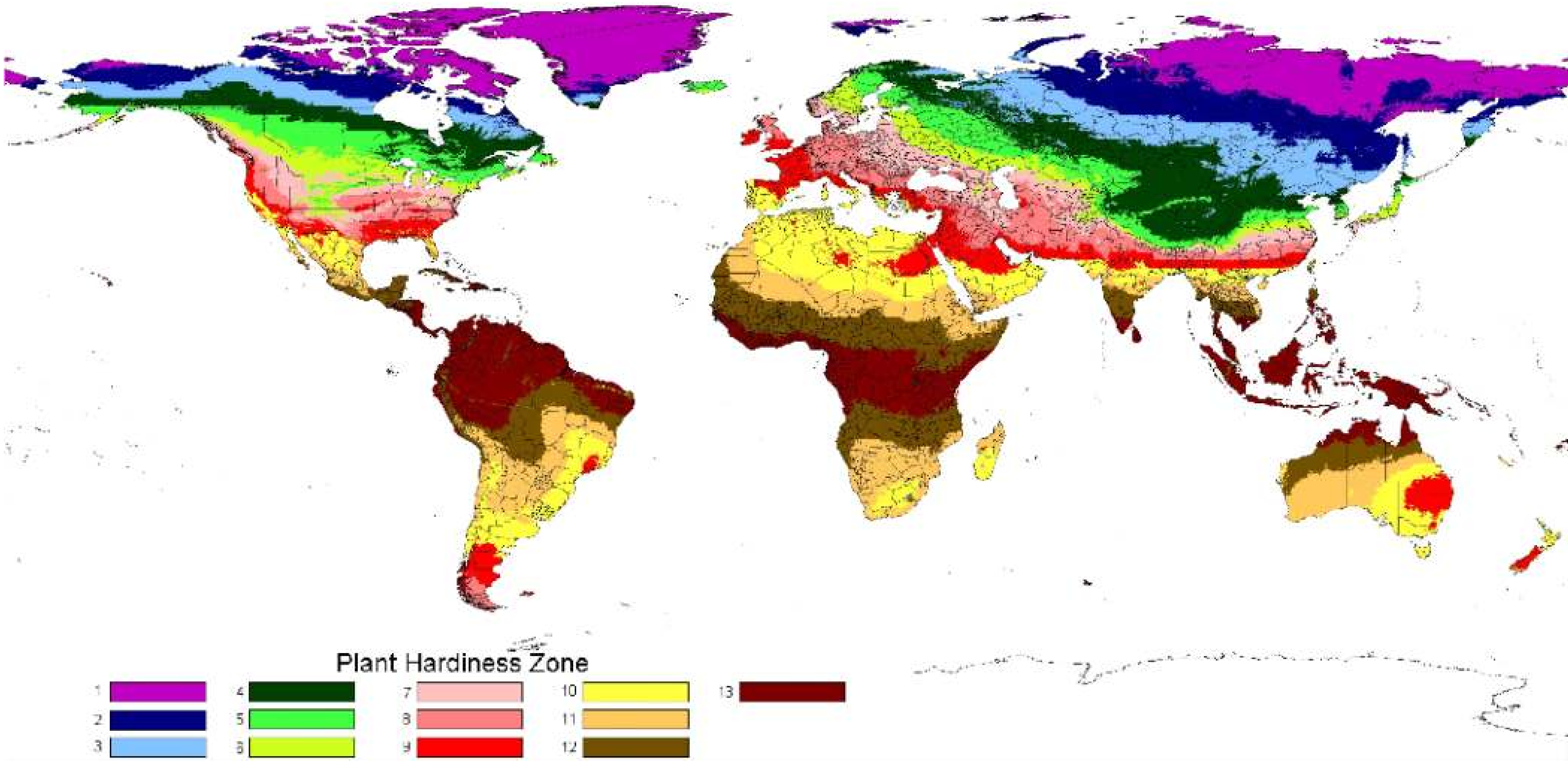
Hardiness Zones 2049.



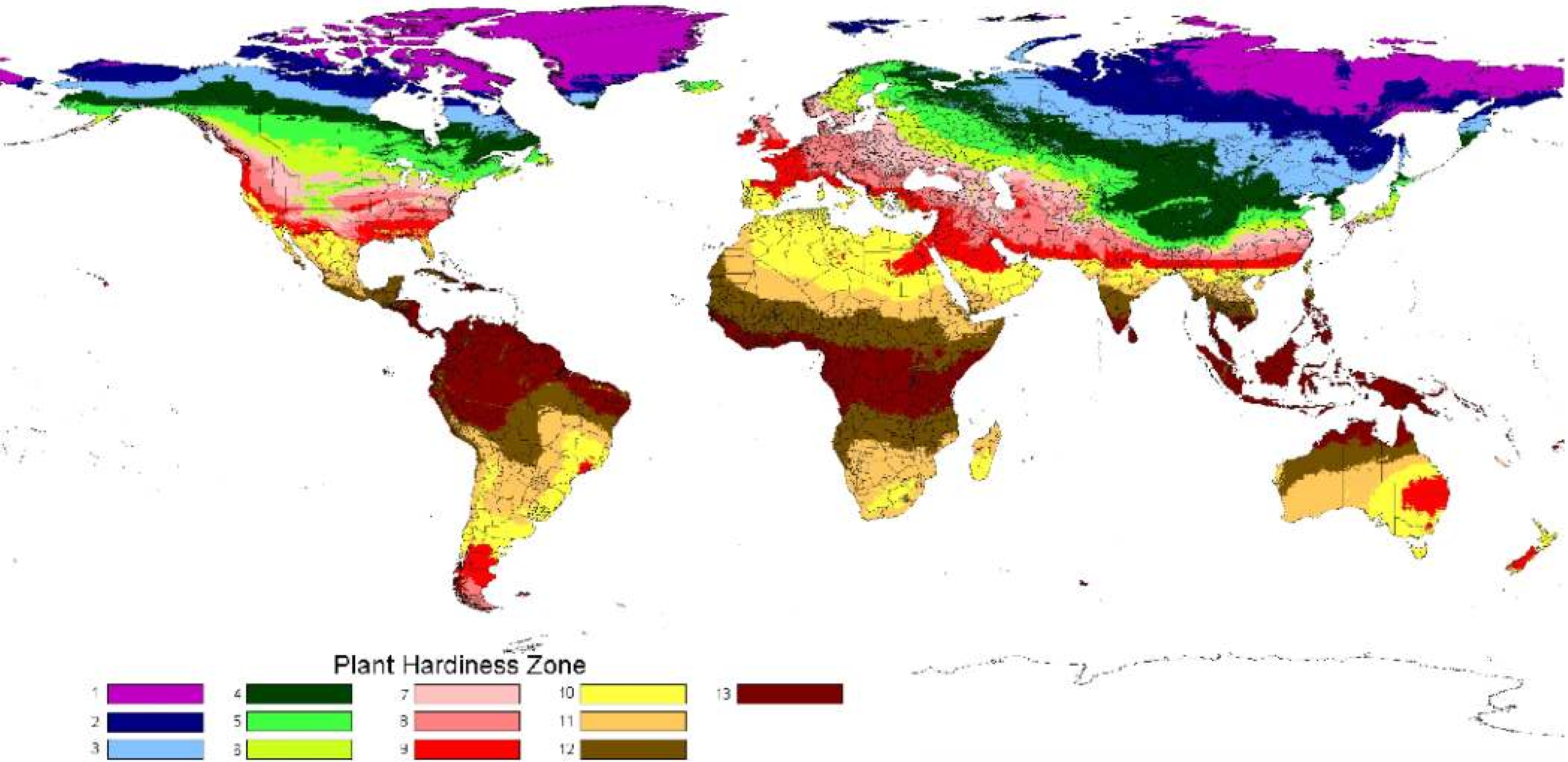
Hardiness Zones 2059.



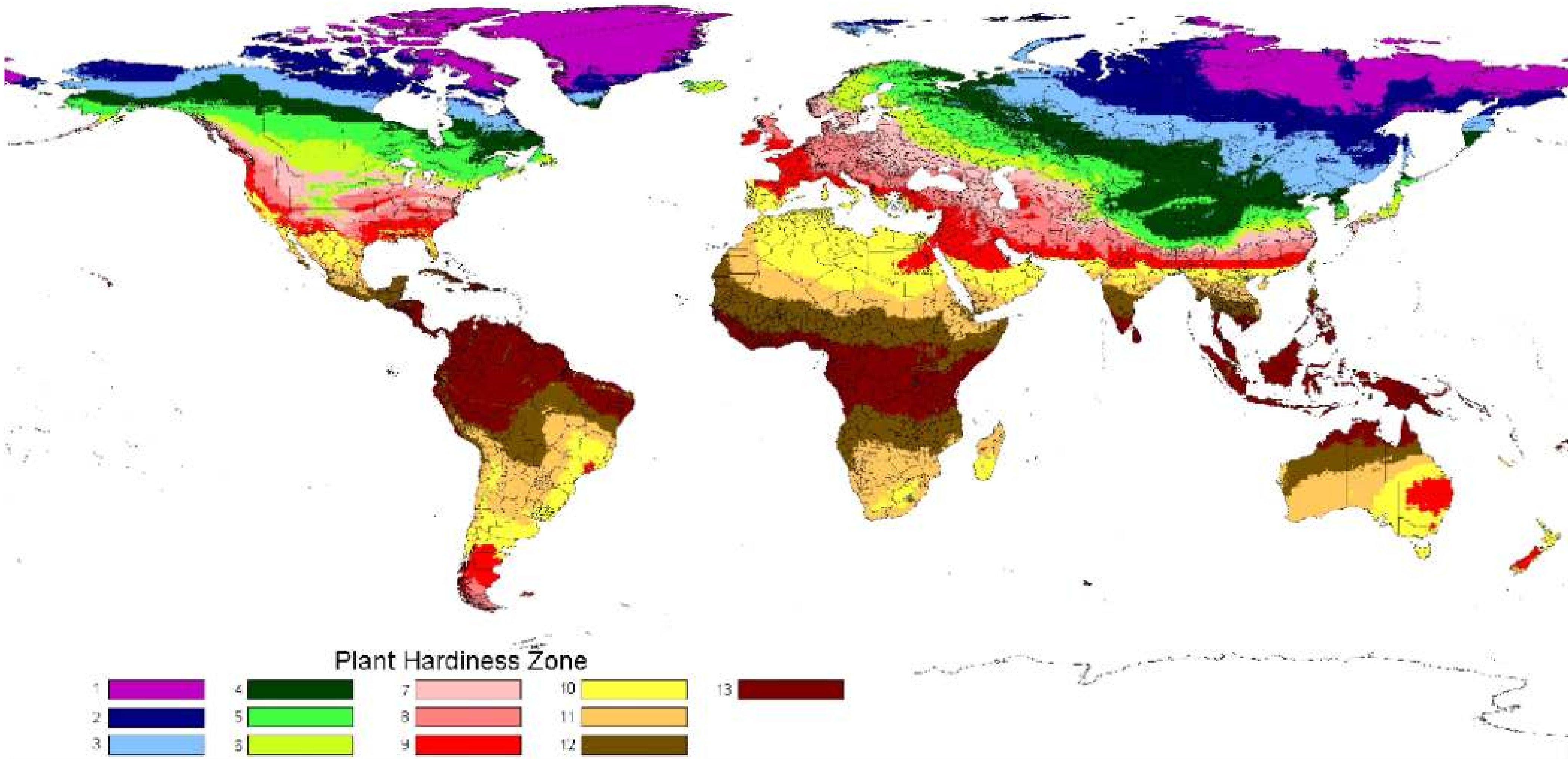
Hardiness Zones 2069.



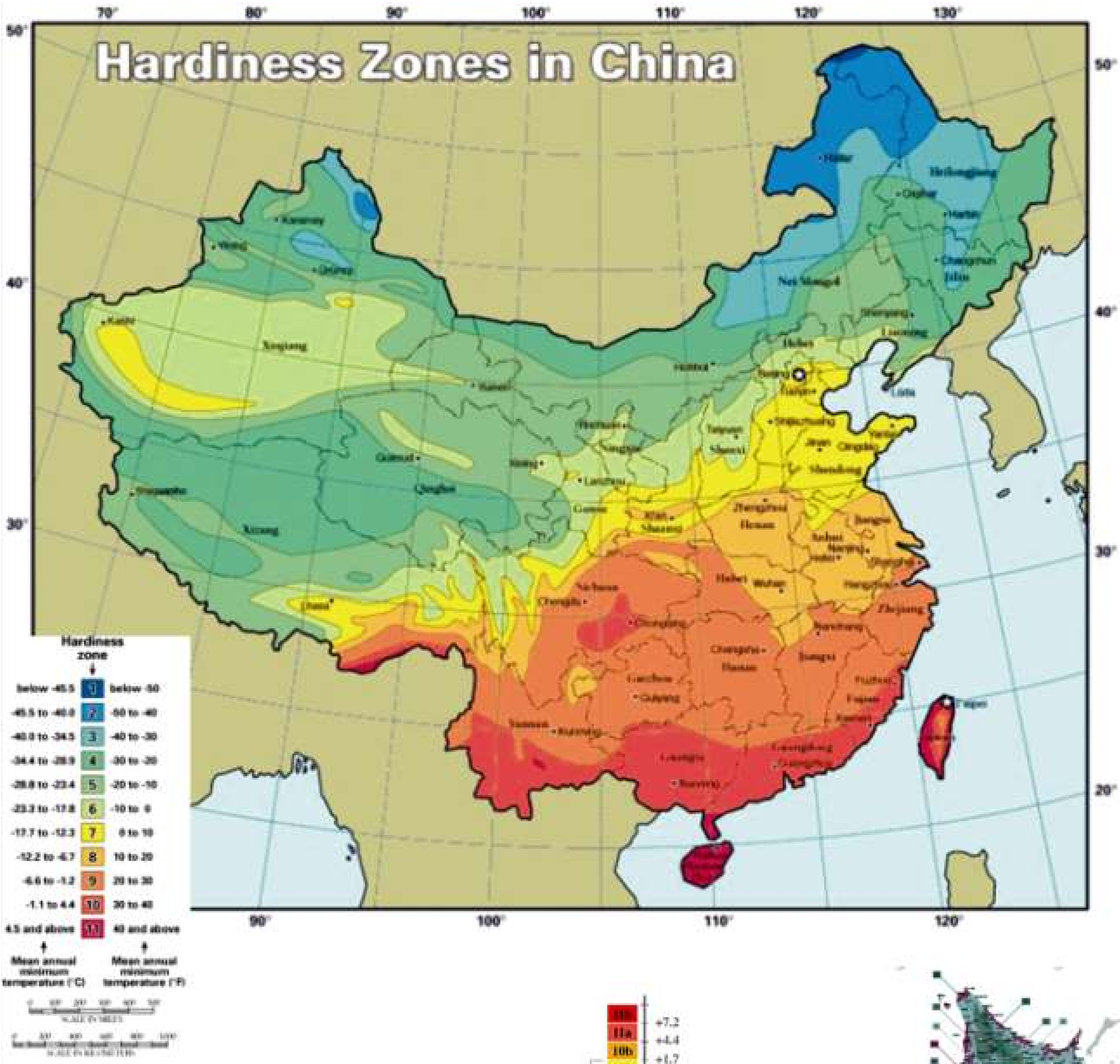
Hardiness Zones 2079.



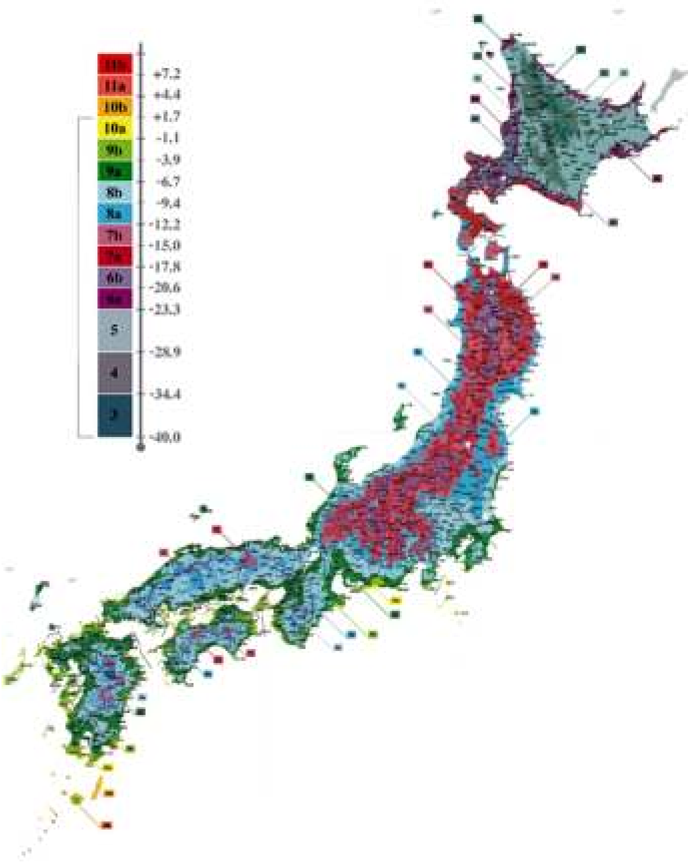
Hardiness Zones 2089.



Hardiness Zones 2099.


Hardiness Zones in China
Hardiness zone
below -45.5 1 below -50
-45.5 to -40.0 2 -50 to -40
-40.0 to -34.5 3 -40 to -30
-34.4 to -28.9 4 -30 to -20
-28.8 to -23.4 5 -20 to -10
-23.3 to -17.8 6 -10 to 0
-17.7 to -12.3 7 0 to 10
-12.2 to -6.7 8 10 to 20
-6.6 to -1.2 9 20 to 30
-1.1 to 4.4 10 30 to 40
4.5 and above 11 40 and above
Mean annual minimum temperature (°C)
Mean annual minimum temperature (°F)

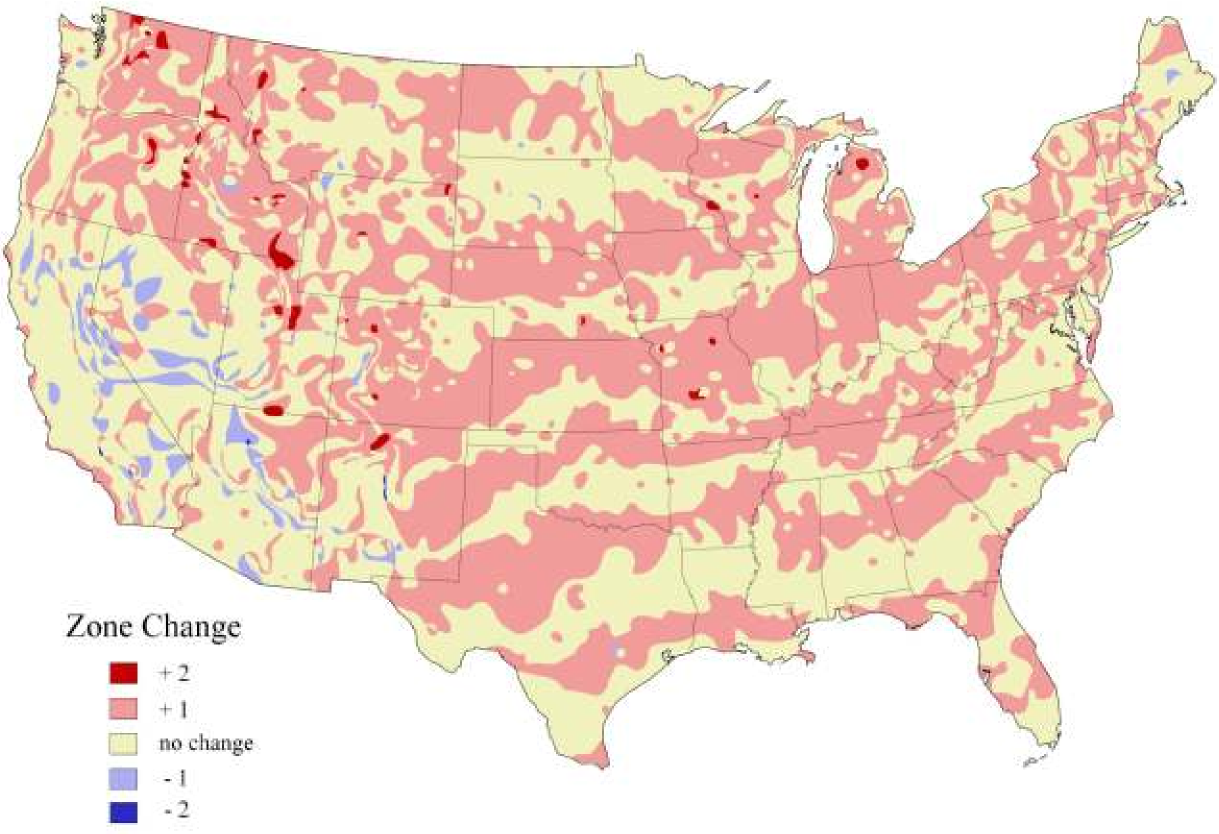
China

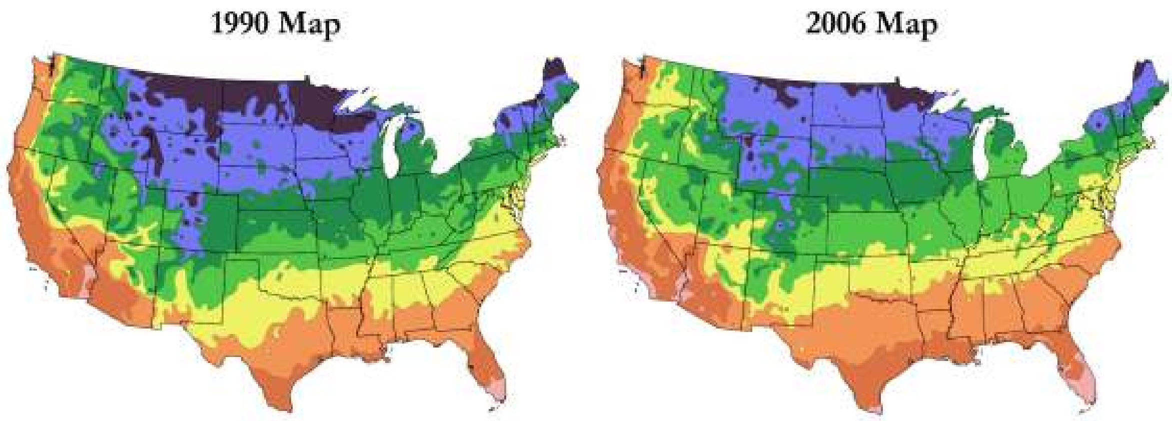

11b 11a 10b 10a 9b 9a 8b 8a 7b 7a 6b 6a 5 4 3
+7.2
+4.4
+1.7
-1.1
-3.9
-6.7
-9.4
-12.2
-15.0
-17.8
-20.6
-23.3
-28.9
-34.4
-40.0

Japan

Ginkgo biloba in Lengqi (Western Sichuan), China. (Photos by Zhou Xiaolin from www.youduo.com in 2008) Down right: photo by Tony Kirkham, England, UK (see pages 209, 250-251).

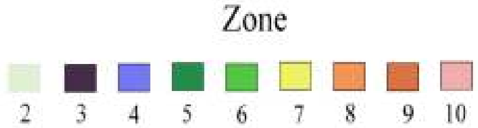
Differences between 1990 USDA hardiness zones and 2006 arborday.org hardiness zones reflect warmer climate



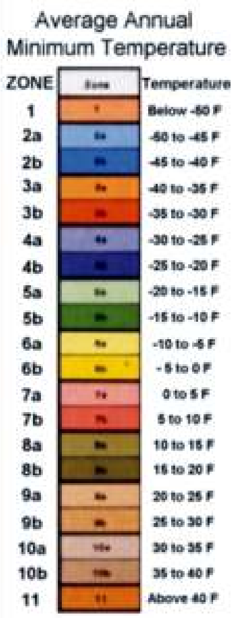


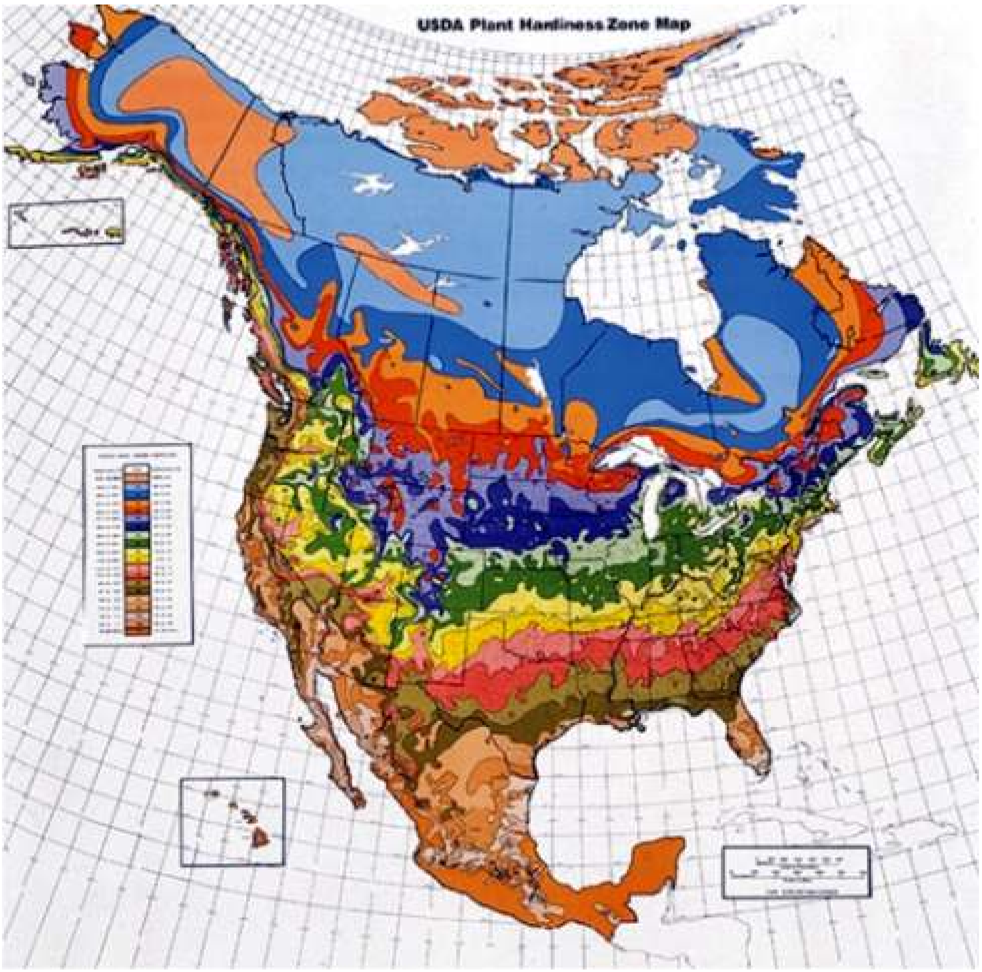
After USDA Plant Hardiness Zone Map, USDA Miscellaneous Publication No. 1475, Issued January 1990

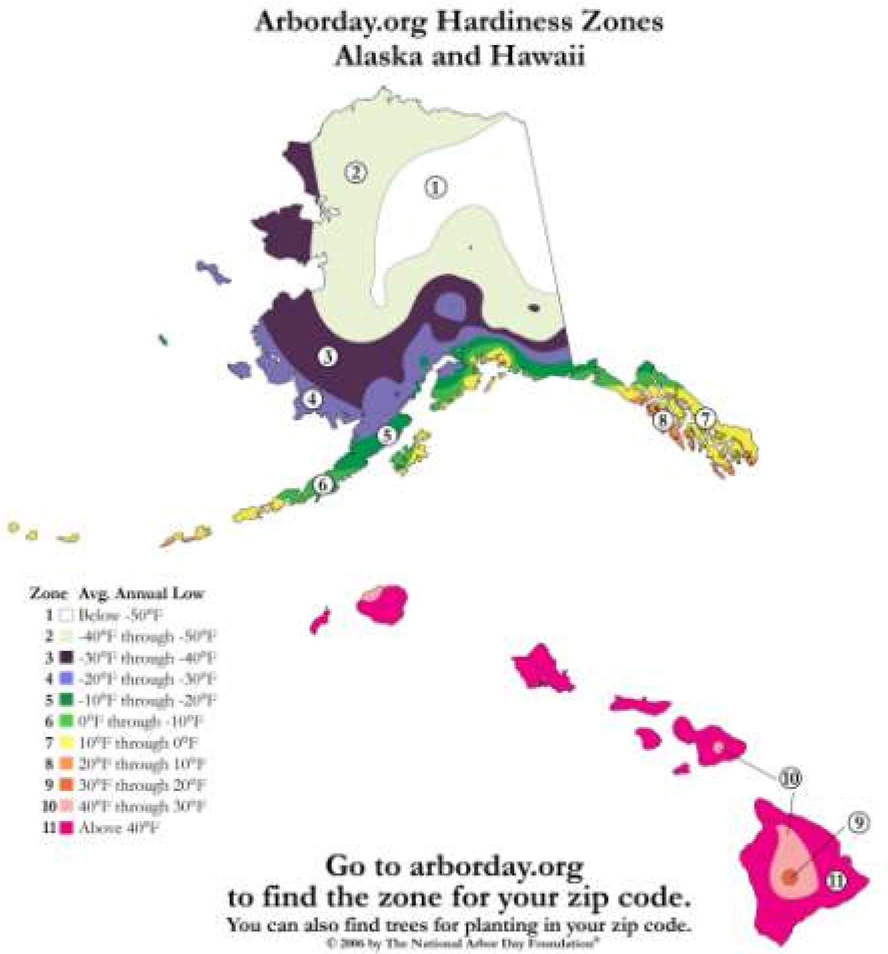
National Arbor Day Foundation Plant Hardiness Zone Map published in 2006.

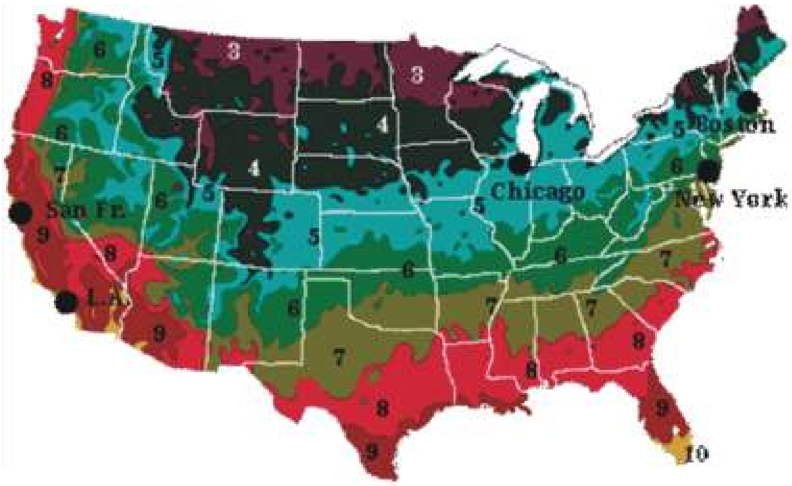


North America



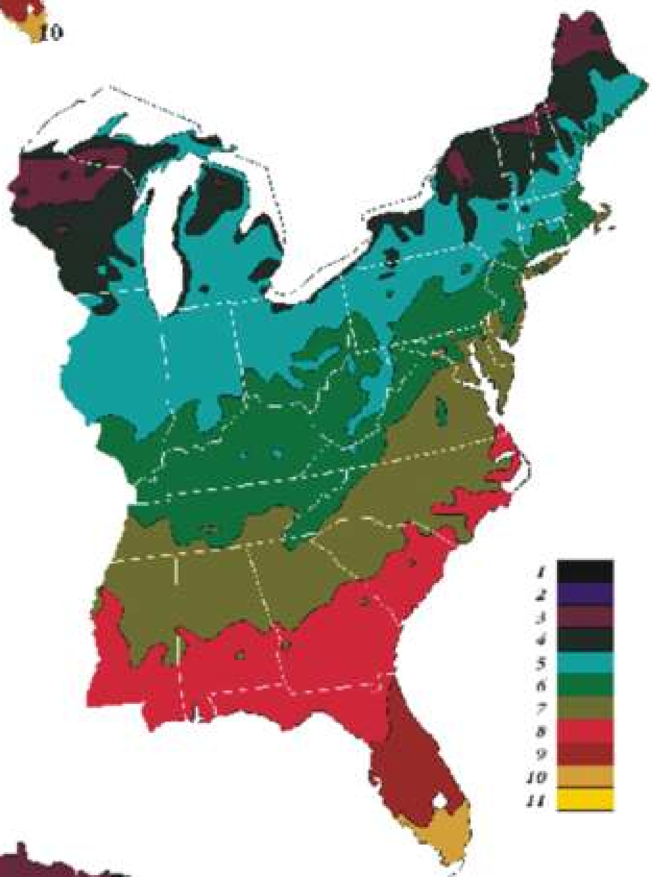


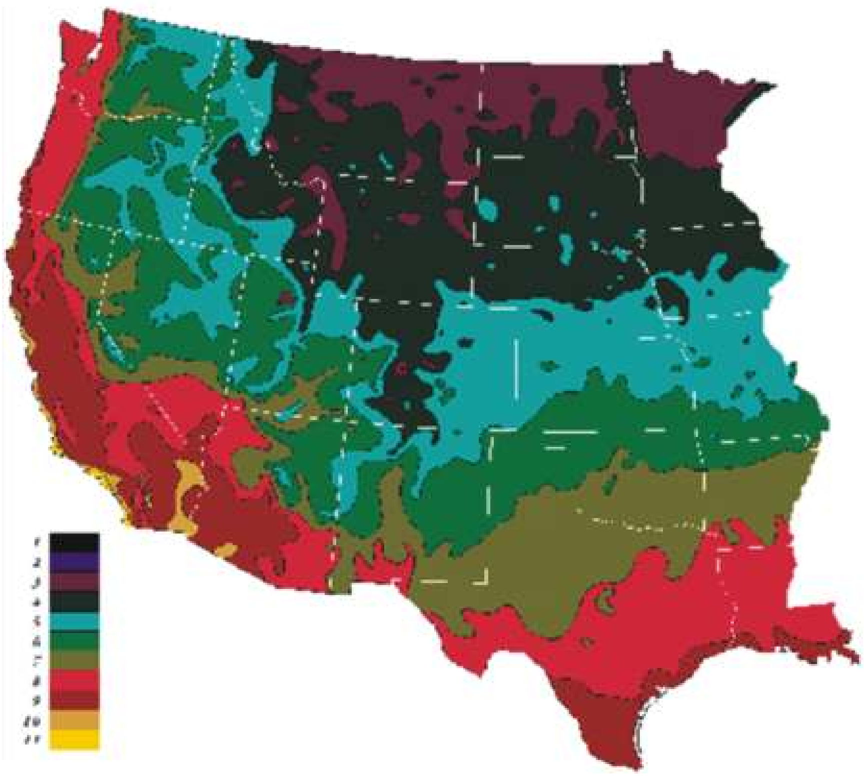




USA: Continent

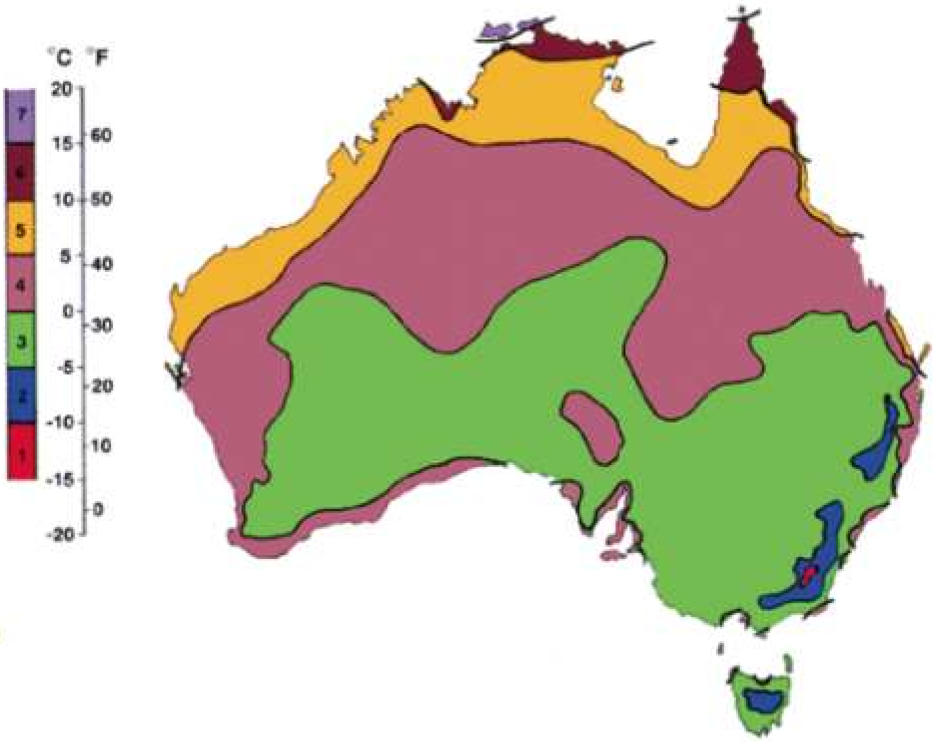
USA: East





USA: West

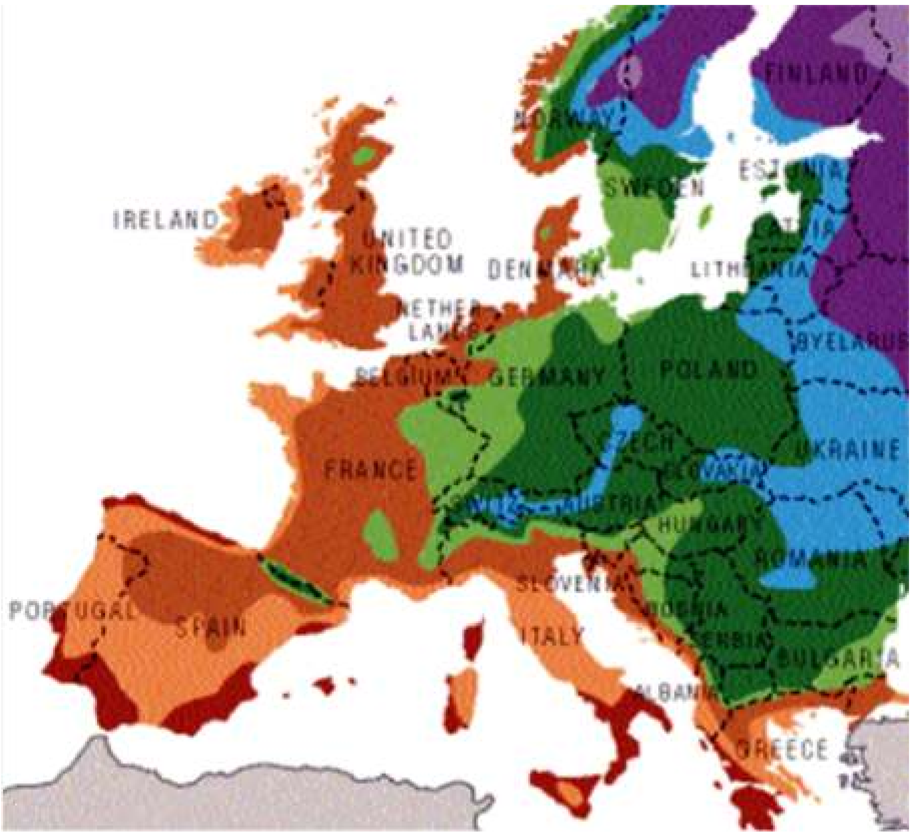
Australia



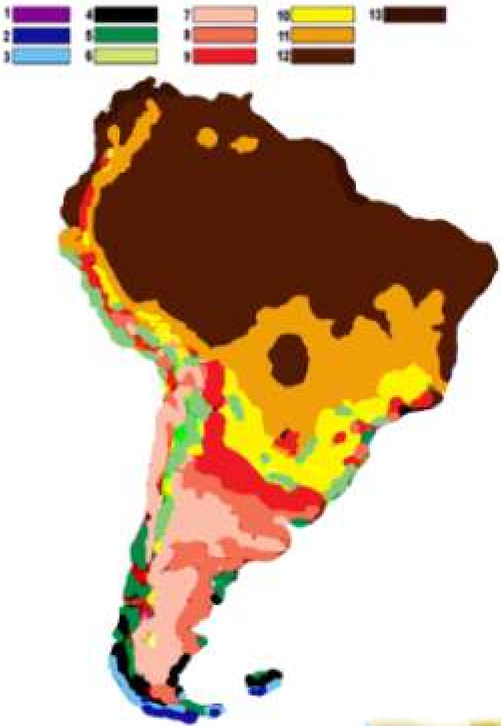
New Zealand

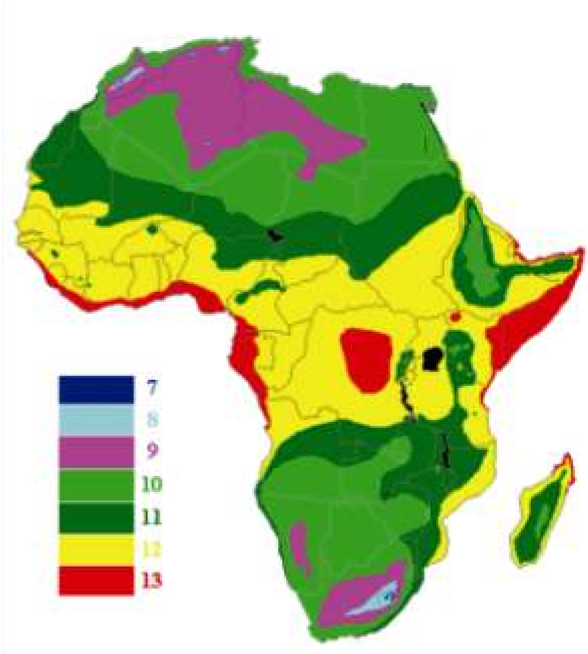
Europa

°C	Zone	°F
-40 to -35	3	-40 to -30
-35 to -29	4	-30 to -20
-29 to -23	5	-20 to -10
-23 to -18	6	-10 to 0
-18 to -12	7	0 to 10
-12 to -7	8	10 to 20
-7 to -1	9	20 to 30
-1 to 5	10	30 to 40



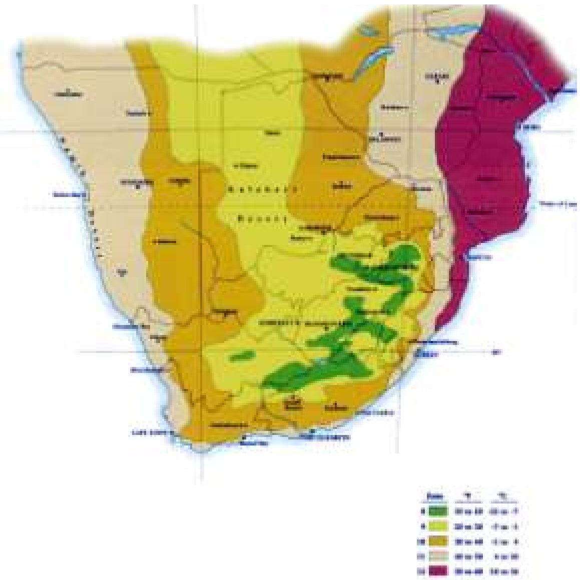
Plant and tree Hardiness Zones in Europe. (111)



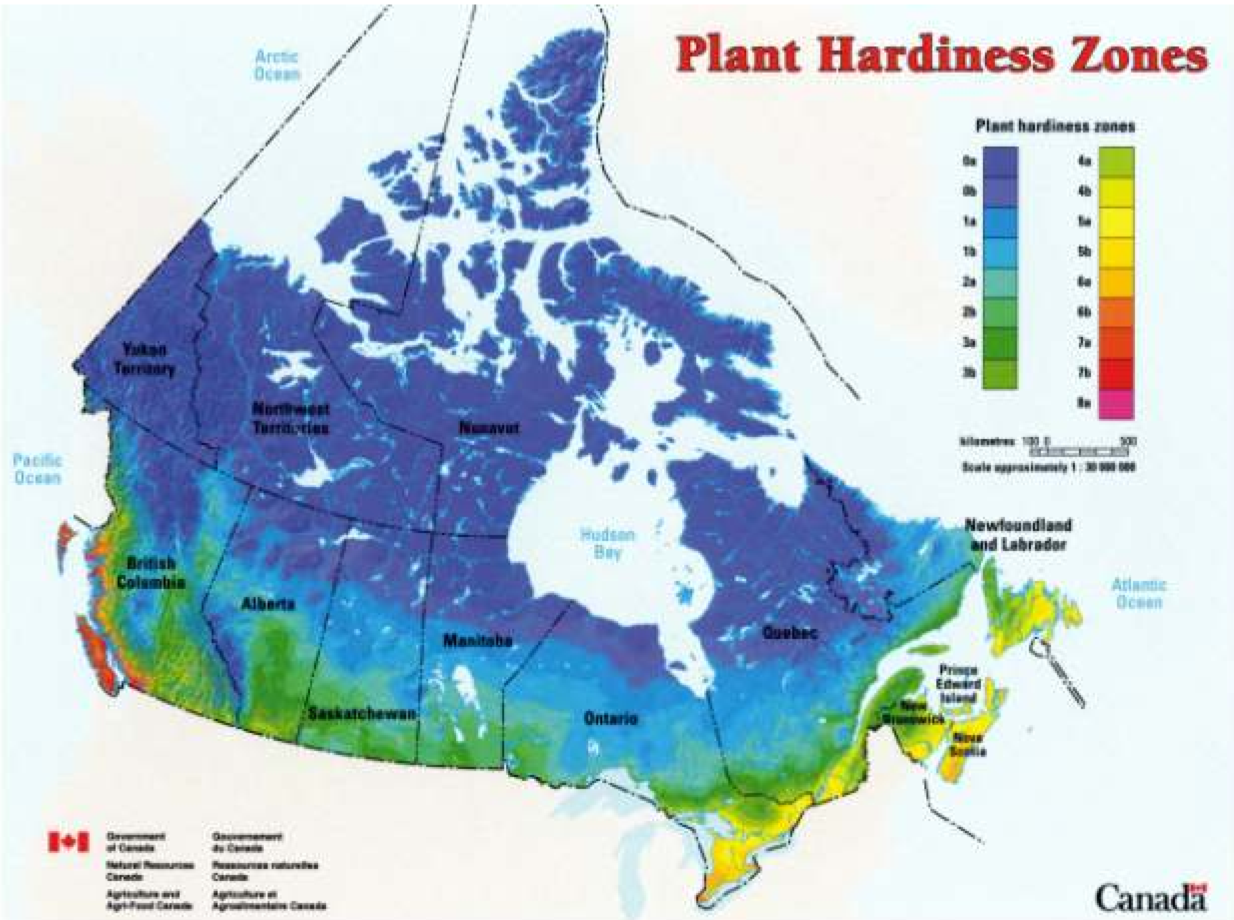


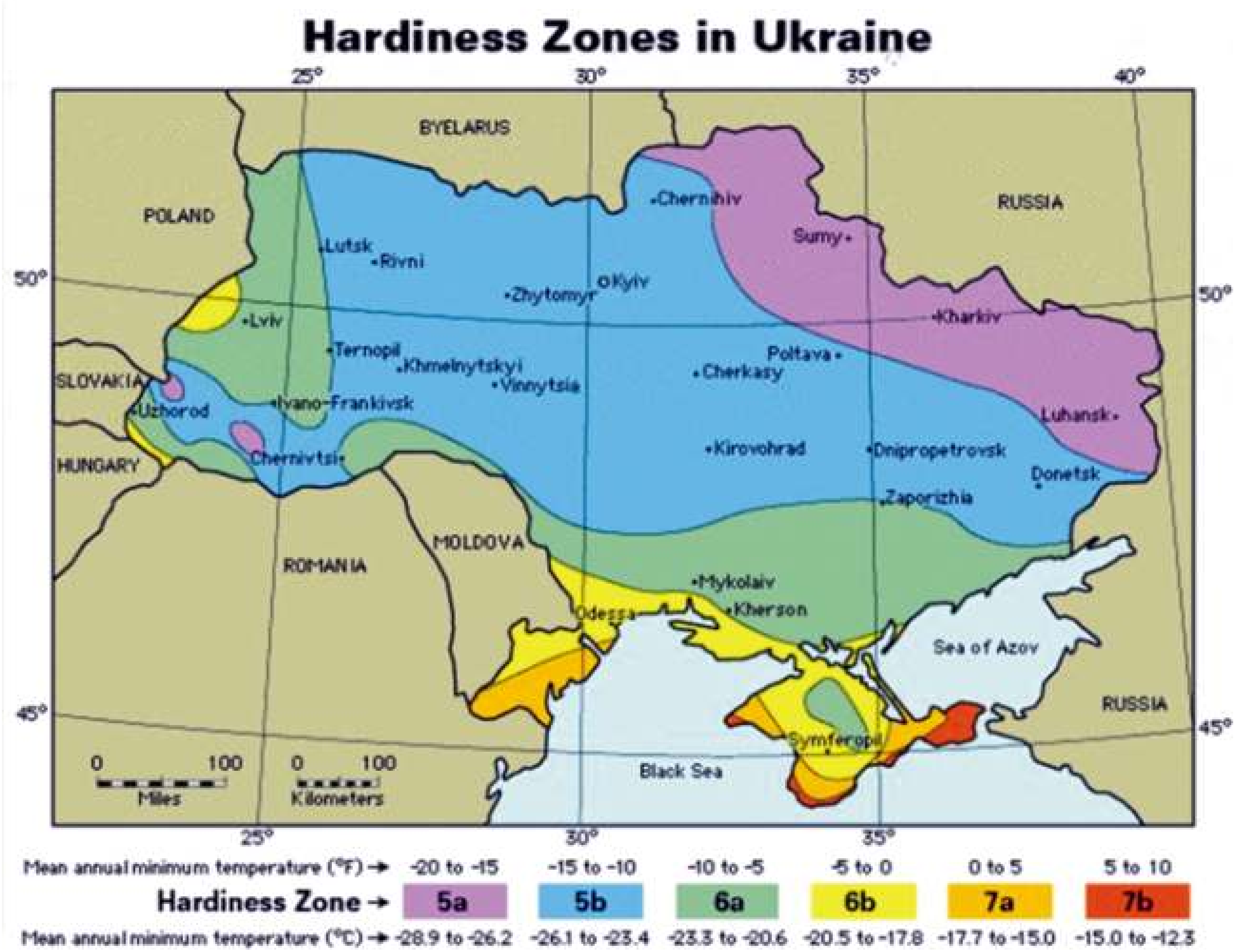
Africa

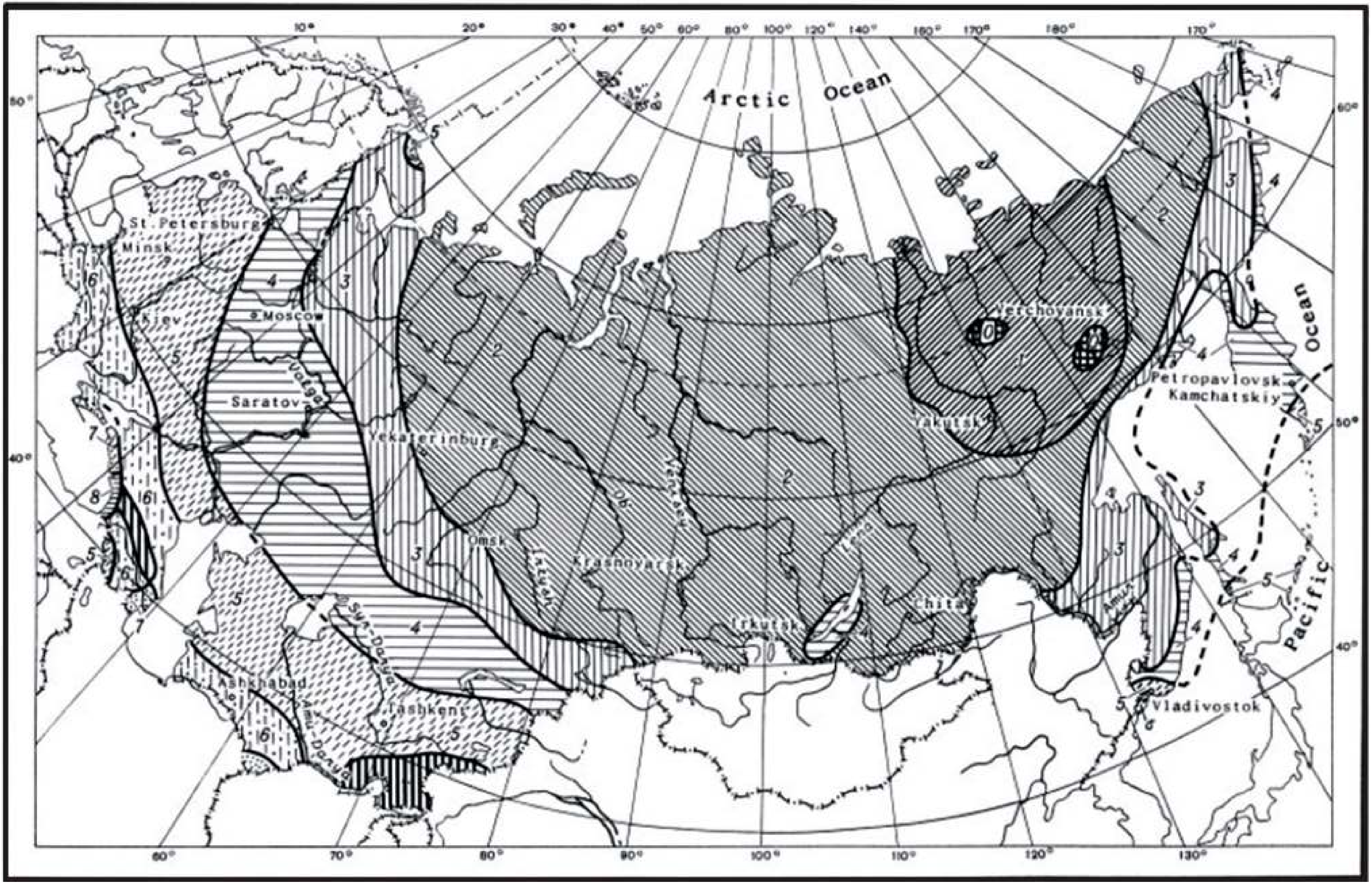
South America



South Africa


Plant Hardiness Zones
Plant hardiness zones
Arctic Ocean
Pacific Ocean
Atlantic Ocean
Hudson Bay
Yukon Territory
Northwest Territories
Nunavut
British Columbia
Alberta
Saskatchewan
Manitoba
Ontario
Quebec
Newfoundland and Labrador
Prince Edward Island
New Brunswick
Nova Scotia
Canada


Hardiness Zones in Ukraine
25°
30°
35°
40°
50°
45°
BYELARUS
POLAND
RUSSIA
SLOVAKIA
HUNGARY
ROMANIA
MOLDOVA
RUSSIA
Chernihiv
Sumy
Lutsk
Rivni
Zhytomyr
Kyiv
Kharkiv
Lviv
Ternopil
Khmelnytskyi
Vinnytsia
Poltava
Cherkasy
Uzhorod
Ivano-Frankivsk
Luhansk
Chernivtsi
Kirovohrad
Dnipropetrovsk
Donetsk
Zaporizhia
Mykolaiv
Odessa
Kherson
Sea of Azov
Symferopil
Black Sea
0 100 Miles
0 100 Kilometers
Mean annual minimum temperature (°F) → -20 to -15 -15 to -10 -10 to -5 -5 to 0 0 to 5 5 to 10
Hardiness Zone → 5a 5b 6a 6b 7a 7b
Mean annual minimum temperature (°C) → -28.9 to -26.2 -26.1 to -23.4 -23.3 to -20.6 -20.5 to -17.8 -17.7 to -15.0 -15.0 to -12.3


Arctic Ocean
Pacific Ocean
St. Petersburg
Minsk
Kiev
Moscow
Volga
Saratov
Yekaterinburg
Omsk
Ob
Yenisey
Krasnoyarsk
Irkutsk
Chita
Yakutsk
Verchoyansk
Petropavlovsk Kamchatskiy
Vladivostok
Amur
Ashkhabad
Tashkent
Syr-Darya
Amu-Darya

Russia (USSR).

Ginkgo tree at 12th Street (University Place in New York), USA. Photo by H. Steed, USA.

References

(correction approach to web sites 2011/01/01-02)

1. http://xs4all.nl/~kwanten (The Ginkgo Pages by Cor Kwant)
2. http://travel.webshots.com/photo/1059403400017608122REqWLF
3. http://www.flickr.com/photos/7441075@N07/915271773
4. http://commons.wikimedia.org/wiki/Category:Kew_Gardens
5. http://ginkgo-biloba1771ginkgoeu.blogspot.com/
6. http://foto-ginkgo.blogspot.com/
7. http://commons.wikimedia.org/wiki/File:Ginkgo_Baum_Harbke.jpg
8. http://www.sachsen-anhalt-abc.de/news/index.php?rubrik=1&news=54127&typ=1
9. http://www.spain-info.co.uk/gardening/ginkgo.htm
10. http://www.ginko.cdfoto.net/photo_ginkgo_tree.htm
11. http://www.pic.piestany.sk/en/useful-information/surroundings-of-piestany/the-trees-of-piestany/
12. http://commons.wikimedia.org/wiki/Ginkgo_biloba
13. http://www.kew.org/plants/trees/ginkgo_biloba.html
14. http://www.gardenguides.com/104605-history-ginkgo-tree.html
15. http://www.panoramio.com/photo/32293021
16. http://fascinatingplants.blogspot.com/
17. http://www.planet-weimar.de/ginkgo-english/goetheandginkgo.html
18. http://ginkgo.dm.pagesperso-orange.fr/GINKGO/GbPictures.htm
19. http://www.nationalarboretum.act.gov.au/tree_stories/the_ginkgo
20. http://ginkgo.liste.free.fr/botanist.htm
21. http://www.50states.com/facts/socaro.htm
22. http://south-carolina-plantations.com/sumter/sumter-county.html
23. http://hors-les-murs.spaces.live.com/blog/cns!4525B5758CCBBECF!8746.entry
24. http://parispassion.canalblog.com/archives/2006/02/28/1443004.html
25. http://emergingwriter.blogspot.com/2009_06_01_archive.html
26. http://forestry.about.com/od/forestphotogalleries/ig/Ginkgo-Biloba-/Planting-Range-of-Ginkgo-.htm
27. http://ontariotrees.com/main/species.php?id=2040
28. http://irenefranseda.blogspot.com/2009/11/day-1-seoul-south-korea-osaka-japan.html
29. http://www.theepochtimes.com/n2/content/view/18896/, http://epochtimes.com/gb/9/6/30/n2573911.htm
30. http://www.xici.net/#d96139740.htm, http://chinaabc.showchina.org/
31. http://www.scielo.br/scielo.php?pid=S0103-90162008000700009&script=sci_arttext
32. http://www.aroid.org/horticulture/zonemap/
33. http://www.pacificbulbsociety.org/pbswiki/index.php/HardinessZoneMaps
34. http://www.pacificbulbsociety.org/pbswiki/files/Maps/JapanHZMap.pdf
35. http://www.planthardiness.gc.ca/
36. http://www.gardenology.org/wiki/Hardiness_zone
37. http://www.usna.usda.gov/Hardzone/hrdzon3.html
38. http://img641.imageshack.us/f/nagasakinavaltraininGce.png/
39. http://www.trackandtrain.com/atmypace/gallery/japanese-art-kuniyoshi-hiroshge-hosukai/deshima.jpg
40. http://www.fairmountpark.org/RecommendedTreeList.asp
41. http://www.cac-biodiversity.org/index.htm
42. http://hbc.bas-net.by/plantae/eng/allplantvyr.php?aaafam=Ginkgoaceae&gen=Ginkgo
43. http://www.huntington.org/huntingtonlibrary.aspx?id=512&terms=ginkgo
44. http://www.sahistory.org.za/pages/governence-projects/organisations/voc/voc.htm
45. http://www.enmu.edu/about/mmemo/2006/oct_30/photo%20gingko%20tree%20600.jpg
46. http://ginko-spg.org/
47. http://www.ginko.cdfoto.net/ginkgo_tree.htm
48. http://en.wikipedia.org/wiki/Ginkgo_biloba
49. http://www.conifers.org/gi/index.htm
50. http://www.tuinenlandschap.nl/aanlegonderhoud/artikelen/654/tweede-leven-voor-veterane-bomen
51. http://www.flickr.com/photos/erfgoed/4017072927/sizes/o/in/photostream/
52. http://www.panoramio.com/photo/32293021
53. http://commondatastorage.googleapis.com/static.panoramio.com/photos/original/32293026.jpg
54. http://ten-thousand-trees.blogspot.com/2008/01/street-lined-with-large-ginkgo-trees.html
55. http://burgersonion.blogspot.com/2009/02/ginkgo-and-trouble-with-living-fossils.html
56. http://www.san.go.kr/english/culture/old_trees_korea.html
57. http://www.womenofmystery.net/2008_12_01_archive.html
58. http://www.mountainplum.com/
59. http://www.mobot.org/Hort/hortsearch/hortresult.asp?kcode=Z990
60. http://picasaweb.google.com/lh/photo/SqLR1tJOMVCuifKxjZuB2g
61. http://www.takungpao.com/chn/chnyw/1349865.html
62. http://www.bj.chinanews.com/news/2010/0831/10550.html, http://bbs.jingtime.com/read.php?tid=1008636
63. http://kawasakimidori.main.jp/
64. http://www.pacificbulbsociety.org/pbswiki/files/Maps/USSRPlantHardiness-MBG.pdf
65. http://www.mobot.org/MOBOT/Research/russia/climatic.shtml,
    http://www.pacificbulbsociety.org/pbswiki/files/Maps/USSRPlantHardiness-MBG.pdf
66. http://www.jxxcw.gov.cn/juxiannew.php?id=2
67. http://www.chinamtours.com/china-guide/Chongqing/Jinfo-Mountain-Scenic-Spot-.html
68. http://image.baidu.com/i?ct=503316480&z=0&tn=baiduimagedetail&word=Jinfo+Shan&in=30370&cl=2&cm=1&sc=0&lm=-1&pn=0&rn=1&di=9302559976&ln=2000&fr=&ic=0&s=0&se=1#pn8

69. http://www.cqjtlyjt.cn/command_view.aspx?fid=2&id=52
70. http://www.cqly.com.cn/scenery_column_view_79.html
71. http://news.sznews.com/content/2009-05/05/content_3741504.htm
72. http://www.sn.xinhuanet.com/2009-05/05/content_16432505.htm
73. http://www.govyi.com/book/tour/hxns/dq/xnly/409250.shtml
74. http://new.takungpao.com/chn/chnyw/1349865.html
75. http://www.binews.com.cn
76. http://japan-cruise.com/attract/nagasaki.html
77. http://chrisinsouthkorea.blogspot.com/2010/11/destination-yongmunsa-yangpyeong.html
78. http://commons.wikimedia.org/wiki/File:Ginkgo_biloba_01_by_Line1.jpg
79. http://commons.wikimedia.org/wiki/File:Ginkgo_biloba_JPG1a.jpg
80. http://commons.wikimedia.org/wiki/File:Kew_Ginkgo.jpg
81. http://www.chinamtours.com/china-guide/Chongqing/Jinfo-Mountain-Scenic-Spot-.html
82. http://www.cqlife.com/bbs/thread-291665-1-1.html
83. http://commons.wikimedia.org/wiki/File:Ginkgo-Baum.jpg
84. http://upload.wikimedia.org/wikipedia/commons/c/ca/Ginkgo_Baum_Harbke.jpg
85. Begovic, B., 2009. Svijet ginka. Croatia (manuscript). (http://foto-ginkgo.blogspot.com/)
86. http://commons.wikimedia.org/wiki/File:Gingko_biloba_CS1.JPG
87. http://commons.wikimedia.org/wiki/File:Ginkgobaum_Herbstferbung.jpg
88. http://commons.wikimedia.org/wiki/File:Jingu_Gaien_Ginkgo_Street_Tokyo.jpg
89. http://www.forestryimages.org/browse/detail.cfm?imgnum=5404857
90. http://www.pbase.com/hjsteed/image/70038519
91. http://www.hudong.com/wiki/%E5%A4%A9%E7%9B%AE%E5%B1%B1
92. http://66yd.com/english/chinese_scene/chinese_scene_show.asp?v_eng_id=145
93. http://cse.naro.affrc.go.jp/sasaki/china/china-e.html
94. http://image.baidu.com/i?ct=503316480&z=0&tn=baiduimagedetail&word=Tianmu+Shan&in=6309&cl=2&cm=1&sc=0&lm=-1&pn=3&rn=1&di=32028734146&ln=2000&fr=&ic=0&s=0&se=1#pn1917
95. http://img1.zszs.cn/2010/09/09/100202010090913353792.jpg, http://img1.zszs.cn/2010/09/09/100202010090913363034.jpg
96. http://libaoming1.blshe.com/post/12371/457685
97. http://www.youduo.com/forum/thread-32330-1-1.html
98. http://www.bbs.hztop.com
99. https://docs.google.com/leaf?id=0B2tuvOhwenxOYWY3NzIxZjgtYmYzNy00MmRiLTgxZWYtYzA0NjNmMTBlYTM4&hl=en&authkey=COeVxMUC
100. https://docs.google.com/leaf?id=0B2tuvOhwenxOMTYwZjk5NGMtNDI5Ni00MWE2LTkxZjMtNTRhYjY5OTY0NGQw&hl=en&authkey=COKJ78QI
101. https://docs.google.com/leaf?id=0B2tuvOhwenxOYTk1M2ZlODgtNDBjOS00OWNkLTlmODktNDBmNGYyNTI1MTEx&hl=en&authkey=CIbHuIAH
102. https://docs.google.com/leaf?id=0B2tuvOhwenxOYWYxYjdkOTYtZTlhZS00YmY0LWIzOGMtMmExMDY2MjY3MWY2&hl=en&authkey=CIXq8G8
103. https://docs.google.com/leaf?id=0B2tuvOhwenxOZmE4NzlkODEtMDM4YS00NmRiLWE1NDctOWY1ZTgwN2Y3Mzkz&hl=en&authkey=CJ6v5e4I
104. https://docs.google.com/leaf?id=0B2tuvOhwenxOYWY3NzIxZjgtYmYzNy00MmRiLTgxZWYtYzA0NjNmMTBlYTM4&hl=en&authkey=COeVxMUC
105. https://docs.google.com/leaf?id=0B2tuvOhwenxOMTBiMmQyY2UtZmMxZC00NjgxLTg4YWMtYWNkNWVlMGI2NTky&hl=en&authkey=CLeIsP4G
106. http://www.flickr.com/photos/mrhayata/314938626/
107. http://www.monumentaltrees.com/en/world-ginkgo/1
108. http://upload.wikimedia.org/wikipedia/lv/6/6d/Ginkgo_biloba_in_Riga.jpg
109. http://www.skyscrapercity.com/showthread.php?t=491800
110. http://www.nappfast.org/Plant_hardiness/ph_index.htm
111. http://www.uk.gardenweb.com/forums/zones/hze.html
112. http://www.aroid.org/horticulture/zonemap/
113. http://www.trekearth.com/gallery/North_America/Canada/photo484035.htm, http://jholm4525.wordpress.com/2008/05/31/le-ginkgo-arbre-fossile-vivant-a-etonnantes-vertus/#comment-531
114. http://www.city-data.com/forum/garden/783712-news-smell-has-some-cities-ripping-2.html
115. http://commons.wikimedia.org/wiki/File:Ginkgo_biloba_junio.jpg
116. http://commons.wikimedia.org/wiki/File:Ginkgo_in_oono_hachiman01.jpg
117. http://commons.wikimedia.org/wiki/File:Ginkgo-Park_in_Vilshofen_an_der_Donau.jpg
118. http://www.esveld.nl/plantdias/28/28587.jpg, http://www.esveld.nl/plantdias/28/28636.jpg
119. http://www.ginko.cdfoto.net/ginko_lednice0072n2005.jpg
120. http://www.ginko.cdfoto.net/wien_gingkobaum2009b013.jpg
121. http://www.fotosnstuff.net/Barb/Italy2007/ginkgo.jpg
122. http://www.ginkgo-biloba.fr/hiroshima-ginkgo-biloba.html, http://www.planet-weimar.de/images/hiroshima.jpg, http://www.lang-arts.com/survivors/shukkeien.html, http://www.lang-arts.com/survivors/sendaes.html, http://www.lang-arts.com/survivors/josei.html
123. http://atidewatergardener.blogspot.com/search/label/Ginkgo
124. http://commons.wikimedia.org/wiki/File:Ginkgo_biloba_PAN.JPG
125. http://blog.goo.ne.jp/michioaruku/e/a2de006ec04a92c9f1f68b349e606f57
126. http://www.britishmuseum.org/images/ginkgo_temple_349x216.jpg
127. Ames, G. J., 2008. The Globe Encompassed: The Age of European Discovery, 1500-1700. Pearson Prentice Hall.
128. Blussé, L. et al., 2004. The Deshima Diaries Marginalia 1740-1800. Tokyo.
129. Burke – Gaffney, B., 2009. Nagasaki: The British Experience, 1854-1945, Global Oriental. 288 pages including

index, bibliography, notes and 66 illustrations in colour and black and white.
130. Campter, N.D. et al., 1997. In vitro culture of Ginkgo. In Vitro Cellular & Developmental Biology – Plant, Vol. 33, 2, 125-127.
131. Cothran, J.R., 1995. Gardens of historic Charleston, South Carolina, 6-7.
132. a) Del Tredici, P., Ling, H., Guang, Y., 1992. The Ginkgos of Tian Mu Shan. Conserv. Biol. 6, 2: 202–210. b) 1996. Ginkgo biloba. In: Enzyklopadie der Holzgewachse: Handbuch und atlas der dendrologie - 6. Erg. Lfg., 10 pp. Ecomed Verlag, Landsberg.
133. Del Tredici, P., 1981. The Ginkgo in America. Arnoldia 41(4): 150-161.
134. Demiel, G. et al., 2002. Palast der Blüten – Das Schönbrunner Palmenhaus, Wien, 13.
134a. Elwes, J. H. & Henry, A., 1906, The Trees of Great Britain & Ireland, Vol 1, Edinburgh.
135. Handa, M., 2001. Ginkgo biloba in Japan. Arnoldia 60/4. 26-34.
136. Israel, J.I., 1989. Dutch Primacy in World Trade 1585-1740. Oxford.
137. Lin, J.-X., 1995. Old Ginkgo trees in China. International Dendrological Society Yearbook, 1995, 32–37.
138. Ling Hsieh & Zhang Duhai, 2004. Analysis for the Origin of Ginkgo Population in Tianmu Mountain, Scientia Silvae Sinicae, Vol 40, No. 2 (In Chinese).
139. Magarey, R., D.; Borchert, D., M. and Schlegel, J., W. 2008. Global plant hardiness zones for phytosanitary risk analysis. Sci. agric. (Piracicaba, Braz.) 2008, Vol. 65, 54-59.
140. Moon, D., 2010. The Debate over Climate Change in the Steppe Region in Nineteenth-Century Russia. The Russian Review Vol. 69: 11 Mar. 2010, 251-275.
141. Petersen, D. & Conti, M., 2008. Survivors: The A-bombed Trees of Hiroshima. Lulu Press.
142. Shen, L., Chen, X.Y., Zhang, X., Li, Y.Y., Fu, C.X., Qiu, Y.X., 2005. Genetic variation of Ginkgo biloba L. (Ginkgoaceae) based on cpDNA PCR-RFLPs: inference of glacial refugia. Heredity 94, 396–401.
143. Shitu, M., 1985. The Rare Plants and Flowers of Western Sichuan. Sichuan (People's Press).
144. Shulkina, T. 2004. Ornamental Plants from Russia and Adjacent States of the Former Soviet Union. Rostok, St. Petersburg, Russia.
145. The book-notes B. Begovic 2005-2010 (manuscript), Croatia.
146. The 2003 US National Arboretum "Web Version" of the USDA Plant Hardiness Zone Map USDA Miscellaneous Publication No. 1475, Issued January 1990.
147. The Ultimate Book of Trees & Shrubs for Southern African Gardeners, Southern Book Publishers (Pty) Ltd., 1996.
148. USDA. 1990. USDA plant hardiness zone map. USDA- Agricultural Research Service (ARS). Miscellaneous Publication Number 1475. USDA-ARS, Washington, DC 20002.
149. Valder, P., 1999. The Garden Plants of China.
150. Xiang, Z. Et al. 2009. The Li Jiawan Grand Ginkgo King, Arnoldia 66/3, 26-30
151. Zion, L. R., 1995. Trees for architecture and landscape. New York (John Wiley & Sons).

Beautiful view of the park near the Eiffel Tower where there are three Ginkgo trees (in the middle). Paris, France. Photo by Pernarić, Belgium (2010).

Attractive about 1700 years old Ginkgo tree in Lengqi, Western Sichuan, China (pages 250-251). Up: photos by Zhou Xiaolin from www.youduo.com in 2008. Photos by Tony Kirkhan, London, UK. Author this photos with friend - and children from Lengqi (down). See pages 209 and 237.

At the foot of the tree is a small temple of the local population (right).

In the foothills. Photo by Zhou Xiaolin from www.youduo.com in 2008.

View of one of the oldest Ginkgo tree in the World. Photos by Tony Kirkhan, London, UK.

The best known outside Asia Ginkgo tree is located in Royal Botanic Gardens, Kew, London, UK.
The tree ("Old Lion") was planted in 1762. Photos by Tony Kirkham, London, UK (pages 252-253).

The oldest Ginkgo tree in Europe. Utrecht, Netherlands. There are many related to the age of the plant. One thing is certain: this is the oldest ginkgo tree in Europe.
Photos by Vincent Mauritz (1/2011). (128)

Up: beauty Ginkgo unrivaled! *Ginkgo biloba* in autumn (Rouen, Normandy, France). Photo by Cs76. (86).
Down: Male Ginkgo tree in autumn, Daruvar (1777), Croatia. That year, here are planted two trees, "Adam" & "Eve" (male and female). Photo by Turist office Daruvar, Croatia.

Celebrity photo unique about 200 years old Ginkgo tree in India, Kashmir. Photo by Afsana Rashid Bhat, Global Press Institute, Kashmir, India (2008, www.thewip.net).

Ginkgo tree in Krakow, Poland.
Botanical Garden Krakow, Poland.
Photos by Pavel Hrubík-Katarína Ražná,
Nitra, Slovakia (2009).

Ginkgo biloba - yellow Autumn in Trenčin, Slovakia. Photos by Richard Masár, Slovakia (2007).

Ginkgo biloba, Janova Ves, Slovakia. Age: about 120 years. Photo by Pavel Hrubík-Katarína Ražná, Nitra, Slovakia (2009).

Ginkgo biloba tree, Nitra, Slovakia. Photo by Pavel Hrubík-Katarína Ražná, Nitra, Slovakia (2010).

Ginkgo biloba, Bojnice, Slovakia. Age: a. 140 years. Photo by Pavel Hrubík-Katarína Ražná, Nitra, Slovakia (2009).

Ginkgo tree in Nadasladany, Hungary. Photo by Laszlo Orloci, Hungary.

Page 261-262: photos by Zhou Xiaolin from www.youduo.com

Photos by Zhou Xiaolin from www.youduo.com.

The Prime Meridian in Greenwich, England, UK & *Ginkgo biloba*. Photos by Jan Purkrábek, Czech Republic.

Epiloque

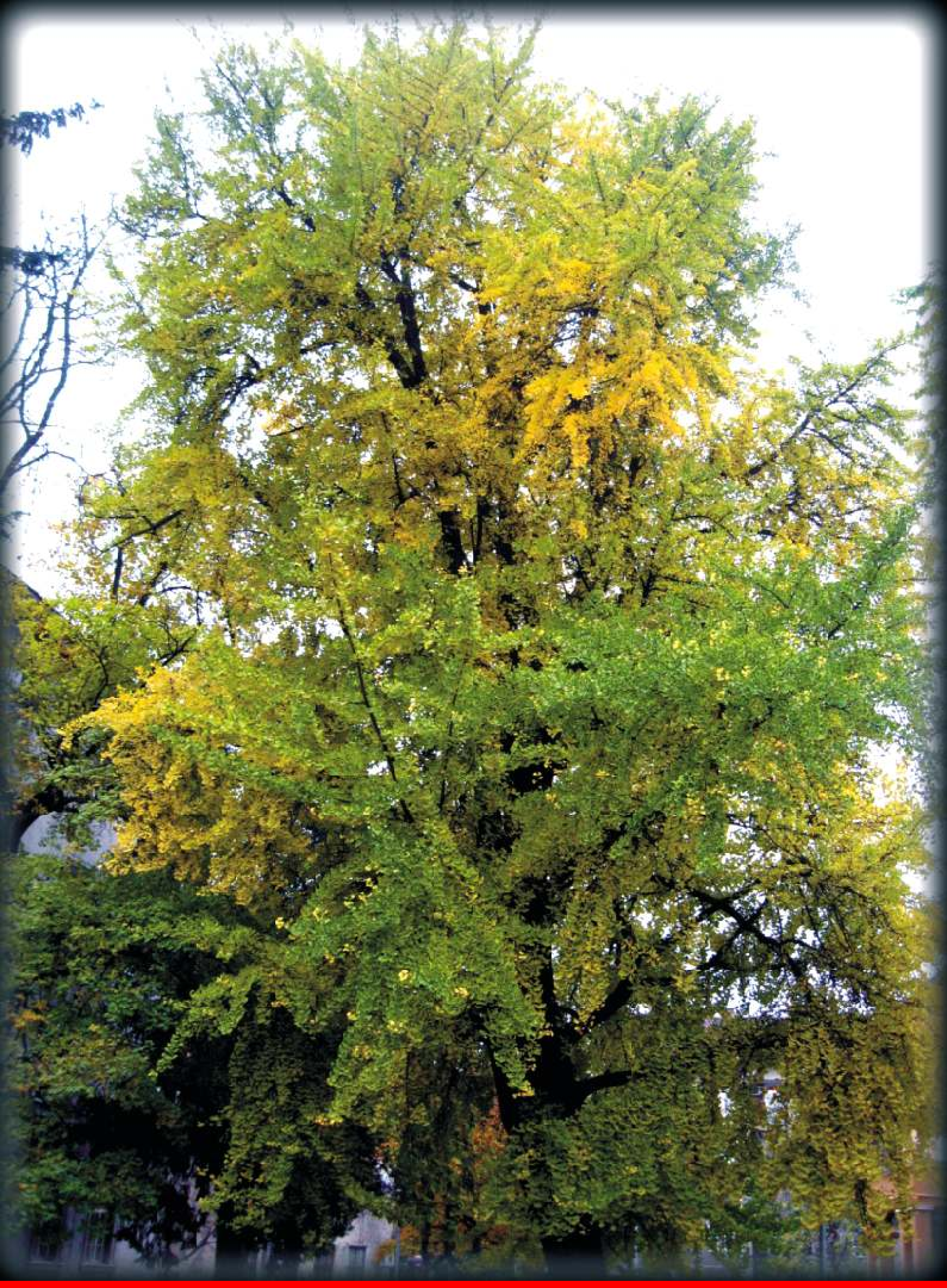
About the plant *Ginkgo biloba* or maidenhair tree we could speak very much and in many ways. This is the first, but a separate part of the edition that shows this plant from all aspects. The intention was for a popular-scientific way to view this plant as it looks, how it is grown, how it reproduces, how it got its name, what is its history as well as all other basic features and value.

Have we managed it, judge for yourself.

We hope that we have chosen the way of presenting Ginkgo - this mysterious and wonderful plants and show it clearly enough and illustrative enough for everyone, and contributed to general knowledge of these plants whose ancestors lived hundreds of millions of years.

Branko M. Begović Bego (2011/03)

Will Ginkgo be the saviour of the human kind?



Dear!

Currently is in the preparation the Book No. 2 (Vol 3-4) “Nature's Miracle - *Ginkgo biloba*” (see please pages 392-395).

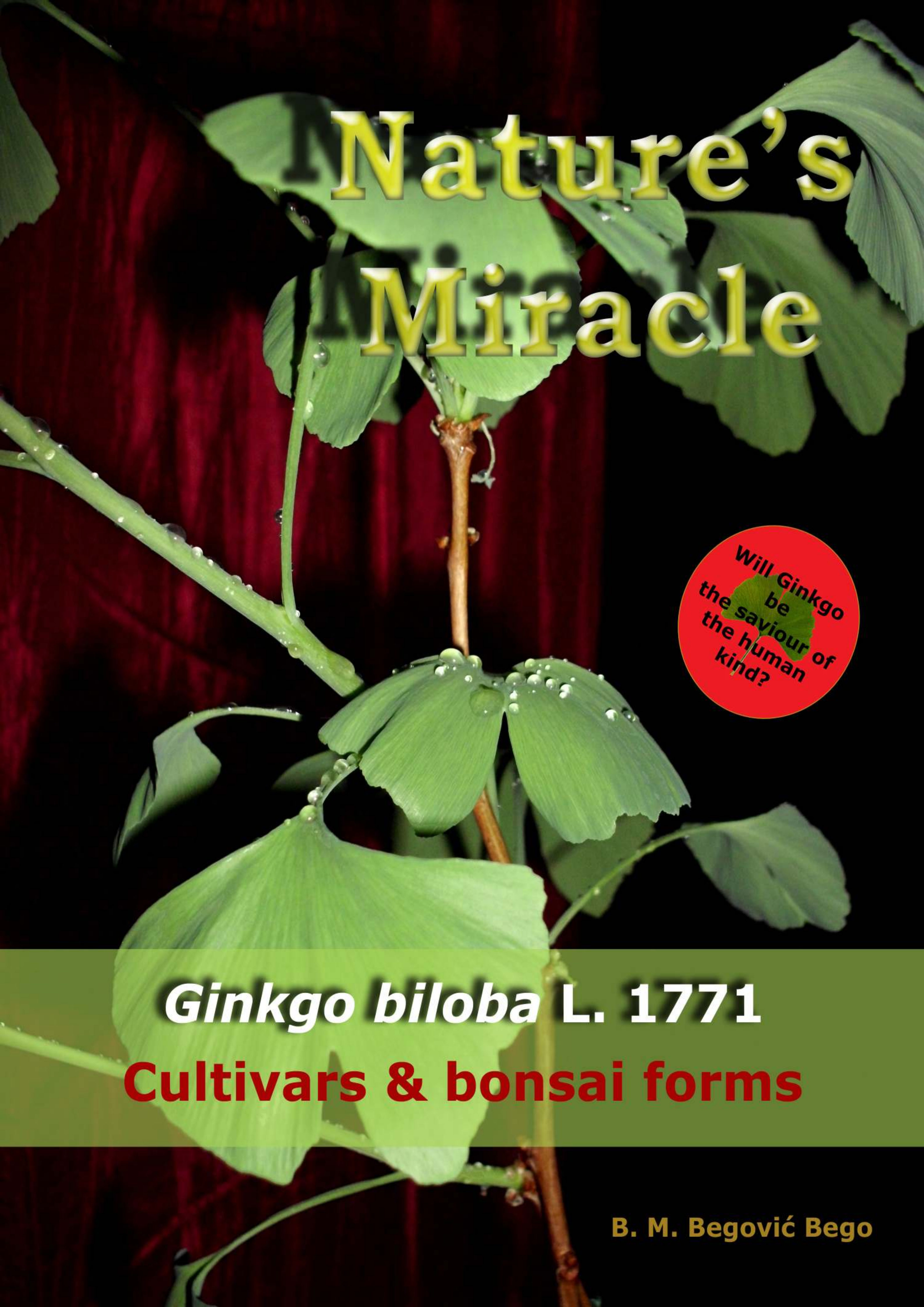
Please anyone who can help (suggestions, articles, tips, photos, etc. - or in any other way) to contact me by e-mails:

ginkgo.begovic@gmail.com
or
begovic.branko@yahoo.com

Thanks!

Address:
Branko M. Begović Bego
Otrovanec 60
33405 Pitomača
Croatia
(Tel. +385 98 1365 893)

For all information about Ginkgo, please contact me on e-mails.



Nature's Miracle

Ginkgo biloba L. 1771

Cultivars & bonsai forms

B. M. Begović Bego

Ginkgo biloba L. 1771

All about Ginkgo (or Maidenhair tree)

Volume 2

by Branko M. Begović Bego

Foreword (Vol 1-2) by

• Prof. Sir Peter Crane, Dr.Sc. *(Director of the Royal Botanic Gardens in Kew, London, UK, etc. and today - Yale School of Forestry and Environmental Studies at Yale University in New Haven, Connecticut, USA)*
• Prof. Peter Del Tredici, Dr.Sc. *(Senior Research Scientist Arnold Arboretum of Harvard University, Boston - Lecturer, Harvard Graduate School of Design, Cambridge, USA)*
• Prof. Ing. Pavel Hrubík, Dr.Sc. *(Slovak Agricultural University in Nitra, Slovakia)*
• Elvira Koić, Mr.Sc. (Gener*al Hospital Virovitica, Head of psychiatry, Virovitica, etc., Croatia)*
• Rade Rakić, M.S. *(Croatian Forests of Croatia, Head of botanical nursery, Krizevci, Croatia)*
• Assoc. Prof. Ing. Katarína Ražná, PhD. *(Department of genetics and plant breeding, Faculty of agriculture and food resources, Slovak Agricultural University in Nitra, Slovakia)*
• Prof. Zhi-Yan Zhou, Member of CAS - Academician *(State Key Laboratory of Palaeobiology and Stratigraphy, and Department of Palaeobotany and Palynology, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, China)*

(Foreword: pages 11-14)

Nature's Miracle

Ginkgo biloba L. 1771

- All about Ginkgo
(or Maidenhair tree)

Vol 2
(Cultivars
and bonsai forms)

Branko M. Begović Bego

Pitomača, Croatia

Ginkgo biloba L. 1771

Ginkgo biloba L. 1771

• All about Ginkgo (or Maidenhair tree)

Volume 2

Foreword (Vol 1-2) by
Peter Crane (UK-USA), Peter Del Tredici (USA), Pavel Hrubík (Slovakia), Elvira Koić (Croatia), Rade Rakić (Croatia), Katarína Ražná (Slovakia), Zhi-Yan Zhou (China) - pages 11-14

Title: *Ginkgo biloba* L. 1771

Author: B. M. Begović Bego

Manuscript Release Date: December 2010/October 2011

The original language manuscript: Croatian

English translation: Blanka Capić (Croatia)

Language: English

Graphic Design: B. M. B. Begović

All illustrations are indicated by the source - in the description.
Illustrations (pictures, graphics and decoration, etc.)
without a source - author: B.M.B. Begović (indicated by the logo)

CIP: No./br. 130313049 (City and University Library Osijek, Croatia - Gradska i sveučilišna knjižnica Osijek, Hrvatska)

Vlastita naklada - Self-Publishing
Branko M. Begović Bego, Otrovanec 60, 33405 Pitomača, Croatia
Contact:
ginkgo.begovic@gmail.com
begovic.branko@yahoo.com

ISBN 978-953-56963-0-8

Contents

Cultivars
&
bonsai forms

Contents

Edition *Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree) consists of four separate but related books.

Volume 1: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of a whole which is mainly about the descriptive part of the Ginkgo: morphological characteristics, name, planting and reproduction, prevalence etc. So, there are only descriptive characteristics.

Volume 2: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of two parts: cultivars and bonsai forms.

Volume 3: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of a whole which is mainly about the pharmacy and medicine (the traditional and the modern), cosmetics etc.

Volume 4: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)" consists of a whole which is mainly about the religion, art, mythology, etc.

Each book can be separate unit, but all together make a complete whole about ginkgo.

Introduction

As a logical extension to a general description of the *Ginkgo biloba* species undoubtedly is a description i.e. introduction of cultivars and bonsai forms of this species. As a logical follow-up on general description of the *Ginkgo biloba* plant as a species and its cultivars just getting to know the plant (its morphological characteristics, prevalence, etc) is nothing but general getting to know Ginkgo from all aspects, I have decided to connect two parts in one, but jet divide them in some manner, too. And this is precise reason why this book consits from two volumes: Vol 1 and Vol 2.

Some years ago when I first started collecting data about cultivars and bonsai forms I have found a large number of confusing and superffical datas distributed in numerous digital and print form. On modern media's, such as Internet datas are informative and very superfficial while print datas are quite rare. So on various ways I contacted manufactuers (growers/gardners) of Ginkgo's bonsai and cultivars. In such way I've collected many necceseary informations about cultivars.

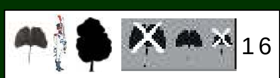
Up to now all literature guess about number of Ginko's cultivars and forms – grown or identified. And there allways number „hundred“ showed up. But while sorting data I have established that this number is around 250 and most of them can be identified.

Through Ginkgo's cultivar and bonsai rewiew one unity is rounded, but there are room to say quite a lot more about all of them.

Still I hope this will be good basic for further research and knowing of Ginkgo as a species and his cultivars and bonsai forms.

Branko M. Begović Bego
(October, 2011)

Ginkgo biloba ‘The President’. Photo by Ender Stewart, USA. (41, 43)



1

Cultivars *Ginkgo biloba*

Foreword

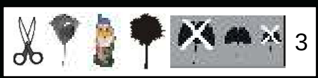
Typicall species *Ginkgo billoba* is only surviving species of Ginkgo familly. During selections, mutations and through botanical interventions there were more than 200 types of known cultivars beeing grown and some of them can not be compared with its beaty with no other plant. Ginkgo's cultivars take a very special place in horticulture so it is very important to get introduce them.

Some of them were grown especially for industrial purposes for example for fruit quantity production or to grow leaf in as short period of time possible or leaf size, etc.

Just as for typical species Ginkgo for cultivars also certain rules apply. Growing cultivars is no different than growing typical species except the reproduction part. Cultivars are reproduced mainly by cuttings and occulation and barely from seed.

In cultivar growth there is a major problem that should be mentioned – most cultivars are beeing grown in male speciment and very rarely in female.This just another way to prove alarming state for survival of Ginkgoas species in future (naturaly complete). There is a real danger from disapearance of natural propagation for this species through seeds, because there is a drastic difference in growing feemale plants.

Ginkgo biloba ‘Tubifolia’ (detail, leaf, in autumn). Photo by M. Šavorić, Croatia. (54)



Ginkgo biloba ‘Tubifolia’.

Some cultivars need winter pruning. One of them is 'Tubifolia'. Example. Photos by Edwin Smits, Netherlands. (7)

1
Cultivars and varieties

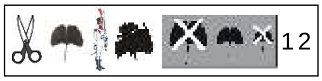
From typical form there has been cultivated more than 200 different cultivars and varyeties of *Ginkgo biloba* species through last 150 years. Most of them were grown on west (USA, Eurpoe) and in China.

Up until 30 years ago only 30 cultivars were known, and now this number is more than doubled. Since second half of 19th century „Pendula“ variety shows up, and „Horizontalis“. They sims to be the oldest ones. One of the most attractive cultivars, 'Variegata', were cultivated by frenchmen André Leroy in 1854. Some cultivars are quite easy to obtaine and some of them are impossible or almost inpossible to obtain and mostly they are quite expensive (if you can find them on sale to begin with). In following lists most of the known cultivars is stated (through literature up to 02/2011) and they can be found on sale through Europe, USA or in rest of the World, but also the ones that can not be bought and they are mostly in botanical gardens, arboretums or some other botanical collections or institutions. But thiose are not all of them. Also it should be told that Ginkgo as typical species is quite specific and beautifull species. But in variation spectrum there are numerous special, beutifulll and decorative forms that are rare in botanic world. Ginkgo's cultivar can be classified on numerous ways but main grupaions are: a) through form (looks) of the leaf, b) through leaf colour, c) through treetop form, d) through size (height) of the plant, e) are they aimed for fruit or leaf production.

Numerous cultivars have only small deviations from typical species but there are those that deviate on all stated ways. There should also mention that quite enough cultivars with multiple names submerge and there are those who are so similar that is almost impossible to tell them appart, while for some only names are known without descriptions since they didi not survive with growers and do not hove special value (horticultural for example).

Cultivation of new cultivars is still in progress for as beautifull and especial apperance (for horticultural purposes) or gaining as much leaf or fruits (for industrial purposes). If we take into consideration that Gingko has spread through out the world through last 200 years number of cultivars is relativly small. If we compare it with Thuja for example which has many species and more thousands of cultivars, varieties and forms. But nor Thuja nor numerous other species had such destiny as ginkgo through out the history. For as clearer rewiew of Ginkgo's cultivars they will be stated in alphabetical order and in same manner the most of them will be shown in picture part also. Growing cultivar has no major differences from growing typical Ginkgo species. However some of them must be cutted regurarely and some of them do not. See table abouth growth in follow up in this part of the book.

Ginkgo biloba ‘Autumn Gold’. Photo by Harold Greer, USA. (2)



Ginkgo biloba ‘Barabit’s Fastigiata’. Photo by David and Chantal Bömer, Netherlands. (33)

Ginkgo biloba 'Princeton Sentry' in the foreground. Photo by Bömer, Netherlands. (33)

17

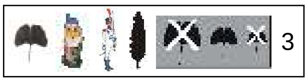
Right: *Ginkgo biloba* 'Saratoga'. Photo by Bömer, Netherlands. (33)

15

Ginkgo biloba 'Everton Broom'. Photo by Stephen Grubb, UK. (46)

2
?

Ginkgo biloba 'Göethe'. Very rare cultivars. In honor of the poet J. W. Göethe. Photo by David and Chantal Bömer, Netherlands. (33)



2 Table with descriptions, origins etc.

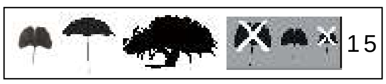
Legend for table on pages 284-313

Selection Group Key: Crown Forms and Leaf Types Varying From Normal Type

WEEP = weeping, pendulous, or umbrella-like
UP = upright or fastigiate
DWARF = dwarf to semi-dwarf size
CHICHI = branches with aerial root bulges
Foliage Variations
TUBE = rolled tubular leaves
VARI = variegated leaves
EPI = leaf and seed-stem fused foliage (epiphylla/ohazuki)
Note: Dwarf forms and most of the foliage variations are usually very slow growing.
Variegated leaves are usually unstable selections of green and yellow which require continuous pruning to maintain and are usually small females.
Sex Key: M = predominately male F = predominately female

Explanation connecetd with table abouth growth in follow up in this part of the book. Table has basic information (sizes) of known cultivars. With basic name sinonims are stated (if they exist). In following columns there is mark in which group they bellong (according to Coder 2003), then gender (mostly) and optimal size for some cultivar (if established). Following column state country from which cultivar originate from and precise source of formation (if known). Following column has comments + short descriptions. Last columns states sourcesfrom References form this part of the book based from which this table is created from. If data has not been checked or entry is not known ? has been added.

Ginkgo biloba 'Pendula'. Old tree in Garden castle, Enghien, Belgium. Photo by Jean-Pol Grandmont. (9)



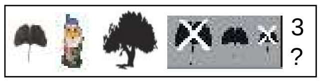
On following pages in table forms you will find 200 Ginkgo's cultivars. Those are not all that are known today and some of them have more then one name. This can be seen at 'Elmwood' cultivar which has several names but is one cultivar altogether (can not be 100% proven that some of them are variations?). In tables you will not find a set of names because for them in litereutre you can find only names without description and it is hard or impossimble to acquire one, for example *Ginkgo biloba* ‘Tood’s Wb’ (50), ‘Golden Globe #12765’, ‘B. Fruit’, ‘Collector’s Variegated’, ‘Spring Grove WB87’, ‘Suncrest’, ‘Utrecht’, ‘Weping Form’ (44), ‘Kohout’s Pendula’, ‘Selection’ (18), ‘Selection Select’ (96), ‘Ming Princess’ (22), ‘Girard's Spreader’ (56), ‘Slovakian Princess’, ‘Low Down’ (102) etc.

Cultivars you will not find in tables are mostly originated from China. They were digested by Frank S. Santamour et al. 1983 (A) and some of them that can be find in tables are there for example only.

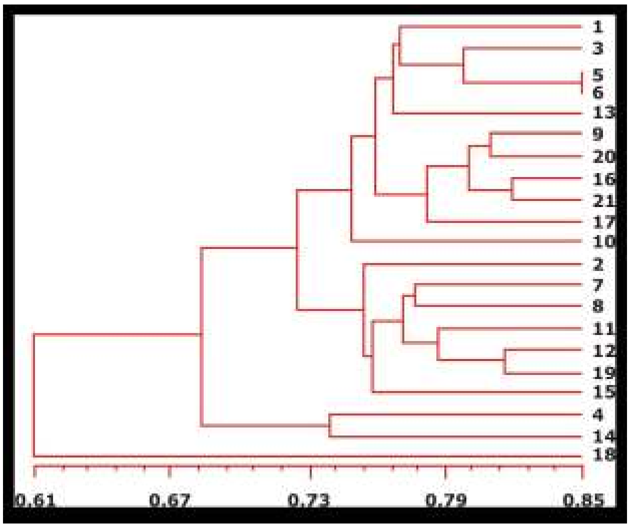
It should be stated that cultivars were not studyed throught history and there are new ones every year, as much as variations or special forms for some cultivars. Valuable reserach was conducted by L. Wang et al. 2006 on most common cultivars. Based on genetic differences i population relationship beetween 21 ornament cultivar created in 5 countries were able to show relations i.e. closest genetic relation beetween them. So 'Fastigiata', 'Fairmount', 'Leiden' and 'Autumn Gold' are directly related and originate from 'Pendula' (see dendogram).

Code	Cultivars	Sex	Origin
1	Fastigiata	M	FR
2	Santa Cruz	M	USA
3	Fairmount	M	USA
4	Horizontalis	F	FR
5	Leiden	M	HOL
6	Autumn Gold	M	USA
7	Ohatsuki	F	JAP
8	Tit	M	JAP
9	Saratoga	M	USA
10	Princeton Sentry	M	USA
11	Male	M	FR
12	Tremonia	F	FR
13	Pendula	F	FR
14	Tubifolia	M	FR
15	Yiyuanyeziyinxing	F	CHN
16	Chuiyeyinxing	M	CHN
17	Pingzhanyinxing	M	CHN
18	Daeryinxing	M	CHN
19	Jindaiyinxing	M	CHN
20	Variegata	M	CHN
21	Huayeyinxing	M	CHN

Beautiful *Ginkgo biloba* ‘Dila’ in autumn. Photo by Lappen, Germany. (45)



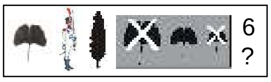
Dendrogram of 21 *Ginkgo biloba* ornamental cultivars. (Source: Wang 2006)

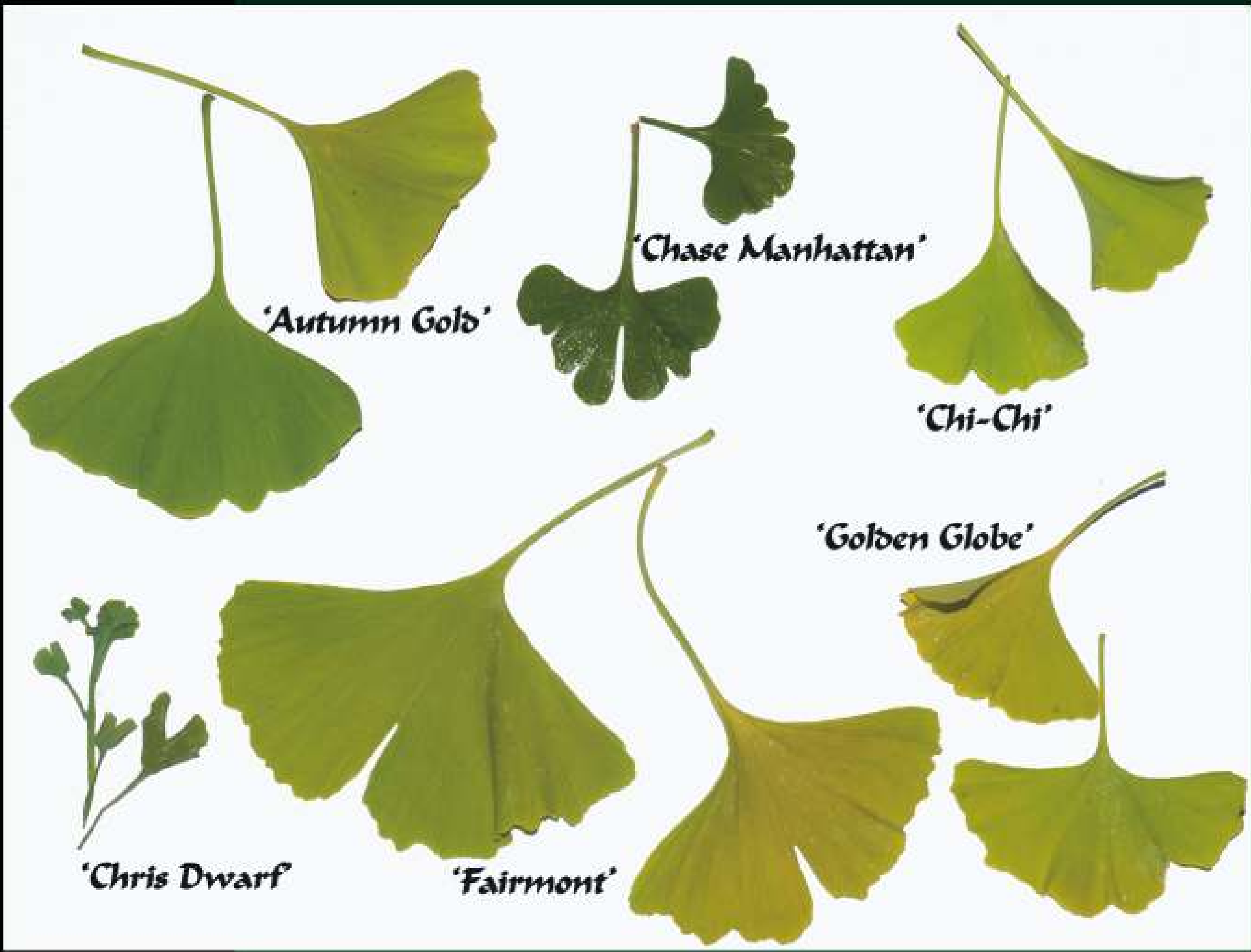


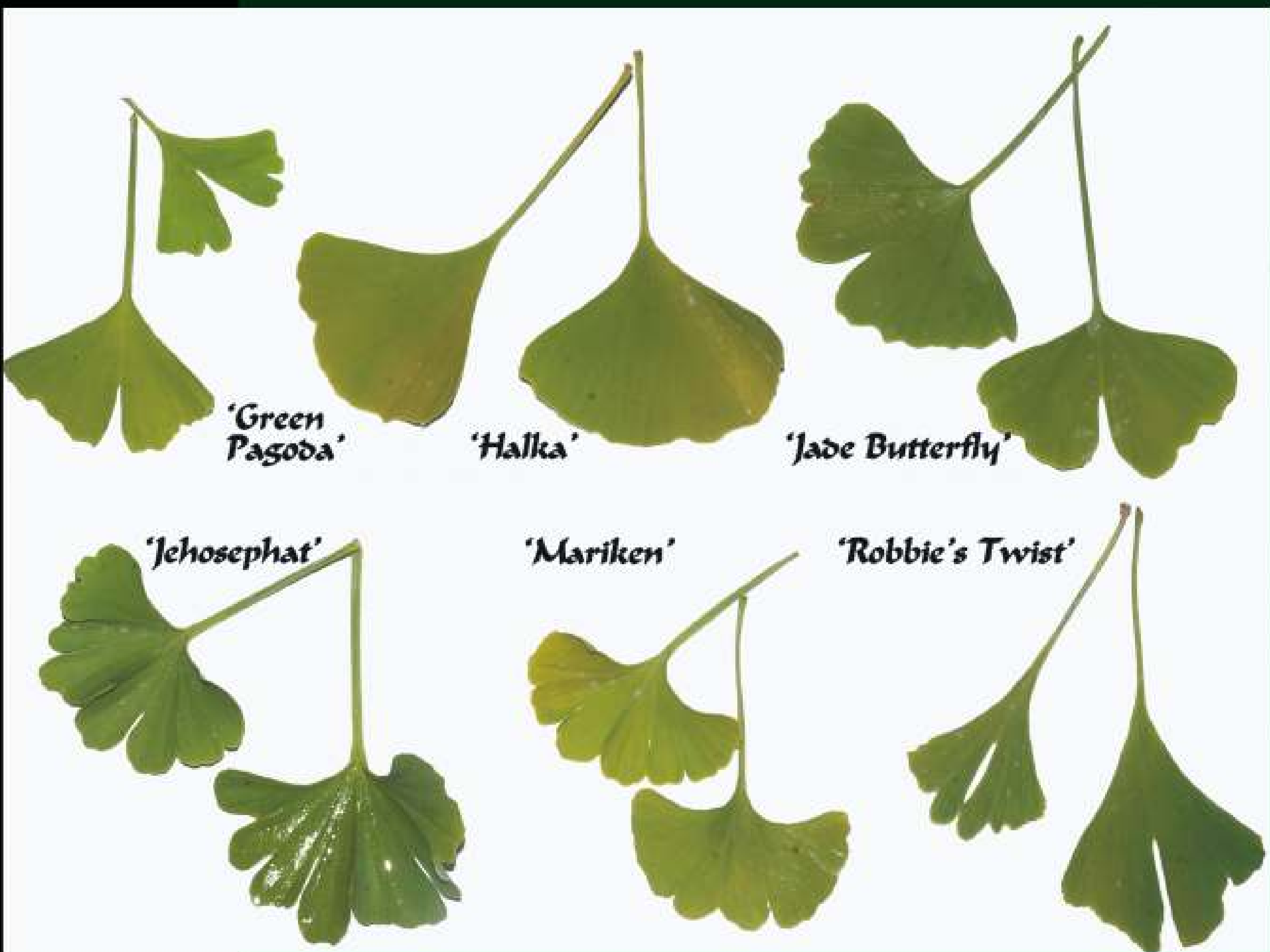
Similarity coefficient

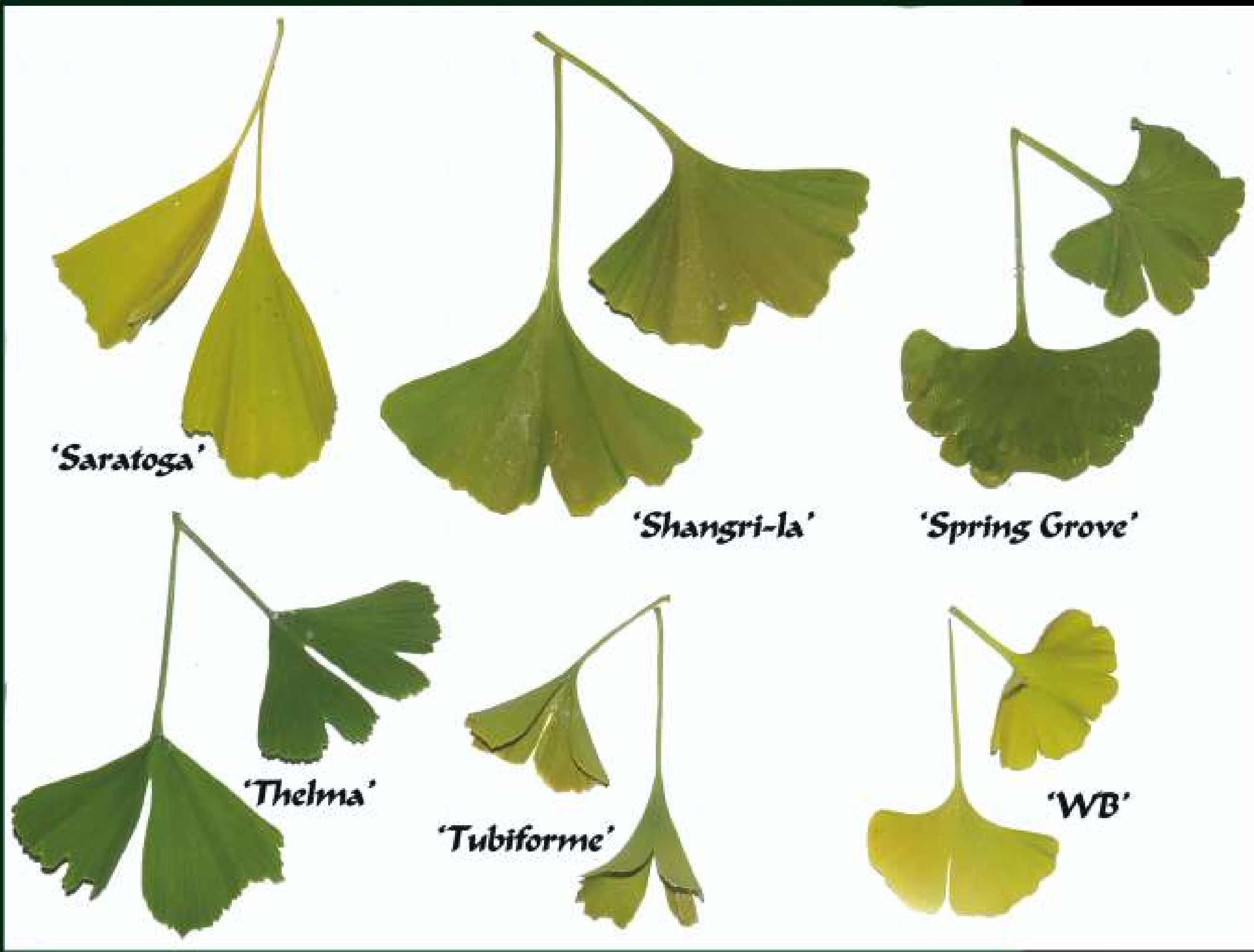
List of cultivar Ginkgo biloba. M = Male & F = Female. FR = France, USA = United States of America, HOL = Holland, JAP = Japan, CHN = China. (Source: Wang 2006)

Ginkgo biloba 'Fastigiata Blagon' ('Blagon Fastigiata'). Photos by Lappen, Germany. (45)




'Autumn Gold'
'Chase Manhattan'
'Chi-Chi'
'Golden Globe'
'Chris Dwarf'
'Fairmont'


'Green Pagoda'
'Halka'
'Jade Butterfly'
'Jehosephat'
'Mariken'
'Robbie's Twist'



Pages 224-225: leaves cultivars *Ginkgo biloba*.
Photo by Harold Greer, USA. (2)

Left: *Ginkgo biloba* 'Variegata' (leaf). Photo by Ewen Brown, UK. (53)

Right: *Ginkgo biloba* 'Mariken' (leaf). Photo by M. Šavorić, Croatia. (54)

Right: *Ginkgo biloba* 'Saratoga' (leaf). Photo by Harold Greer, USA. (2)

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
1	*Ginkgo biloba* 'Akebono'	-'Akebono Ginkgo'	UP	M	13	JPN (?)
2	*Ginkgo biloba* 'Anny's Dwarf'	-'Annys Dwarf'	DWARF	M	5 ?	? (HOL)
3	*Ginkgo biloba* 'Argentea'	-	UP - DWARF	?	?	GBR
4	*Ginkgo biloba* 'Aurea'	-'Pterophyllus Salisburiensis aurea' -'Yellowleaf'	UP-VARI	-	?	GBR
5	*Ginkgo biloba* 'Aureovariegata'	-'Aureo-variegata'	VARI	-	8	?
6	*Ginkgo biloba* 'Autumn Glory'	-	UP	-	12	USA
7	*Ginkgo biloba* 'Autumn Gold'	- 'Autumnalis Gold'	UP	M	12	USA
8	*Ginkgo biloba* 'Bai guo'	-	-	-	-	-
9	*Ginkgo biloba* 'Baldi'	-	DWARF-WEEP	M	5	? USA
10	*Ginkgo biloba* 'Barabit's Fastigiata'	-	UP	M	15	HUN
11	*Ginkgo biloba* 'Barabits Nana'	-'Barabits Dwarf' -'Barabit's Nana' -'Kitsi'	DWARF	M	3	HUN
12	*Ginkgo biloba* 'Barabits Sztráda'	- 'Barabit's Strada' - 'Barabits Strada' -'Globus'	DWARF-UP	M	5	HUN
13	*Ginkgo biloba* 'Barabitsii'	-'Conica' -'Nana'	DWARF	M	2	HUN
14	*Ginkgo biloba* 'Beijing Gold'	-	DWARF-UP-VARI	-	4	CHN ?
15	*Ginkgo biloba* 'Bell'	-'Canopy' (new name) -'No. 3 Horse Bell'?	DWARF-UP	-	?	USA

Source, author...	Comments, description...	Source: for table
?	A rigidly upright form of this ancient tree, featuring distinctive fan-shaped leaves on sharply ascending branches, very good fall color; good size for home landscape use, does not produce fruit.	15, 16, 17
?	Dwarf tree of the gods, like the species is very hardy and adaptable absolute. The leaves of this variety are striking deep slit. Makes beautiful round crowns. Thrives in any good garden soil, and bucket. (From A. van Nijnatten, Zundert - 33b)	10, 18, 20, 33b
Nelson, 1866, GBR	There is no specific description.	23, 126
Nelson, 1866, GBR	Leaves golden-yellow.	20, 23, 126 (A)
Senecl., 1867	Variegated variety, whose leaves are conspicuously striped yellow-green. This species is much smaller than the species and is unlikely to reach more than 8 meters. Yellow variegated.	10, 20, (A)
1958, Nelson Nurs., CA, USA, Saratoga Horticultural Foundation	There is no specific description.	23, 114 (A)
M. van Rensselar, 1956, USA	Oval upright crown, staminate tree, selected in 1951 and introduced in 1955. Original tree near corner of El Abra Way and Lincoln Ave., San Jose, California, USA. Symmetrical habit and brilliant golden yellow autumn foliage.	20, 23, 24, 28, 114 (A)
-	This is an error when writing for *Ginkgo biloba*.	62
?	Dwarf form of the maidenhair tree.	10, 25
?	A good slim columnar form with attractive smaller leaves than the species. Found by Dr. Elemer Barabits from Hungary. Introduced by Boomkwekerij Bömer, Netherlands. (33b)	18, 28, 33
Dr. Elemer Barabit - Barabits's Lővér Pinetum Sopron, HUN	*Ginkgo biloba* 'Barabits Nana' is a rare form selected by Dr. Elemer Barabits in Hungary and is peculiar by being a very compact shrub-like plant but with slightly larger leaves than the species creating a very ornamental effect. Perfect where space is limited and stunning in a container.	17, 20, 23, 29, 33, 114
Dr. Elemer Barabit - Barabits's Lővér Pinetum Sopron, HUN	A regular ball-like habit clone, about 2 m diameter. Very decorative as high graft.-A broad dwarf with dense habit. Original plant in the Barabits's Lővér Pinetum Sopron, HUN.	23, 30, 31
1983, Barabits E., HUN	A broad dwarf with dense habit. Original plant in the Barabits's Lővér Pinetum Sopron, HUN. Maybe the same: 'Barabits Nana' or 'Barabits Dwarf' or 'Kitsi'?	20, 23, 62
?	Spectacular new introduction, *Ginkgo biloba* 'Beijing Gold' has leaves which emerge in spring as a lovely golden-yellow, gradually darkening later in the year to a variegated white and green. In the autumn the leaves turn butter yellow before falling. An unusual, colourful and elegant small tree.	23, 32
1959, James Bell, USA	Name found in records of the Plant Sciences Data Center of the American Horticultural Society. Original tree at the home of James Bell, Atherton, California and propagated under this name by the Saratoga Horticultural Foundation, Saratoga, California, until 1959, when the name 'Canopy' was assigned to it.	23, 136 (A)

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
16	*Ginkgo biloba* 'Bergen op Zoom'	-'Bergen of Zooh' -'Bergman Dwarf'? -'Lakeview'	UP	?	12 ?	HOL (USA?)
17	*Ginkgo biloba* 'Bernheim Broom'	-'Witches' Broom'	DWARF	M	2.5	USA
18	*Ginkgo biloba* 'Bertold Leendertz'	-	DWARF-UP	-	4.5	GER
19	*Ginkgo biloba* 'Bonn'	?	DWARF (?)	?	?	?
20	*Ginkgo biloba* 'Bon's Dwarf'	-	DWARF	M	2.5	USA (?)
21	*Ginkgo biloba* 'Broom with Tubes'	-'Brooms & Tubes' -'Brooms and Tube' -'Broom with Tub'	TUBE-DWARF	M	2 ?	USA
22	*Ginkgo biloba* 'Buddy'	-	DWARF	M	2 ?	USA (?)
23	*Ginkgo biloba* 'Bullwinkle'	-'Bunki' ?	UP	M/F	12	USA (?)
24	*Ginkgo biloba* 'Californian Sunset'	-	VARI-DWARF	M	3 <8	USA ? (HOL)
25	*Ginkgo biloba* 'Canopy'	-'Bell' (old name)	DWARF-UP	-	?	USA
26	*Ginkgo biloba* 'Chase Manhattan'	-'Bonn's Dwarf'	DWARF	M	2.5	USA
27	*Ginkgo biloba* 'Chi-chi'	-'Chichi' -'Tit' -'Icho' -'Tschi Tschi' -'Chi Chi Icho'	CHICHI-DWARF	M	2.5	JAP ?
28	*Ginkgo biloba* 'Chiński'	-'Chiński Pendula' -'Pendula Chiny' - 'Katimierz Wielki'	WEEP	?	?	POL
29	*Ginkgo biloba* 'Chotek'	Form of 'Witches Broom' -'Kroměříž'	DWARF-WEEP	M	2>	CZR
30	*Ginkgo biloba* 'Chris Dwarf'	-'Chris's Dwarf'	DWARF	M	2 ?	USA

Source, author...	Comments, description...	Source: for table
?	(Dutch selection that grows as a good solitary tree. Probably up to 12 m high. - 33)?	20, 23, 33, 102
White Hall, Louisville, KY, USA	Fall color, environmental adaptability and pest resistance all are the same as the straight species, excellent.	23, 35
Berthold Leendertz, GER	Form. nov., narrow column, slowly growing.	18, 36
?	There is no specific description.	23
?	A very dwarf growing Ginkgo with rich green color. Leaves are small in size. Good for small gardens and lots. Plant in full sun.	20, 37
?	This is a rare dwarf with very unusual leaves. Some are flat like small whisk brooms while others are rolled into tubes or funnels. You will also find some normal foliage for a third texture.	20, 23, 38, 39
?	A very low form.	23, 40, 46
USA (?)	There is no specific description.	18, 83
HOL ?	Variegated variety which originated as a sport of 'Saratoga'. A low-growing species of the Ginkgo tree, which will be up to about 3 (max 8) m high only. Therefore well suited for small gardens and container plants. The variety is characterized by narrow, deeply cut leaves. Very hardy! (Low-growing by medium-growing. Plant is found by Bömer, Zundert, Netherlands - 33b)	23, 32, 33b, 34
1959, Saratoga Horticultural Foundation, Saratoga, Calif., USA	Name found in records of the Plant Sciences Data Center of the American Horticultural Society. Formerly known as 'Bell' and propagated by the Saratoga Horticultural Foundation, Saratoga, California. Trees growing at four major arboreta, but the cultivar has never been described or commercially available.	23, 130
Stanley & Sons Nurs. Inc. Boring, OR, USA (?)	A very slow grower with small dark green leaves which are often cupped upright. Small branches are closely spaced.	2, 20, 23, 41
JAP ?	Also know as 'Tschi Tschi' but probably named for the unusual growths found on mature Ginkgos called chi-chis. This is a dense, multi-stemmed, shrubby tree that grows in a fanlike shape. It is a fruitless dwarf that will rarely exceed 2 m. Very good choice!	2, 20, 23
Sylw. Tomszak Nurs., Bielsko-Biala POL (?)	Maybe the Polish name for Ginkgo biloba 'Pendula'?	23, 42, 114
Horák, Bystřice pod Hostýnem, CZR (Unverified information)	Named to tribute the house of Choteks, the family of archbishop Ferdinand Maria von Chotek. The species has very different leaf shapes. Normal part of ginkgo leaves, some tube-shaped leaves and sometimes filamentous. (Mesterházy, Z. quote source: "2003 Uwe Horstmann Baumschulen GER".)	1, 10, 23, 55
?	Reportedly one of the best dwarf Ginkgos on the market at this time, with a more upright habit and numerous slender branches it has a tendency to be more regular in shape. The tiny leaves do not exceed the size of a quarter and are very dense on the plant.	2, 20, 23

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
31	*Ginkgo biloba* 'Cleveland'	-	UP	M	10 ?	USA
32	*Ginkgo biloba* 'Columnaris'	-	UP	-	15 ?	USA
33	*Ginkgo biloba* 'Compacta'	-'Compact' -´Korínek' (?) -'Kromeriz'	DWARF	-	3 ?	GBR
34	*Ginkgo biloba* 'Conica'	-'Barabitsii' -'Nana'	DWARF	M	3	HUN
35	*Ginkgo biloba* 'Cutleaf'	-'Cut Leaf' - 'Dissecta' - 'La-ciniata' -'Largeleaf' -'Longifo-lia' -'Macrophylla' -'Macrophylla Incisa' - 'Macrophylla Laciniata' -'Triloba'	UP	M	18	FRA
36	*Ginkgo biloba* 'Damaling'	**See Notes (A)**	?	?	?	CHN
37	*Ginkgo biloba* 'Dameihai'	**See Notes (A)**	?	?	?	CHN
38	*Ginkgo biloba* 'David'	-	UP/DWARF	M	5	HOL
39	*Ginkgo biloba* 'Dila'	-	DWARF-WEEP	M	3 ?	GER ?
40	*Ginkgo biloba* 'Ding-A-Ling'	-'Ding-a-Ling' -'Ding-a-ling' -'Dingaling'	DWARF	?	?	USA
41	*Ginkgo biloba* 'Dissecta'	-'Laciniata'	UP	M	18	FRA
42	*Ginkgo biloba* 'D.J.s Bow Tie'	-'Dj's Bowtie'	UP	?	?	?
43	*Ginkgo biloba* 'Dongtinghuang'	**See Notes (A)**	UP	?	?	CHN
44	*Ginkgo biloba* 'Dr.Gerd Krüssmann'	-	UP	F	?	GER
45	*Ginkgo biloba* 'Eastern Star'	-	DWARF	F	4 ?	CHN

Source, author...	Comments, description...	Source: for table
Cleveland, OH, USA.	Name found in the records of the Plant Sciences Data Center of the American Horticultural Society. Propagated from a fastigiate tree in Cleveland, Ohio by the Saratoga Horticultural Foundation, Saratoga, California and tested under this name. Tree at Los Angeles State and County Arboretum, Arcadia, California, although the cultivar has not been described or commercially available.	20, 23 (A)
Arrowhead Nurs. MA USA. (?)	A narrow and high form. Suitable for alleys.	17, 23
1973, GBR (?)	Form broad and low crown. (WitchBroom from Kromeriz. - 33b)?	23, 33b, 44, 55
1983, Barabits E.	A broad dwarf with dense habit. Original plant in the Barabits's Lővér Pinetum Sopron, HUN. Maybe the same: 'Barabits Nana' or 'Barabits Dwarf' or 'Kitsi'?	20, 23, 62
1942, USA (?) - new name	Deeply divided leaves. Very large leaves. View No. 101 in table. This is new, USA, name.	17, 23, 118 (A)
Cheng & Fu, 1978	There is no specific description.	23
Cheng & Fu, 1978	There is no specific description.	23
?	A small permanent form of ginkgo, which was selected from nursery Bomer in Zundert, Netherlands.	10, 17, 23, 33
?	Low and very luxurious form.	23, 45
?	A deciduous, upright, small tree. Interesting protuberances on bark of maturing trees appear more oblong in shape than the species. Fall color is yellow to gold.	23, 44, 46
GBR ?	(C. Hochstetter, Coniferze, 1882, p. 101) = LACINIATA according to A. Rehder, Bibliography of cultivated trees and shrubs, Arnold Arboretum of Harvard University, 1949, 825 p.	20, 23, (A)
?	An upright deciduous small tree with small bow tie-shaped leaves. Not as vigorous as the type but still quite easy to grow. Prefers sun/partial shade in well-drained soil.	44, 83
Cheng & Fu, 1978	There is no specific description.	23, (A)
2006, GER (?)	There is no specific description.	47, 48
?	A female variety that's very productive and easy to grow. Bears abundant crops of large, sweet nuts. This one is a Chinese selection.	2, 49

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
46	*Ginkgo biloba* 'El Abra'	-	?	-	?	USA
47	*Ginkgo biloba* 'Elmwood'	-'Elmwood Fastigiata'	UP	M	4<	USA
48	*Ginkgo biloba* 'Elmwood Fastigiata'	-'Elmwood Fastigata'	UP	M	4<	USA
49	*Ginkgo biloba* 'Elmwood Pillar'	-'Elmwood'	UP	M	4<	USA
50	*Ginkgo biloba* 'Elmwood WB'	-'Elmwood' or -'WB' ?	?	?	?	?
51	*Ginkgo biloba* 'Epiphylla'	-'Ohatsuki' -'Oha-suki' -'Ohazaki' -'Ohazuki'	EPI-DWARF	F	4.5 (19) ?	JAP
52	*Ginkgo biloba* 'Everton Broom'	-	DWARF	M	2 ?	USA
53	*Ginkgo biloba* 'Fairmount'	-'Fairmont'	UP	M	20	USA
54	*Ginkgo biloba* 'Fastigiata'	-'Sentry'	UP	M	7-8	FRA
55	*Ginkgo biloba* 'Fastigiata Bielsko Biała'	-'Bielsko Biała'	UP	M	12 ?	POL
56	*Ginkgo biloba* 'Fastigiata Blagon'	-'Blagon' - 'Blagon Fastigiata'	UP	M	5-6 ?	FRA
57	*Ginkgo biloba* 'Finger Variegatet'	-'Finger Variegated'	DWARF/VARI	M	3-4	CZR
58	*Ginkgo biloba* 'Firehouse'	-	DWARF ?	?	?	USA
59	*Ginkgo biloba* 'Flagstaff'	-	DWARF	M	3-4 ?	?
60	*Ginkgo biloba* 'Freak'	-	DWARF	M ?	3-4 ?	AUT

Source, author...	Comments, description...	Source: for table
San Jose, CA, USA	Name found in the records of the Plant Sciences Data Center of the American Horticultural Society. Original tree on Sierra Street, San Jose, California and propagated and tested under this name by the Saratoga Horticultural Foundation, Saratoga, California. The cultivar has never been described or commercially available.	23, (A)
?	A witch's broom, which was selected in the USA. Narrow and upright form, but should hardly reach a height of 4 meters. Small very pretty and very smooth leaves.	10, 50
?	This fruitless maidenhair tree has a narrowly columnar crown and fan-shaped leaves that turn shades of yellow in fall. In the winter, its stark, deeply furrowed, grayish tan bark and knobby branches add additional landscape interest.	23, 50
?	See 'Elmwood'.	51
?	2004 River Rock Nursery OR USA.	23
?	(J. Ohwi, Flora of Japan, Smithsonian Inst., Wash., D.C., 1965, p. 109, English translation edited by F.G. Meyer and E.H. Walker) - no cultivars were given in the original 1953 Japanese version of Ohwi's work, but the extended English translation listed 'Epiphylla', which must be considered invalid because of the use of Latin form after 1959. Japanese equivalent given as OHATSUKI.	20, 23, 114 (A)
?	A very rare variety. Discovered as a Witches' broom by us. Leaves small on a very dense compact plant. All main branches seem to grow at 45 degree angles. A 10 year plant will be in the region of 150 x 150 cm.	21, 23, 46, 52
Krüssmann 1972, 1876 Fairmount Park, PA, USA	(Saratoga Horticultural Foundation, Saratoga, California, Wholesale price List, October 15, 1962, p. 1, Trade-marked) - without description. Propagated from a male grafted tree planted in 1876, during the Centennial Exposition in Philadelphia, Pennsylvania, at the site of the Horticultural Hall in Fairmount Park. Mature tree has dense, upright pyramidal crown; younger trees have a horizontal branching habit. Validated here for the first time.	20, 23, 114 (A)
Mast. 1896 ex Henry 1906	(Kew Hand-List of Coniferae, Ed. 1, 1896, p. 19) - without description. Branches ascending, forming a columnar head, according to A. Rehder, Manual of cultivated trees and shrubs, Macmillan, 1940, 996 p. Description: columnar maidenhair tree. Height: 800 cm. Hardiness : completely hardy. This plant is only available on a very limited basis!	10,20, 21,23, 26, 136 (A)
Sylw. Tomszak Nurs., Bielsko-Biala, POL	There is no specific description. Very similar to *Ginkgo biloba* 'Fastigiata'.	23, 42
FRA ?	Very similar to *Ginkgo biloba* 'Fastigiata'. Outstanding male, non-fruiting French selection with a distinct pyramidal form and tight dense habit due to its short internodes. A light annual spring shearing for the first 3-4 years will greatly aid the development of its tight appearance. The unique fan-shaped leaves turn a stunning golden yellow in fall. An extremely tolerant, easily grown specimen tree for small landscapes.	17, 45, 62, 75
CZR	There is no specific description. Very similar to *Ginkgo biloba* 'Variegata'. Czech version of 'Variegata'.	10, 55, 113
Listed name in Europe c. 2006.	There is no specific description. At this strain, no further description was found, only a treatise Kennet D. Cochran at The Marketing Potential of Ginkgo biloba in the USA.	113, 114
?	A slow-growing male Ginkgo with very broad leaves. According Conifer Gardens Nursery describing the slow-growing, with very light green to golden yellow foliage and unusually strong fan-shaped leaves.	113
Josef Hahnl, AUT	A new variety of Josef Hahnl from Austria. His quote: "This variety is distorted by an irregular Growth of the branches and artuntypischen, unbalanced and serrated leaves on. The mother plant is 6-7 years old, about 2 m high (in 100 L containers). I have not made refinements on small stems, which I at this Variety is very interesting."	113

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
61	*Ginkgo biloba* 'Fozhi'	-'Fuzi' (A)	DWARF	-	3-4 ?	CHN
62	*Ginkgo biloba* 'Gaulaufoshou'	-	DWARF?	-	3-4 ?	CHN
63	*Ginkgo biloba* 'Geisha'	-	WEEP	F	3-6	JAP
64	*Ginkgo biloba* 'Globosa'	-	DWARF	M	2	HOL / GER?
65	*Ginkgo biloba* 'Globus'	- 'Barabit's Strada' - 'Barabits Strada' -'Globus'	DWARF-UP	M	5	HUN
66	*Ginkgo biloba* 'Globus Mini'	- 'Barabit's Strada' - 'Barabits Strada' -'Globus'	DWARF	M	2 ?	HUN
67	*Ginkgo biloba* 'Gnome'	-	DWARF	M	2	USA
68	*Ginkgo biloba* 'Golden Colonnad'	-'JFS-UGA2' -'Golden Colonnade'	UP	M	13	USA
69	*Ginkgo biloba* 'Golden Globe'	-	DWARF	M	3-6 ?	JAP -USA
70	*Ginkgo biloba* 'Goethe'	- 'Göethe'	DWARF	M	5	HOL
71	*Ginkgo biloba* 'Green Pagoda'	-	UP	M	6 ?	USA
72	*Ginkgo biloba* 'Green Summer'	-	UP	M	?	?
73	*Ginkgo biloba* 'Grenhouse'	-	?	M ?	?	?
74	*Ginkgo biloba* 'Gresham'	-	UP-WEEP	M	11	USA
75	*Ginkgo biloba* 'Halka'	-	UP	M	13	USA

Source, author...	Comments, description...	Source: for table
Cheng & Fu 1978, CHN	There is no specific description.	23
Cheng & Fu 1978, CHN	There is no specific description.	23
?	An new introduction from Japan, Geisha produces heavy crops of large, richly-flavored nuts. Geisha is also very attractive with long pendulous branches and dark green foliage very large foliage which turns lemon-yellow in the fall.	2, 17
?	A spherical shape of the ginkgo tree, which is suitable with its compact round crown for small gardens. It hardly reaches a height of 2 m. Nice slight moderate and well-shaped foliage.	10, 23, 33b, 56
Dr. Elemer Barabit - Barabits's Lővér Pinetum, Sopron, HUN	Big leaves. A regular ball-like habit clone, about 2 m diameter. Very decorative as high graft.-A broad dwarf with dense habit. Original plant in the Barabits's Lővér Pinetum Sopron, HUN.	10,20, 23, 30, 31
Dr. Elemer Barabit - Barabits's Lővér Pinetum, Sopron, HUN	Spherical shape. Very slow, dense and compact growth. This variety is also without a cut shot around un reached a height of about 2 m. The leaves vary greatly in this variety. Variation cultivars 'Globus'.	10,20, 23, 30, 31
Iain R. Hiscock, Commercial Nursery Co., Inc. Tennessee, USA	This very cute dwarf ginkgo has leaves that grow on short internodes (the part of the stems between the nodes where leaves grow). It's nice to be able to include a ginkgo in an urban landscape–the typical species gets really big.	23, 57, 76, 77
USA ?	13 m tall and 7 m wide, narrow oval shape that has medium green summer foliage that turns bright-yellow in the fall. This tree was discovered by Dr. Michael Dirr and is ideal for use on narrow streets. The tree is male and seedless.	23, 56, 58, 91
?	A male selection in the USA. This tree is not typical for ginkgo branches very densely and later forms broad rounded crown. Particularly intense and prolonged autumn color.	10, 21, 23, 26
HOL	Found (in 2003) by Bart Schupper, Hazerswoude , The Netherlands. Introduced by Bömer, Zundert, The Netherlands. (33b)	14, 33a, 33b
Leo Gambardella in Northern Pazific Nurs. OR, USA	Upright conical growth with a tight branching habit this tree is excellent for bonsai. Also good for the formal garden its habit gives it the appearance of being sheared without the work! (Stanley & Sons Nurs. Inc. Boring, OR, USA.)	2, 23
?	There is no specific description.	17
?	There is no specific description.	17
?	Has a wide spreading branch habit that is perfectly horizontal. Found by Dan Hinkley growing in front of a high school in Gresham Oregon. (Stanley & Sons Nurs. Inc. Boring, OR, USA.)	2, 17, 20, 23
Halka Nurseries, NJ, USA	A strong central leader supports dense, uniform branches which creates a very symmetrical canopy. Distinctly pyramidal through middle age, becoming more oval with age. Bright yellow fall color. Very hardy. Fruitless male. Slow growing and long-lived.	23, 41, 43, 59, 60

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
76	*Ginkgo biloba* 'Hayanari'	-'Hiyanari'	?	F	?	USA ?
77	*Ginkgo biloba* 'Hiyanari'	-'Hayanari'	?	F	?	USA ?
78	*Ginkgo biloba* 'HB Leiden'	-'Heksenbezem Leiden' -'Hex-enbesen Leiden' -'WB'	DWARF	M	3	HOL
79	*Ginkgo biloba* 'HB Trompenburg'	-	DWARF	M	3	HOL
80	*Ginkgo biloba* 'Heksenbezem Leiden'	-'HB Leiden' -'Hex-enbesen Leiden' -'WB'	DWARF	M	3	HOL
81	*Ginkgo biloba* 'Helmers'	-	?	M	?	GER
82	*Ginkgo biloba* 'Hettich'	-'Wiener Walzer' -'Hetych'	WEEP	M	7 ?	AUT
83	*Ginkgo biloba* 'Hetych'	-'Wiener Walzer' -'Hetlich'	WEEP	M	7 ?	AUT
84	*Ginkgo biloba* 'Hexenbesen Leiden'	-'HB Leiden' -'Hek-senbezem Leiden' -'WB'	DWARF	M	3	HOL
85	*Ginkgo biloba* 'Horizontalis'	-	DWARF	M	5	FRA
86	*Ginkgo biloba* 'Horizontalis Nana'	-'Nana Horizontalis'	DWARF	M	2>	USA ?
87	*Ginkgo biloba* 'Hungaria'	-	UP	-	?	HUN
88	*Ginkgo biloba* 'Icho'	-'ChiChi Icho'	CHICHI-DWARF	M	2.5	JAP ?
89	*Ginkgo biloba* 'Jade Butterfly'	-'Jade Butterflies'	DWARF	M	5	NZL
90	*Ginkgo biloba* 'Jehosephat'	-'Jehosaphat' -'Jehoshaphat' -'Jeosaphat'	UP	F ?	12?	?

Source, author...	Comments, description...	Source: for table
?	A recent selection of women who otherwise has not yet become well understood.	10, 23, 41, 43, 114
?	A recent selection of women who otherwise has not yet become well understood.	10, 23, 41, 43, 114
?	One is in Leiden in an old ginkgo incurred witches broom, the densely branching small, about 3 m high, more rounded plants.	10, 23, 41, 43, 114
?	Very small differences in relation to HB Leiden. A witch's broom of adult in a Ginkgo in the Arboretum Trompsburg near Rotterdam was found. Little difference to 'Hekzembezen suffering'.	10, 23, 114
?	One is in Leiden in an old ginkgo incurred witches broom, the densely branching small, about 3 m high, more rounded plants.	10, 23, 41, 43, 114
?	There is no specific description.	17, 33b, 61
Orlóci László, HUN	Heinz Hetych, former director of the Schönbrunn Gärten AUT made a great number of seedling from the “Maria Theresia Tree” of Vienna Botanical Research Institute at Belvedere Gardens. Some of them were planted in the City of Vienna, and later was recognized by Orlóci László, that the tree is a short branched pendulous globose tree.	17, 23
Orlóci László, HUN	Ibid.	17, 23
?	One is in Leiden in an old ginkgo incurred witches broom, the densely branching small, about 3 m high, more rounded plants.	10, 23, 41, 43, 114
?	As the name of this plants suggests, the habit of this Ginkgo is remarkably flat growing and although it may be trained upright initially, in time this plant will resemble a huge umbrella. It is marvellous in pots where it quickly assumes a strikingly shaped plant. Also looks stunning planted near a low wall or on a rockery where the cascading branches can tumble over for dramatic effect.	10, 17, 23, 33, 62, 63, 136
?	Almost the same as 'horizontalis', but smaller plant.	17, 23, 44, 62
Original plant in the Barabits's Lővér Pinetum Sopron, HUN	Slower, narrow, variable from very narrow to wide.	23, 114
JAP ?	Probably distorted or abbreviated name for the cultivar 'Chi-Chi'.	20, 64
Duncan & Davies Nurs., NZL	Selected form with unusual Jade Green foliage which looks like a butterfly flapping in the wind. Growth rate approximately 1.6 metres high x 1 metres in 3 years in our Nursery/Garden. An upright, deciduous, small tree with lovely petite, jade-green butterfly-shaped leaves. Fall color is a spectacular vivid yellow.	2, 10, 20, 23, 41, 43, 114
?	This is a rare dwarf that has a normal size leaf and is very full and dense. Even when very small it says "Look at Me, aren’t I cute!"	2, 23, 33, 44, 65, 114

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
91	*Ginkgo biloba* 'Joe's Dwarf'	-	DWARF	M	3 ?	?
92	*Ginkgo biloba* 'Joe's Great Ray'	-'Joes Great Ray'	DWARF ?	M ?	?	?
93	*Ginkgo biloba* 'Katlan'	-'Umbrella'?	UP / WEEP	M	8	HUN
94	*Ginkgo biloba* 'Kazimierz Wielki'	-'K. Wielki Baranow' -'Chiński Pendula' -'Pendula Chiny'	WEEP	?	?	POL
95	*Ginkgo biloba* 'Kew'	-	UP	M / F ?	6 ?	?
96	*Ginkgo biloba* 'Kitsi'	-'Barabit's Nana' -'Kicsi' -'Barabits Dwarf'	DWARF	M	2	HUN
97	*Ginkgo biloba* 'King of Dingting'	-'King of Dongting' -'King of Dongtong'	UP	F	10-15	CHN
98	*Ginkgo biloba* 'KLMM Samurai'	-'Samuraiô'	UP	M	12-16	USA
99	*Ginkgo biloba* 'Korinek'	-'Chotek' (?) -'Kromeriz' (?)	UP	M ?	10	POL
100	*Ginkgo biloba* 'Kristina'	-	DWARF	?	?	USA ?
101	*Ginkgo biloba* 'Laciniata'	-'Cut Leaf' - 'Dissecta' - 'Cutleaf' -'Largeleaf' -'Longifolia' -'Macrophylla' -'Macrophylla Incisa' -'Macrophylla Laciniata' -'Triloba'	UP	M	18	FRA
102	*Ginkgo biloba* 'Lakeview'	-'Bergen of Zooh' -'Bergman Dwarf'? -'Bergen of Zoom'	UP	M ?	15	USA (HOL)
103	*Ginkgo biloba* 'Largeleaf'	-'Cut Leaf' - 'Dissecta' - 'Cutleaf' -'Laciniata' -'Longifolia' -'Macrophylla' -'Macrophylla Incisa' -'Macrophylla Laciniata' -'Triloba'	UP	M	18	FRA
104	*Ginkgo biloba* 'Late Fall Gold'	-'Fall Gold'	UP ?	?	7-15	?
105	*Ginkgo biloba* 'Leda'	-	DWARF / VARI	F ?	3 ?	POL

Source, author...	Comments, description...	Source: for table
?	There is no specific description.	20, 114
?	There is no specific description.	23, 39, 41, 43,
Barabits E. jr. Nurs., Alsótekeres, HUN	Slower growing, upright at first, later a wider, spreading tree. The similarity with the *G.b.* 'Santa Cruz' and *G.b.* 'Umbrella'.	23, 66, 103, 114
Sylw. Tomszak Nurs., Bielsko-Biala POL	Maybe the Polish name for *Ginkgo biloba* 'Pendula'?	23, 42, 114
?	Name found in the records of the Plant Sciences Data Center of the American Horticultural Society. Propagated from a fastigiate male tree in the Royal Botanic Garden (Kew Gardens), England, by the Saratoga Horticultural Foundation, Saratoga, California, and tested under this name. The cultivar has never been described or commercially available. ("Named for a tree at Kew Gardens planted in 1762" - Hatch)	20, 67, 114 (A)
Dr. Elemer Barabit - Barabits's Lővér Pinetum Sopron, HUN	*Ginkgo biloba* 'Barabits Nana' is a rare form selected by Dr. Elemer Barabits in Hungary and is peculiar by being a very compact shrub-like plant but with slightly larger leaves than the species creating a very ornamental effect. Perfect where space is limited and stunning in a container.	17, 20, 23, 29, 62, 114
Imp. by M.M. Bömer, Zundert, Netherlands from CHN	Cultivated for high seed production. - 'Dongtinghuang' - 'King of Dongtingshan Mountain'?	17, 23, 33, 62, 114 (A)
Beaver Creek Nurseries, IL, USA.	Beautiful healthy tree with outstanding form.	23, 68, 69
Kórnik Arboretum, POL	Smaller leaf than species typical. Habitus - similar to a typical type.	23, 33, 70, 71, 114
?	There is no specific description.	18, 46, 72
Avignon, FRA 1840	Deeply divided leaves. Very large leaves. ("(E.-A. Carriere, Rev. Horticole, 1854, p. 412) -leaves deeply laciniated, wavy at the margins. Raised by Reynier of Avignon (France) in 1840 and put into commerce by Seneclauze's nursery." - (A)	17, 20, 23, 62 114, 118 (A)
E. H. Scanlon, Cleveland, OH, USA	"(Shade Tree Selection Committee of the National Shade Tree Conference, Trees Mag. 15(3): 10-11, 1955) - male, pyramidal. Illus. E.H. Scanlon & Assoc, Olmsted Falls, Ohio, Advert., Trees Mag. 19(2): 2, 1959, broadly pyramidal." - (A) Selection from USA. 'Bergen of Zoom' is Dutch selection.	20, 23, 33, 114 (A)
1942 USA (?) - new name	Deeply divided leaves. Very large leaves.	20, 23, 62, 118 (A)
USA ?	There is no specific description.	18, 85
?	Poland variations *Ginkgo biloba* 'Variegata' ?	23, 73

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
106	*Ginkgo biloba* 'Leiden'	-	UP ?	M	?	HOL
107	*Ginkgo biloba* 'Liberty Splendor'	-	UP	F	14	USA
108	*Ginkgo biloba* 'Linarifolia'	-	?	?	?	AUT
109	*Ginkgo biloba* 'Linea'	-	UP	?	?	HUN
110	*Ginkgo biloba* 'Little Joe'	-	DWARF	M	?	?
111	*Ginkgo biloba* 'Little Pete'	-	DWARF	M ?	?	USA?
112	*Ginkgo biloba* 'Longifolia'	-'Cut Leaf' -'Dissecta' - 'Cutleaf' -'Laciniata' -'Largeleaf' -'Macro-phylla' -'Macrophylla Incisa' - 'Macrophylla Laciniata' -'Triloba'	UP	M	18	FRA
113	*Ginkgo biloba* 'Long March'	-	?	?	?	?
114	*Ginkgo biloba* 'Louie'	-'Luis' ? -'Louis' ?	DWARF	M ?	?	?
115	*Ginkgo biloba* 'Louis'	-'Luis' ? -'Louie' ?	DWARF	M ?	?	?
116	*Ginkgo biloba* 'Luangoufoshou'	-'Luanguo-fushon'	UP ?	M/F	?	CHN
117	*Ginkgo biloba* 'Macrophylla'	-'Cut Leaf' - 'Dissecta' - 'Cutleaf' -'Laciniata' -'Largeleaf' -'Longifolia' -'Macrophylla Incisa' - 'Macrophylla Laciniata' -'Triloba'	UP	M	18	FRA
118	*Ginkgo biloba* 'Macrophylla Laciniata'	-'Cut Leaf' - 'Dissecta' - 'Cutleaf' -'Laciniata' -'Largeleaf' -'Longifolia' -'Macrophylla Incisa' - 'Macrophylla' -'Triloba'	UP	M	18	GBR
119	*Ginkgo biloba* 'Magnifica'	-	?	?	?	?
120	*Ginkgo biloba* 'Magyar'	-'Magyer'	UP	M	18	USA

Source, author...	Comments, description...	Source: for table
HOL	Also: *G.b.* 'HB Leiden' (?) - 33b	21, 33, 62, 136
USA	There is no specific description.	20, 23, 114, 117
Helmut Honemann Gartenbau, Wien, AUT	There is no specific description.	23
Dr. Elemer Barabit - Barabits's Lővér Pinetum Sopron, HUN	"Habitus: vigorous, straight trunk, branching high and neatly." - Hatch	62, 74, 114
?	There is no specific description.	18
USA ?	There is no specific description.	23, 39
?	Deeply divided leaves. Very large leaves. (L. Henry, Rev. Horticole 11: 80-84, 1911)	20, 23, 62, 118 (A)
?	There is no specific description.	18
?	There is no specific description.	23, 62, 114
?	There is no specific description.	23, 62, 114
CHN	There is no specific description. (ovate-fruited finger citron)	23, 130
1854, Seneclause Nurs. Bourg-Argental, FRA - new name	Deeply divided leaves. Very large leaves. (E.-A. Carriere, Traite Gen. Conif., Paris, 1855, p. 504) - as a synonym for LACINIATA, and referenced to Cat. Senecl., 1854, p. 40.	20, 23, 62, 114, 118 (A)
Mast. 1896, GBR - new name	Deeply divided leaves. Very large leaves.	20, 23, 62, 118 (A)
?	There is no specific description.	62, 79
Stanley & Sons Nurs. Inc. Boring, OR USA	'Magyar' is a male form that was discovered growing in front of Magyar Bank in New Brunswick, New Jersey. It is a narrow upright form with ascending branching that matures over time to as much as 60' tall and 30' wide. Green leaves turn a uniform and very showy golden yellow in autumn. Insignificant greenish male flowers bloom in catkins in spring.	18, 20, 23, 43, 80

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
121	*Ginkgo biloba* 'Majestic Butterfly'	-'Majestic Butterflies'	DWARF/VARI	M	?	USA ?
122	*Ginkgo biloba* 'Male'	-	?	M	?	FRA
123	*Ginkgo biloba* 'Maribo'	-'Peve Maribo' (?)	VARI	M ?	?	POL
124	*Ginkgo biloba* 'Mariken'	-'Marikirum' (-'Marikin' ?)	DWARF/WEEP	M	2	HOL
125	*Ginkgo biloba* 'Mayfield'	-	UP	M	12	USA
126	*Ginkgo biloba* 'Maytown'	-	?	M ?	?	USA ?
127	*Ginkgo biloba* 'Mephisto'	-	?	M ?	?	USA ?
128	*Ginkgo biloba* 'Miauhuanguo'	-'Mianhuaguo'	UP	F	?	CHN
129	*Ginkgo biloba* 'Montezuma'	-	?	?	?	?
130	*Ginkgo biloba* 'Moraine'	-	?	?	?	USA
131	*Ginkgo biloba* 'Mother Load'	-	UP	F	?	USA
132	*Ginkgo biloba* 'Munchkin'	-	DWARF	F	1,5 ?	USA
133	*Ginkgo biloba* 'Nana'	-'Barabitsii' -'Conica'	DWARF	M	2	HUN
134	*Ginkgo biloba* 'Nana Horizontalis'	-'Horizontalis Nana'	DWARF	-	2>	USA ?
135	*Ginkgo biloba* 'Nelleke'	-	DWARF/WEEP	M ?	2> ?	HOL

Source, author...	Comments, description...	Source: for table
USA ?	There is no specific description.	62, 81
?	There is no specific description.	62, 136
Burdan Nursery, Lubska, POL	(Variegated form of G.b. 'Mariken'. Found by Piet Vergeldt, Lottum, HOL. - 33b) ?	23, 33b, 79
Piet Vergeldt in Lottum, HOL	Compact form of Ginkgo with a pendulous habit. It should be staked in youth for a taller plant.	2, 20, 21, 23, 33, 39, 62
E. H. Scanlon, 1961, 1948, E. H. Scanlon, Cleveland, OH, USA	(E.H. Scanlon, Plant Prop. Soc. Proc. 1: 20-32, 1951, illus. with leaves, p. 28) - male, pyramidal, very narrow, strictly fastigiate and "Lombardy-like" in outline. Also in E.H. Scanlon & Assoc, Olmsted Falls, Ohio, Advert., Trees Mag. 19 (2): 2, 1959, illus. without leaves.	20, 21, 23, 62, (A)
?	There is no specific description.	10, 18
?	There is no specific description.	10, 18
Cheng & Fu 1978, CHN	Cotton-fruit like; often with twin fruit.	23, (A)
?	There is no specific description.	21
USA	Name found in the records of the Plant Sciences Data Center of the American Horticultural Society. Plant obtained from The Siebenthaler Co., Dayton, Ohio and grown at the Saratoga Horticultural Foundation, Saratoga, California. Cultivar never commercially available.	23, 44, (A)
Siebenthaler Co., Dayton, UH, USA	Low scent seeds. Saratoga Horticultural Foundation, Saratoga, CA, USA.	20, 23, 62
USA ?	One of the best dwarf selections we have worked with thus far. The habit is semi upright with numerous small slender branches radiating outward. Can be trained into a small tree or grown as a low branched multi-stem shrub. Perfect selection for the rock garden setting or for bonsai culture. Certainly the daintiest of all the dwarf selections in leaf type. Many leaves are no larger than a quarter with most being more nickel size or even sma-ller. They are closely attached, emerging from the stem in a circular fashion making a very dense arrangement. Leaf shape is similar to the species although not as finely fut to the center, medium green summer color gives way to solid yellow in the fall.	23, 62, 81, 82
1983, Barabits E.	A broad dwarf with dense habit. Original plant in the Barabits's Lővér Pinetum Sopron, HUN. Maybe the same: ‘Barabits Nana’ or ‘Barabits Dwarf’ or ’Kitsi’?	20, 23, 62
?	Almost the same as 'horizontalis', but smaller plant.	17, 23, 62
HOL (?)	Weeping form, found and named by Van Aart Boomkwekerijen, Oudenbosch, Netherlands (33b)	18, 33b, 34, 56,

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
136	*Ginkgo biloba* 'Noble's Horizontalis'	-	UP	F	12	USA
137	*Ginkgo biloba* 'Obelisk'	-	UP	M	15	ITA
138	*Ginkgo biloba* 'Ohazuki'	-'Epiphylla' -'Oha-suki' -'Ohazaki' -'Ohatsuki'	EPI-DWARF	F	4.5 (19) ?	JAP
139	*Ginkgo biloba* 'Ohatsuki'	-'Epiphylla' -'Oha-suki' -'Ohazaki' -'Ohazuki'	EPI-DWARF	F	4.5 (19) ?	JAP
140	*Ginkgo biloba* 'Oszlopos Tekeres'	-	UP ?	M ?	?	HUN
141	*Ginkgo biloba* 'Overlook'	-	?	?	?	USA
142	*Ginkgo biloba* 'Palo Alto'	-	UP	M	15	USA
143	*Ginkgo biloba* 'Pendula'	-'Weeping'	WEEP	F	<8	BEL
144	*Ginkgo biloba* 'Pendula Chiny'	-	WEEP	F ?	<8 ?	POL
145	*Ginkgo biloba* 'Pendula Gruda'	-'Pendula Gruga'	WEEP	F ?	<8 ?	GER
146	*Ginkgo biloba* 'Pendula Rowe'	-	WEEP	F ?	<8 ?	USA
147	*Ginkgo biloba* 'Pendula Variegata'	-	WEEP/VARI	F ?	<8 ?	USA ?
148	*Ginkgo biloba* 'Pete's Dwarf'	-	DWARF	M ?	<3 ?	USA
149	*Ginkgo biloba* 'Peve Lobo'	-'Pevé Lobo'	UP/VARI	F ?	?	HOL
150	*Ginkgo biloba* 'Peve Maribo'	-'Pevé Maribo'	UP/VARI	F ?	?	HOL

Source, author...	Comments, description...	Source: for table
Richard Wolford, USA	Yup this guy finally has an official name. Originally rediscovered by Richard Wolford on an old nursery, Noble's has really added a different perspective to Ginkgo's. Its inability to develop a central leader allows the plant to display a very squat and broad habit. This form can easily fit into smaller landscapes where the straight species is too large.	83, 84
?	As 'Fastigiata'.	18, 33, 87
?	(J. Ohwi, Flora of Japan, Smithsonian Inst., Wash., D.C., 1965, p. 109, English translation edited by F.G. Meyer and E.H. Walker) - no cultivars were given in the original 1953 Japanese version of Ohwi's work, but the extended English translation listed 'Epiphylla', which must be considered invalid because of the use of Latin form after 1959. Japanese equivalent given as OHATSUKI.	20, 23, 114, (A)
?	(J. Ohwi, Flora of Japan, Smithsonian Inst., Wash., D.C., 1965, p. 109, English translation edited by F.G. Meyer and E.H. Walker) - no cultivars were given in the original 1953 Japanese version of Ohwi's work, but the extended English translation listed 'Epiphylla', which must be considered invalid because of the use of Latin form after 1959. Japanese equivalent given as OHATSUKI.	20, 23, 114, (A)
?	There is no specific description.	18, 86
E. H. Scanlon, Cleveland, OH, USA	Name found in the records of the Plant Sciences Data Center of the American Horticultural Society. Propagated from a tree selected by E.H. Scanlon, Olmsted Falls, Ohio, on Mt. Overlook Ave., Cleveland, Ohio by the Saratoga Horticultural Foundation,	23, 114, (A)
E. H. Scanlon, Cleveland, OH, USA	(Shade Tree Selection Committee of the National Shade Tree Conference, Trees Mag. 15 (3): 10-11, 1955) - male. Illus. E.H. Scanlon & Assoc, Olmsted Falls, Ohio, Advert., Trees Mag. 19(2): 2, 1959, as nicely formed specimen representing the species. P. L. M. van der Bom 1982 (23)	20, 23, (A)
Ch. van Geert, 1855, BEL	(A. Van Geert Nurs., Belgium, Cat. 1862, p. 62) - branches pendulous. (Sant.) Hort. 1855 Bonn, Nancy, Prague Botanic Garden EUR, *G. biloba* f. *pendula* Hort. (23)	20, 23, 33, 114, 136, (A)
Sylw. Tomszak Nurs., Bielsko-Biala, POL	The new variant *G.b.* 'Pendula'. Made in Poland.	23, 42
Essen, Grugapark, GER	This is var. *G.b.* 'Pendula'.	18, 89
Arrowhead Nurs., MA, USA	This is var. *G.b.* 'Pendula'.	23
?	Weeping form with leaves as 'Variegata'.	18
Girard Nurseries, OH, USA	Found as a witch's broom on a Ginkgo seedling. Very dense thick branching habit. Dark green foliage. Heavy trunks. Good for bonsai. Plant in full sun.	37
Vergeldt Nursery, HOL, 2003	As *G.b.* 'Peve Maribo'. This is var. *G.b.* 'Variegata'.	18, 23, 88, 116
Vergeldt Nursery, HOL, 2003	An upright deciduous tree with green and white variegated leaves. Amount of variegation can vary, so care must be taken to propagate from most colorful wood. New from Vergeldt Nursery in Holland. Prefers sun/partial shade in well-drained soil. Too new to evaluate size. Small, flattened, globular plant.	18, 23, 44, 88, 116

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
151	*Ginkgo biloba* 'Pillar'	-	UP	M ?	5 ?	HUN
152	*Ginkgo biloba* 'Pine Glen Dwarf'	-	DWARF	M ?	2 ?	USA
153	*Ginkgo biloba* 'PNI 2720'	-'Princeton Sentry'	UP	M	17	USA
154	*Ginkgo biloba* 'Praga'	-'Prague', -'Praha' -'Pragense', -'Pragensis'	DWARF / WEEP	M	< 3	CZR
155	*Ginkgo biloba* 'Pragense'	-'Prague', -'Praga', -'Pragensis'	DWARF / WEEP	M	< 3	CZR
156	*Ginkgo biloba* 'Pragensis'	-'Prague', -'Praga', -'Pragense'	DWARF / WEEP	M	< 3	CZR
157	*Ginkgo biloba* 'President'	-'The President' -'Presidential Gold'	UP	M	< 15	USA
158	*Ginkgo biloba* 'Princeton Gold'	-	UP	M	< 15	USA
159	*Ginkgo biloba* 'Princeton Sentry'	-'PNI 2720'	UP	M	17	USA
160	*Ginkgo biloba* 'Prostrata'	-	WEEP	?	?	GBR
161	*Ginkgo biloba* 'Pyramidal'	-	UP	M	?	USA ?
162	*Ginkgo biloba* 'Pyramidalis'	-	UP	M	12	USA
163	*Ginkgo biloba* 'Pyramis'	-	DWARF	?	2 ?	HUN
164	*Ginkgo biloba* 'Rainbow'	-'Summer Rainbow'	VARI / DWARF	F	< 3	USA
165	*Ginkgo biloba* 'Robbies Twist'	-	UP	M ?	12	USA ?

Source, author...	Comments, description...	Source: for table
Barabits E., HUN, 1983	A witch's broom of narrow habit and slow growing. Original plant in the Barabits's Lővér Pinetum Sopron, Hungary.	23
?	There is no specific description.	18, 23
Princeton Nurs. NJ, USA, 1967	(Princeton Nurs., Princeton, New Jersey, Wholesale Price List, Fall 1972-Spring 1 973, p. 32) - upright growing, male. Illus. in Wholesale Price List, Fall 1 973-Spring 1974, p. 33 as new columnar tree with a unique narrow head similar to Lombardy poplar. Plant Patent No. 2726, March 7, 1967.	18, 20, 23, 90, (A)
CZR	Sin. 1930 *G. biloba* var. *Pragensis* (Domin). 1996 VÚOZ Průhonice named the *G. biloba* 'Praga'. This is Czech version of *G. biloba* 'Pendula'. "(J.P. Krouman, Gard. Chron. 166(14): 14-15, 1969) - low, spreading, parasol-shaped crowns, two trees in Prague, Czechoslovakia. This is not the same cultivar as 'Pendula' of British gardens, M. Hadfield, Gard. Chron. 166(18): 6, 1969. Name invalid because in Latin form after 1959." - Santamour 1983.	18, 20 23, 33, 92, 130
CZR	As previously.	18, 20 23, 92, (A)
CZR	As previously.	18, 20 23, 92, (A)
Michael Dirr, Athens, GA, USA	15 m tall and 12 m wide, Zone 4, broad oval to pyramidal shape with medium-green summer foliage that turns bright yellow in the fall. This tree was selected by Dr. Michael Dirr and sets a new standard for ginkgos. It is male and seedless.	20, 23, 58, 91
Princeton Nurs. NJ, USA, 1966	Name found in records of the Plant Sciences Data Center of the AHS. Trees at the Morton Arboretum, Lisle, Illinois and Longwood Gardens, Kennett Square, Pennsylvania. A selection of Princeton Nurs., Princeton, NJ, as a male with a strong central leader and perfect regularity of branching habit. Plant Patent No. 2675, October 4, 1966. This cultivar was never advertised by Princeton Nurs. and was discontinued because of propagation difficulties.	20, 23, 90, 91, 114, (A)
Princeton Nurs. NJ, USA, 1967	(Princeton Nurs., Princeton, New Jersey, Wholesale Price List, Fall 1972 - Spring 1 973, p. 32) - upright growing, male. Illus. in Wholesale Price List, Fall 1 973-Spring 1974, p. 33 as new columnar tree with a unique narrow head similar to Lombardy poplar. Plant Patent No. 2726, March 7, 1967. (Santamour)	18, 20, 23, 90, 91, 114, (A)
1992, GBR	There is no specific description.	23, 93, 114
?	(E.H. Scanlon, Plant Prop. Soc. Proc. 1: 20-32, 1951, illus. p. 27) - male. Not intended as a cultivar name. (Santamour)	23, (A)
Vermeulen Nurs., Neshanic St. NJ, 1963, USA	(John Vermeulen & Son, Inc., Neshanic Station, New Jersey, Cat. Spring 1963, p. 7) - male, from cuttings. Tree of this cultivar growing at Holden Arboretum, Mentor, Ohio. Name invalid because in Latin form after 1959. (Santamour)	20, 23, (A)
Barabits E., HUN	Original plant in the Barabits's Lővér Pinetum Sopron, HUN.	18, 23
Stanley & Sons Nurs. Inc. Boring, OR, USA	One version of *G.b.* 'Variegata'.	20, 23, 114, (A)
?	There is no specific description.	18, 94

No.	Cultivar name	Other names	Selection group	Sex M / F	Height (m)	Country of origin
166	*Ginkgo biloba* 'Robin'	-	UP ?	M	< 15	USA
167	*Ginkgo biloba* 'Rocky'	-	?	?	?	?
168	*Ginkgo biloba* 'Roosevelt'	-	UP ?	M	< 15	USA
169	*Ginkgo biloba* 'Roos Moore'	-'Roos More'	WEEP	M ?	5 ?	USA
170	*Ginkgo biloba* 'Roswitha'	-	VARI / DWARF	M ?	< 3	GER
171	*Ginkgo biloba* 'Saint Cloud'	-'St. Cloud'	UP	M	< 15	FRA
172	*Ginkgo biloba* 'Salem Lady'	-	UP ?	F	?	USA
173	*Ginkgo biloba* 'San Jose'	-	?	M	?	USA
174	*Ginkgo biloba* 'San Jose Gold'	-	?	M	?	USA
175	*Ginkgo biloba* 'Santa Cruz'	-'Umbrella' -'Umbraculifera'	WEEP / DWARF	F	< 3	USA
176	*Ginkgo biloba* 'Saratoga'	-	UP	M	< 15	USA
177	*Ginkgo biloba* 'Schloss Dyck'	-	?	?	?	GER
178	*Ginkgo biloba* 'Schönbrunn'	-	?	?	?	?
179	*Ginkgo biloba* 'Sentry'	-'Fastigiata'	UP	M	?	USA
180	*Ginkgo biloba* 'Shangri-La'	-'Shangri-la'	UP	M	13	USA

Source, author...	Comments, description...	Source: for table
Cole Nurs., Circleville, OH, USA	Name found in records of Plant Sciences Data Center of the American Horticultural Society. Tree at Holden Arboretum, Mentor, Ohio obtained from Cole Nursery Co. in 1968. Male tree selected in southern Ohio as a most well-formed ginkgo, with crown characteristics similar to Tllla cordata. Propagated and evaluated under this cultivar name by Cole Nursery Co., Circleville, Ohio. Cultivar never commercially available. (Santamour)	20, 23, (A)
USA ?	There is no specific description.	52
Found on Roosevelt Boulevard, Philadelphia, PA, USA	Name found in the records of the Plant Sciences Data Center of the American Horticultural Society. Propagated from a tree on Roosevelt Boulevard, Philadelphia, Pennsylvania, by the Saratoga Horticultural Foundation, Saratoga, California, and tested under this name. The cultivar has never been described or commercially available. (Santamour)	20, 23, (A)
USA	This cultivar was found by Ross Moore, Moore's Natives, Lenoir, North Carolina who found it in a clients' landscape. It is strongly weeping, unlike the other 'Pendulous' forms in the trade that are merely horizontal at best. They also exhibit the excellent golden-yellow fall color typical of the species. The ultimate height is anyone's guess. 10-15'?? The sex? Again, anyone's guess. (2)	2, 18, 20, 94
Asbach-Bäumenheim, GER, 1992	*G.b.* 'Hortizontalis' with colorful leaves as *G.b.* 'Variegata'. See Houtman 2004. p. 147.	18, 23, 33a, 116
Albert Kahn's Garden, St. Cloud sur Seine, 1959, FRA	(F.G. Meyer, Baileya 9: 127-133, 1961) - branches at right angles to the trunk or slightly ascending, rarely with secondary branches, densely leafy. Original tree at Jardin Kahn, St. Cloud-sur-Seine, Boisde Boulogne, Paris, France. Introduced as P.I. 242018. (Santamour) - Dense crown.	20, 23, 33a, 114 (A)
Salem, OR, USA	When this female is pollinated, she produces a heavy yield of almond sized, orange nuts with a thin shell that are considered a delicacy when roasted!	2, 23, 49
J. Clarke Nurs., CA, USA, 1969	As G.b. 'San Jose Gold'. Ibid. ?	23, 33a, (A)
Holden Arboretum, OH, USA, 1969	Name found in the records of the Plant Sciences Data Center of the American Horticultural Society. Trees at Holden Arboretum, Mentor, Ohio, received from J. Clarke Nurs., San Jose, California, in 1969. (Santamour)	23, 33a, (A)
E. H. Scanlon, OH, USA, 1959	(E.H. Scanlon & Assoc, Olmsted Falls, Ohio, advert., Trees Mag. 19(2): 2, 1959, illus.) - umbrella form, low and spreading, illustration same as for UMBRELLA. (Santamour)	20, 23, 33a, (A)
Saratoga, CA, USA, 1975	(Calif. Assoc. Nurserymen, Peninsula Chapter Bull., March 1976, p. 2), - originated at the Saratoga Horticultural Foundation, Saratoga, California, first introduced in 1975, notable for its dense, compact habit with ascending branches, distinct central leader, and moderately slow growth rate. Saratoga Horticultural Foundation, Price and Availability List, February 15, 1977, p. 2 listed tree as "male," with some further description. (Santamour)	2, 23, 33a, 114 (A)
1985, GER ?	There is no specific description.	18, 95, 96
?	In fact it is *Ginkgo biloba* tree in Schönbrunn, Austria (?).	18, 97
USA	• Grafted Male. A narrow pyramidal upright male. Very symmetrical short branching. Good fall color. (49) • (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 274) = FASTIGIATA. Name may also be mistakenly used for PRINCETON SENTRY or refer to a fastigiate tree propagated and tested under the name "Sentry" by the Saratoga Horticultural Foundation, Saratoga, California. (Santamour)	20, 23, 49, (A)
Stanley & Sons Nurs. Inc. Boring, OR, USA	Grafted Male. Faster growing than most ginkgo. Grows into a medium sized tree. (49)	20, 23, 49

No.	Cultivar name	Other names	Selection group	Sex M / F	Height (m)	Country of origin
181	*Ginkgo biloba* 'Simon'	-	DWARF	M ?	6	HOL
182	*Ginkgo biloba* 'Sinclair'	-	UP ?	M	< 14	USA
183	*Ginkgo biloba* 'Slim Jim'	-	UP	M	< 13	USA
184	*Ginkgo biloba* 'Snow Flake'	-'Snowflake'	VARI	M	?	NZL
185	*Ginkgo biloba* 'Sotaju'	-	DWARF	M ?	< 6	?
186	*Ginkgo biloba* 'Sport Tit'	-'Spot Tit'	CHICHI / DWARF	M ?	2 ?	?
187	*Ginkgo biloba* 'Spring Grove'	-	DWARF	F	2	USA
188	*Ginkgo biloba* 'Spring Grove Sport'	-'Spring Grove #86' -'Spring Grove WB'	DWARF	F	2 ?	USA
189	*Ginkgo biloba* 'Stanley's Dwarf'	-	DWARF	M ?	3 ?	USA
190	*Ginkgo biloba* 'Sterile'	-	UP ?	M	?	USA
191	*Ginkgo biloba* 'Summer Rainbow'	-'Rainbow'	VARI / DWARF	F	< 3	USA
192	*Ginkgo biloba* 'Sunstream'	-	VARI	F	?	USA
193	*Ginkgo biloba* 'Thelma'	-'Telma'	DWARF	M ?	3 ?	USA
194	*Ginkgo biloba* 'Tit'	-'Chi-chi' -'Icho' -'Tschi Tschi' -'Chi Chi Icho'	CHICHI / DWARF	M	2 ?	JAP
195	*Ginkgo biloba* 'Todds'	-'Todd's Dwarf' ?	DWARF ?	M ?	2 ?	USA

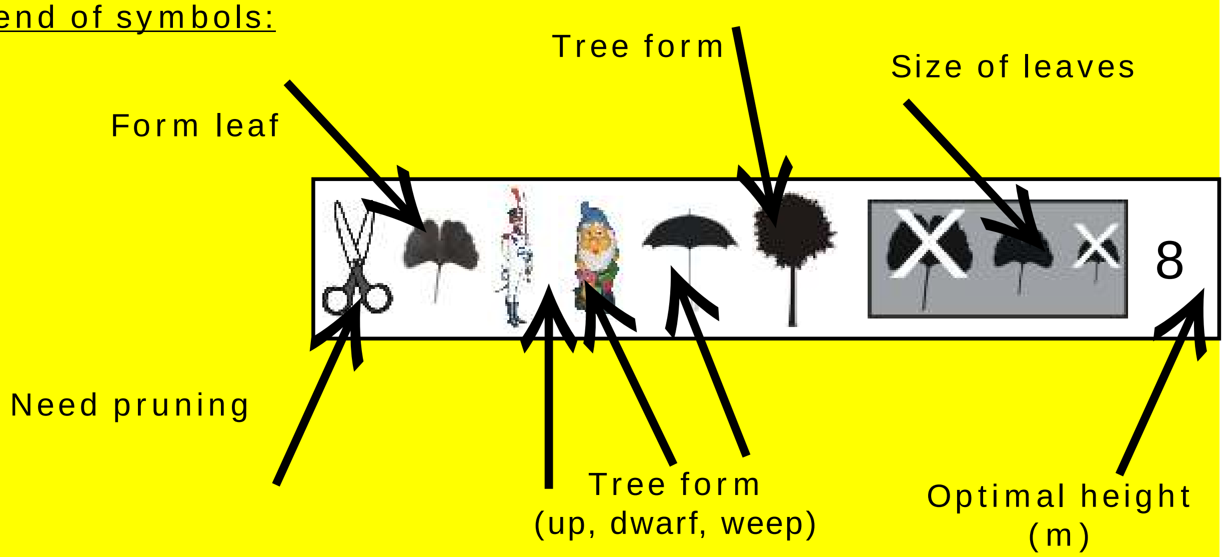
Source, author...	Comments, description...	Source: for table
Bömer, Zundert, HOL	The perfect ginkgo for smaller gardens: slow-growing, multi-branched, attractive foliage. (Found by M.M. Bömer, Zundert, HOL. - 33b)	18, 23, 33, 98, 99
Princeton Nurs. NJ USA, 1967 (?)	(The Siebenthaler Co., Dayton, Ohio, Trade List Fall 1977, p. 19) - without description. A male, wellbranched selection of Princeton Nurs., Princeton, New Jersey, but never advertised by them because of propagation difficulties. Name validated here for the first time. (Santamour)	20, 23, (A)
Cole Nurs., Circlevill, OH, USA	Name found in records of Plant Sciences Data Center of the American Horticultural Society. Tree at Holden Arboretum, Mentor, Ohio, obtained from Cole Nursery Co. in 1968. Male, fastigiate tree selected by M.W. Staples in Kent, Ohio and propagated and evaluated under this cultivar name by Cole Nursery Co., Circleville, Ohio. Cultivar never commercially available. (Santamour)	20, 23, (A)
Cedar Lodge Nurs. New Plymouth, NZL, 2009	A variegated form. Ideal for a shady or semi-shady spot. Production underway soon. No further information available yet.	20, 23
?	It has very large leaves.	18, 96
?	Form cultivar 'Tit'.	18, 20, 96
Spring Grove Arboretum, in Cincinnati, OH, USA	True dwarf species *Ginkgo biloba*. Very similar to the cultivar 'WB'. A compact, rounded form, discovered as a 'witches' broom' in Ohio. One of the nicest of the small Ginkgos!	2, 20, 23, 33, 39, 96
USA	Form cultivar 'Spring Grove'. Very similar to the cultivar 'WB'. Or 'Spring Grove Witches Broom'.	20, 23, 33, 39, 96
USA	One of the best dwarf forms with short internodes and a dwarf columnar habit we think it is outstanding. (41)	23, 39, 41
OH, USA	Name used by the SiebenthalerCo., Dayton, Ohio to denote males obtained from various sources.	114, (A)
Stanley & Sons Nurs. Inc. Boring, OR, USA	One version of *G.b.* 'Variegata'.	20, 23, 114, (A)
USA, 2003	A variegated form less reversion prone than most it is slow growing and you still need to clip green shoots.	2, 20, 23, 41
USA	New foliage is small and deeply fimbriated, then enlarges from the leaf base and forms a semi-tubular, or cup shaped mature leaf with divided edges. Different and very nice. There is still confusion about how large this plant will grow. (2)	2, 18, 23, 33, 96
Grootendorst 1978, JAP ?	Back again after a brief absence and more entertaining than Nip/Tuck reruns we proudly present the perfect plant for all those customers with the annoying touchy feely plant fondling fetishes. Now you can get that out of your system before you visit the nursery and maul our display troughs. 'Tschi -Tschi', also listed as Chi-Chi, by nurseries that apparently think Ginkgo originated in Mexico is indeed a botanical classic. How could you pass up a Ginkgo with breasts? Hey they even sag with age albeit more slowly than human ones. Even a thousand years from now the future, owners of your property can gaze in wonder at your kinky taste. (43)	20, 23, 33a, 43, 136
Stanley & Sons Nurs. Inc. Boring, OR, USA ?	(Syn. Todd, Todd's WB) This compact form will reach 4' in 10 years. (2)	2, 23, 43

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
196	*Ginkgo biloba* 'Todd's Dwarf'	-'Todd's Dwarf'	DWARF	M ?	2 ?	USA
197	*Ginkgo biloba* 'Tongzigou'	-	?	F	?	CHN
198	*Ginkgo biloba* 'Törpe Enlopes'	-	?	?	?	?
199	*Ginkgo biloba* 'Tremonia'	-	UP	F	8	GER
200	*Ginkgo biloba* 'Triloba'	-'Cut Leaf' -'Cutleaf' -'Dissecta' -'Laciniata' -'Largeleaf' -'Longifolia' -'Macrophylla' -'Macrophylla Incisa' -'Macrophylla Laciniata'	UP	M	18	FRA
201	*Ginkgo biloba* 'Troll'	-	DWARF	M ?	1.5 ?	GER
202	*Ginkgo biloba* 'Tschi-Tschi'	-'Chi-chi' -'Icho' -'Tit' -'Chi Chi Icho'	CHICHI / DWARF	M	2 ?	JAP ?
203	*Ginkgo biloba* 'Tubifolia'	-'Tubiformis' -'Tubeleaf' -'Tubiforme'	TUBE / UP / DWARF	M	< 3	FRA
204	*Ginkgo biloba* 'Tubiformis'	-'Tubifolia' -'Tubeleaf' -'Tubiforme'	TUBE / UP / DWARF	M ?	< 3	FRA
205	*Ginkgo biloba* 'Umbraculifera'	-'Umbrella' -'Santa Cruz'	WEEP / DWARF	F	< 3	USA
206	*Ginkgo biloba* 'Umbrella'	-'Santa Cruz' -'Umbraculifera'	WEEP / DWARF	F	< 3	USA
207	*Ginkgo biloba* 'Variegata'	-'Variegated' -'Varigata'	VARI / DWARF	M / F	< 3	FRA
208	*Ginkgo biloba* 'Variegata Searles'	-	VARI / DWARF	F ?	< 3	USA
209	*Ginkgo biloba* 'Variegata Tomszak'	-	VARI / DWARF	F ?	< 3	POL
210	*Ginkgo biloba* 'Wavecrest No. 238' & 'No.240'	-	?	?	?	USA

Source, author...	Comments, description...	Source: for table
Stanley & Sons Nurs. Inc. Boring, OR, USA ?	(Syn. Todd, Todd's WB) This compact form will reach 4' in 10 years. (2)	2, 23, 43
CHN	There is no specific description.	23, (A)
?	There is no specific description.	18
Dortmund Botanic Garden, GER, 1930	*Gingko biloba* 'Tremonia' is a German selection which is wonderfully columnar but differs from the other fastigiate forms due to its heavily textured blue-green foliage. This tree makes a very narrow specimen, ideal for planting in groups or for use in the small garden where it will take up very little room. (63)	18, 20, 23, 33a, 33b, 63, 96
1942 USA (?) - new name	(H.J. Elwes and A. Henry, Trees of Great Britain and Ireland 1: 58, 1906) - "scarce worthy of recognition, as the leaves in all ginkgo trees are exceedingly variable in lobing." May = LACINIATA. (Santamour)	20, 118, (A)
Bömer, Zundert, HOL	*Ginkgo biloba* 'Troll' is a lovely form of the *Ginkgo biloba* with compact, bushy growth. Ideal as a container plant on the patio where after several years it will form a stunning leafy specimen tree that is not too large. Ideal if you would like a Ginkgo but do not have very much space - and much better behaved than a real life Troll as well! (Found by J.Wieting, GER, introduced by M.M. Bömer, Zundert, HOL. - 33b)	2, 20, 23, 33b
JAP ?	Back again after a brief absence and more entertaining than Nip/Tuck reruns we proudly present the perfect plant for all those customers with the annoying touchy feely plant fondling fetishes. Now you can get that out of your system before you visit the nursery and maul our display troughs. 'Tschi -Tschi', also listed as Chi-Chi, by nurseries that apparently think Ginkgo originated in Mexico is indeed a botanical classic. How could you pass up a Ginkgo with breasts? Hey they even sag with age albeit more slowly than human ones. Even a thousand years from now the future, owners of your property can gaze in wonder at your kinky taste. (43)	20, 23, 33a, 43
FRA	A small, multistemmed cultivar with interesting funnel shaped leaves. Leaves tend to be rolled into tubes; the effect is most pronounced on vigorous juvenile shoots, although many cultivars have the occasional tubed or dissected leaf.	2, 20, 23, 114, 136
JAP / HOL ? - new name	A small, multistemmed cultivar with interesting funnel shaped leaves. Leaves tend to be rolled into tubes; the effect is most pronounced on vigorous juvenile shoots, although many cultivars have the occasional tubed or dissected leaf.	2, 20, 23, 114
Saratoga, CA, USA	(Shade Tree Selection Committee of the National Shade Tree Conference, Trees Mag. 15(3): 10-11, 1955) - umbrella shaped. Name also found in records of Plant Sciences Data Center of the American Horticultural Society, plants growing at the Saratoga Horticultural Foundation, Saratoga, California, original tree in Santa Cruz, California, = SANTA CRUZ. (Santamour)	20, 23, 33a, (A)
Saratoga, CA, USA	(E.H. Scanlon, Plant Prop. Soc. Proc. 1: 20-32, 1 951, illus. p. 29) - male umbrella shaped ginko (sic), Trees Mag. 12(3): 12, 1952, illus. and mentioned as "sent to us by Maunsell Van Rensselaer" (Saratoga Horticultural Foundation, Saratoga, California) = SANTA CRUZ. (Santamour)	20, 23, 33a, (A)
M. Andre Leroy Nurs., Angers, FRA, 1854	(E.-A. Carriere, Rev. Horticole, 1854, p. 41 2) - leaves variegated yellow. 'Variegata' is an incredibly rare sport of Ginkgo biloba. The leaves are covered in random white/cream striping with occasional leaves being completely white. It is a slow growing tree and grows best in part sun-part shade to avoid scorching. Occasional leaves will revert to green and these should be removed as soon as they appear. Very unusual and highly sought after.	2, 20, 23, 63, 39, 136 (A)
USA ?	Form of cultivar 'Variegata'.	100
Sylw. Tomszak Nurs., Bielsko-Biala, POL	Poland variant of cultivar 'Variegata'.	23
Wavecrest Nurs., USA	There is no specific description.	100

No.	Cultivar name	Other names	Selection group	Sex M/F	Height (m)	Country of origin
211	*Ginkgo biloba* 'WB'	-'Witches Broom' -'Vital Spring'	DWARF	M	2.5	USA
212	*Ginkgo biloba* 'Weeping'	-'Pendula'	WEEP	F ?	<8	FRA
213	*Ginkgo biloba* 'Weeping Wonder'	-	WEEP	F	?	USA
214	*Ginkgo biloba* 'White Variegata'	-	VARI / DWARF	F	<3 ?	USA ?
215	*Ginkgo biloba* 'White Winter'	-	?	?	?	USA ?
216	*Ginkgo biloba* 'Wiener Walzer'	-'Hetlich' -'Hetych' -'Hettich'	WEEP	M	7 ?	AUT
217	*Ginkgo biloba* 'Windover Gold'	-'Windover'	?	M	14	USA
218	*Ginkgo biloba* 'Witches Broom'	-'WB' -'Vital Spring'	DWARF	M	2.5	USA
219	*Ginkgo biloba* 'Woodstock'	-'Emperor'	UP	M	15	USA
220	*Ginkgo biloba* 'Yellowleaf'	-'Pterophyllus Salisburiensis aurea' -'Aurea'	UP-VARI	-	?	GBR

Legend of symbols:



Source, author...	Comments, description...	Source: for table
Stanley & Sons Nurs. Inc. Boring, OR, USA	Originated as a witch's broom. It is just a little ball of beautiful green foliage.	2, 20, 23, 101
USA ?	(H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 274) = PENDULA. (Santamour)	20, (A)
USA	Prostrate female witches' broom found by Rich Eyre & Mike Dirkson in Springfield IL. Aka 'Mutant Weeper'. Tree Form: Weeping Pendulus. (102) Form of cultivar 'Pendula'.	23, 39, 43, 102
USA ?	Form of cultivar 'Variegata'.	23, 101
?	There is no specific description.	101
Orlóci László, HUN	Heinz Hetych, former director of the Schönbrunn Gärten AUT made a great number of seedling from the "Maria Theresia Tree" of Vienna Botanical Research Institute at Belvedere Gardens. Some of them were planted in the City of Vienna, and later was recognized by Orlóci László, that the tree is a narrow long branched compactous tree.	23
USA ?	There is no specific description.	20, 23, 43
Stanley & Sons Nurs. Inc. Boring, OR, USA	Originated as a witch's broom. It is just a little ball of beautiful green foliage.	2, 20, 23, 101
Berthold Nursery, Woodstock, IL, USA. (1900's)	Strong central leader, well-branched, uniformfly oval. Selected from local private residence.	20, 114
Nelson, 1866, GBR	Leaves golden-yellow.	20, 23, 126, (A)

Ginkgo biloba 'Ohatsuki', Lučenec, Slovakia. The fruit is on the leaf. Research of the fruit *G.b.* 'Ohatsuki'. Dr. P. Hrubik, Nitra, Slovakia (2009).

Ginkgo biloba ‘Autumn Gold’: before pruning - after pruning. Photos by Edwin Smits, Netherlands. (7, 56)

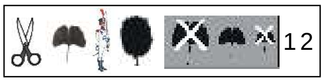


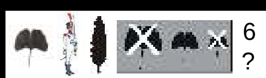
Photo by Bömer, Netherlands. (33)

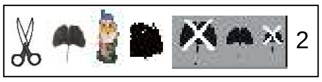
Ginkgo biloba ‘Autumn Gold’. Photo by Ender Stewart, USA. (41, 43)
Down: photo by Rich's Foxwillow Pines Nursery, Woodstock, IL, USA. (102)

Collection young plants ginkgo cultivars before and after pruning
- in “Boomkwekerij Edwin Smits”, Volkel, Netherlands.
Photos by Edwin Smits, Netherlands.
(7, 56)

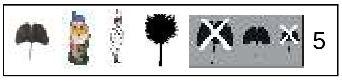
For example. All cultivars are sold mainly in containers. This plant *Ginkgo biloba* 'Fastigiata Blagon' is 9 years old.

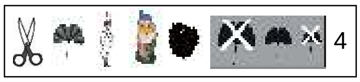
Height: approx 3.5 m with container. The size of containers: 50 liters. (54)





Ginkgo biloba ‘Barabit’s Nana’. Photo by Edwin Smits, Netherlands. (56)

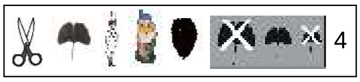




Ginkgo biloba ‘Beijing Gold’. Photos by T. Schaner, USA. (104)

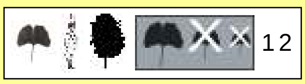
Ginkgo biloba ‘Barabits Sztrada’. Photo by Orlóci László, Hungary. (66, 103, 106)


Ginkgo biloba ‘Beijing Gold’. Photos by Bömer, Netherlands. (33)



Ginkgo biloba ‘Bergman Dwarf’. Photo by Rich's Foxwillow Pines Nursery, USA. (102)

Ginkgo biloba ‘Bullwinkle’. Photos by Todd Schaner, USA. (83)

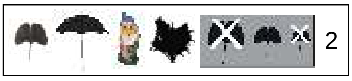


Mutations of the young plant
Ginkgo biloba.

("Weeping Maidenhair Tree
'Mutant Weeper'")
Photos by Todd Schaner, USA.
(104) Up right: Photo By BMB.

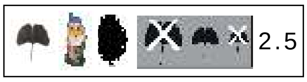
Ginkgo biloba ‘Chotek’. Photo by E. Smits, Netherlands. (56)

Ginkgo biloba ‘Chotek’. Photo by Bömer, Netherlands. (33)

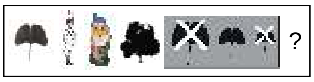


Ginkgo biloba ‘Chotek’. Photos by Dušan Horák, Czech Republic. (55) Down.

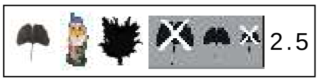
Page 318 right down: *Ginkgo biloba* ‘Chi-chi’. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)



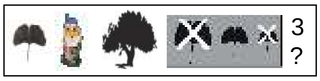
Ginkgo biloba ‘Canopy’. Photo by Tood Schaner, USA. (83)



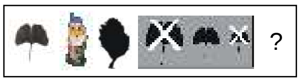
Ginkgo biloba ‘Chase Manhattan’ (‘Bonn's Dwarf’). Photo by Ender Stewart, USA. (41)



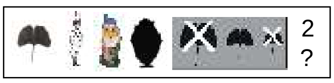
Beautiful *Ginkgo biloba* ‘Dila’. Photos by Lappen, Germany. (45)



Ginkgo biloba ‘Dj’s Bowtie’. Photos by T. Schaner, USA. (83)

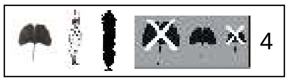


Ginkgo biloba ‘Dingaling’. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)



Left: *Ginkgo biloba* ‘David’. Photo by Bömer, Netherlands. (33)

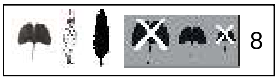
Ginkgo biloba 'Elmwood'. Photos by T. Schaner, USA. (83)



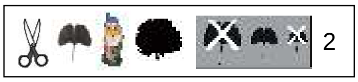
Ginkgo biloba 'Elmwood Pillar' - 'Elmwood', Photos by Dax Herbst, USA. (72)

Ginkgo biloba 'Fastigiata' in Winter, Photo by Edwin Smits, Netherlands. (7, 56)

Ginkgo biloba ‘Fastigiata’. Photo by Bömer, Netherlands. (33)



Ginkgo biloba ‘Globosa’. Photo by Bömer, Netherlands. (33)



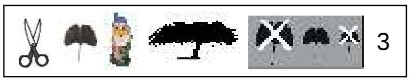
Ginkgo biloba ‘Globosa’. Photo by Edwin Smits, Netherlands. (56)

Ginkgo biloba ‘Horizontalis’. Photos by Plantentuin Esveld, Boskoop (Dirk and Cor van Gelderen), Netherlands. (21, 26)

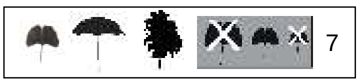
Ginkgo biloba ‘Horizontalis’. Photo by Ginkgo Museum, Weimar, Germany. (14)

Ginkgo biloba ‘Horizontalis’. Photo by Dušan Horák, Czech Republic. (55)

Ginkgo biloba 'Horizontalis'. Photo by Trompenburg Tuinen & Arboretum, Rotterdam, Netherlands. (12, 26)

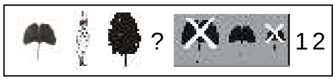


Ginkgo biloba 'Horizontalis'. Photo by Bömer, Netherlands. (33)

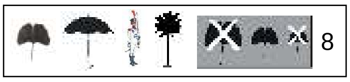


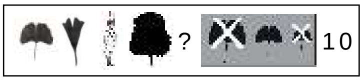
Ginkgo biloba 'Hettich'. Photos by Orlóci László, Hungary. (66, 103, 106)

Ginkgo biloba 'Jehosepat'. Photo by Harold Greer, USA. (2)

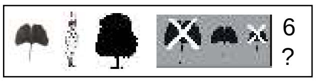


Ginkgo biloba 'Katlan'. Photo by Orlóci László, Hungary. (106)

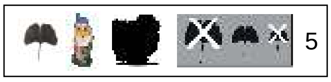




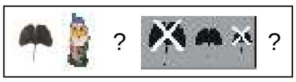
Ginkgo biloba 'Korinek'. Photos by Dušan Horák, Czech Republic. (55)



Ginkgo biloba 'Kew'. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)



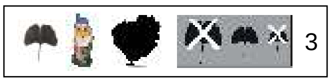
Ginkgo biloba 'Jade Butterfly'. Photo by Ender Stewart, USA. (41)



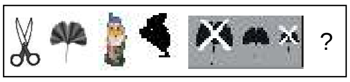
Ginkgo biloba 'Kristina'. Photo by Dax Herbst, USA. (72)

Ginkgo biloba 'Jade Butterfly'. Photos by Tood Schaner, USA. (104)

Ginkgo biloba 'Leiden'. Photo by Plantentuin Esveld, Boskoop (Dirk and Cor van Gelderen), Netherlands. (21, 26)



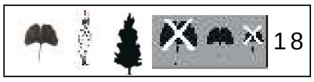

Copyright (c) dybbuk, 2007
http://davesgarden.com/members/dybbuk/
Unauthorized Use Prohibited

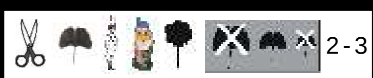


Ginkgo biloba 'Magyar'. Photo by Bömer, Netherlands. (33)

Ginkgo biloba 'Majestic Butterfly'. Photos by Tood Schaner, USA. (104)

Ginkgo biloba 'Magyar'. Photo by Dax Herbst, USA. (72, 107) Left down.





Ginkgo biloba ‘Mariken’ in autumn. Photo by M. Savorich. (54)

Ginkgo biloba 'Mariken'. Photo by Dušan Horák, Czech Republic. (55)

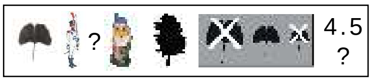
Ginkgo biloba 'Mariken'. Photo by Arboretum Žampach, Czech Republic. (78)

Ginkgo biloba 'Mariken' ('Marikin' ?). Photo by Harold Greer, USA. (2)

Ginkgo biloba 'Mariken'. Photo by Plantentuin Esveld, Boskoop (Dirk and Cor van Gelderen), Netherlands. (21, 26)

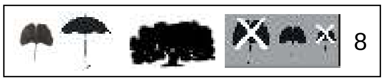
Ginkgo biloba 'Mariken'. Photo by Bruce Jordan, Big Plant Nursery, UK. (33)

Ginkgo biloba 'Ohazuki' ('Ohatsuki', 'Epiphylla', 'Ohasuki', 'Ohazaki') in Lečenec, Slovakia. Photo by Pavel Hrubík-Katarína Ražná, Nitra, Slovakia. (Left).
This tree is a unique 'Ohatsuki' old Ginkgo tree outside Asia (Japan, China). Age: 150-200 years. Height: 19 m (7.5 f.).



Ginkgo biloba 'Ohazuki' ('Ohatsuki', 'Epiphylla', 'Ohasuki', 'Ohazaki').
Photo by Plantentuin Esveld, Boskoop (Dirk and Cor van Gelderen), Netherlands. (21, 26)

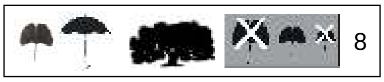
Ginkgo biloba 'Pendula'. Photo by Bömer, Netherlands. (33b) Down.



Ginkgo biloba ‘Pendula’. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)

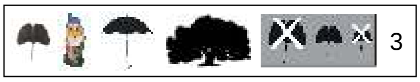
Ginkgo biloba ‘Pendula’ (young plant). (54)

Ginkgo biloba ‘Pendula’. Photo by Trompenburg Tuinen & Arboretum, Rotterdam, Netherlands. (12, 26)

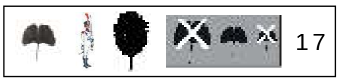


Ginkgo biloba ‘Pendula Rowe’. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)

Up: *Ginkgo biloba* ‘Pragensis’ (or ‘Praga’). (78) In Botanic Gardens of Carls University in Prague. Photo by Luděk Grätz, Czech Republic. Down: Arboretum Žampach, Czech Republic. See p. 348.



Ginkgo biloba ‘Pendula pragensis’ (or ‘Praga’). This is Czech version of ‘Horizontalis’ ?. Photos by Arboretum Žampach, Czech Republic. (78)
Left up: 1992.

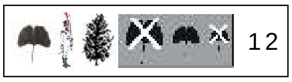


Ginkgo biloba ‘Princeton Sentry’. Photo by H. Greer, USA. (2)

Ginkgo biloba ‘Princeton Sentry’ (leaves, detail). Photo by Plantentuin Esveld, Boskoop (Dirk and Cor van Gelderen), Netherlands. (21, 26)

Ginkgo biloba 'Ross Moore'. Photos by Tood Schaner, USA. (83)

Ginkgo biloba 'Robbie's Twist'. Photos by Tood Schaner, USA. (104)

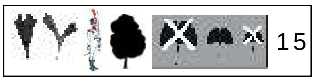


Ginkgo biloba 'Saratoga'. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)

Ginkgo biloba 'Saratoga'. (21, 26)

Ginkgo biloba 'Saratoga'. Photo by Edwin Smits, Netherlands. (56)

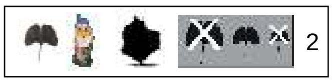
Ginkgo biloba ‘Saratoga’. Photo by Arboretum Žampach, Czech Republic. (78)

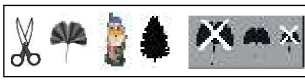


Ginkgo biloba ‘Spring Grove’. Photo by Ender Stewart, USA. (41)

Ginkgo biloba ‘Saratoga’. Photo by Tood Schaner, USA. (104)

Ginkgo biloba ‘Spring Grove’. Photos by Ender Stewart, USA. (2)

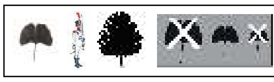




3

Ginkgo biloba ‘Summer Rainbow’. Photos by Tood Schaner, USA. (83, 104)

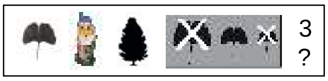
Ginkgo biloba ‘Shangri-La’. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)



13

Ginkgo biloba ‘Tit’. Photo by Dušan Horák, Czech Republic. (55)

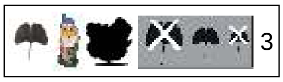
Ginkgo biloba ‘Tit’. Photo by by W. Rutten, Leende, Netherlands. (33b)



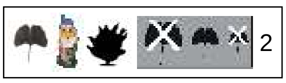
Ginkgo biloba ‘Tit’. Photo by Plantentuin Esveld, Boskoop (Dirk and Cor van Gelderen), Netherlands. (21, 26)

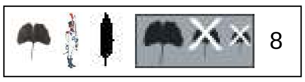
Ginkgo biloba ‘Thelma’. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)

Ginkgo biloba ‘Thelma’. Photo by Edwin Smits, Netherlands. (56)



Ginkgo biloba ‘Todd’s Dwarf’. Photo by Harold Greer, USA. (2)



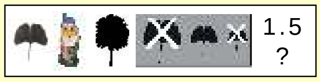


Ginkgo biloba ‘Tremonia’. Photo by Dušan Horák, Czech Republic. (55)

Ginkgo biloba 'Troll'. (63)

Ginkgo biloba 'Troll'. Photo by Dušan Horák, Czech Republic. (55)

Ginkgo biloba 'Troll'. Photo by Edwin Smits, Netherlands. (56)

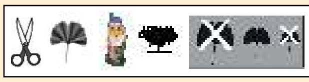


Ginkgo biloba 'Tubifolia'. Photo by Bruce Jordan, UK. (63)

Ginkgo biloba 'Tubifolia'. Photo by Arboretum Žampach, Czech Republic. (78)

Ginkgo biloba 'Tubifolia'. (78)

Ginkgo biloba 'Variegata'. (83) Maybe 'White Variegata' (?)



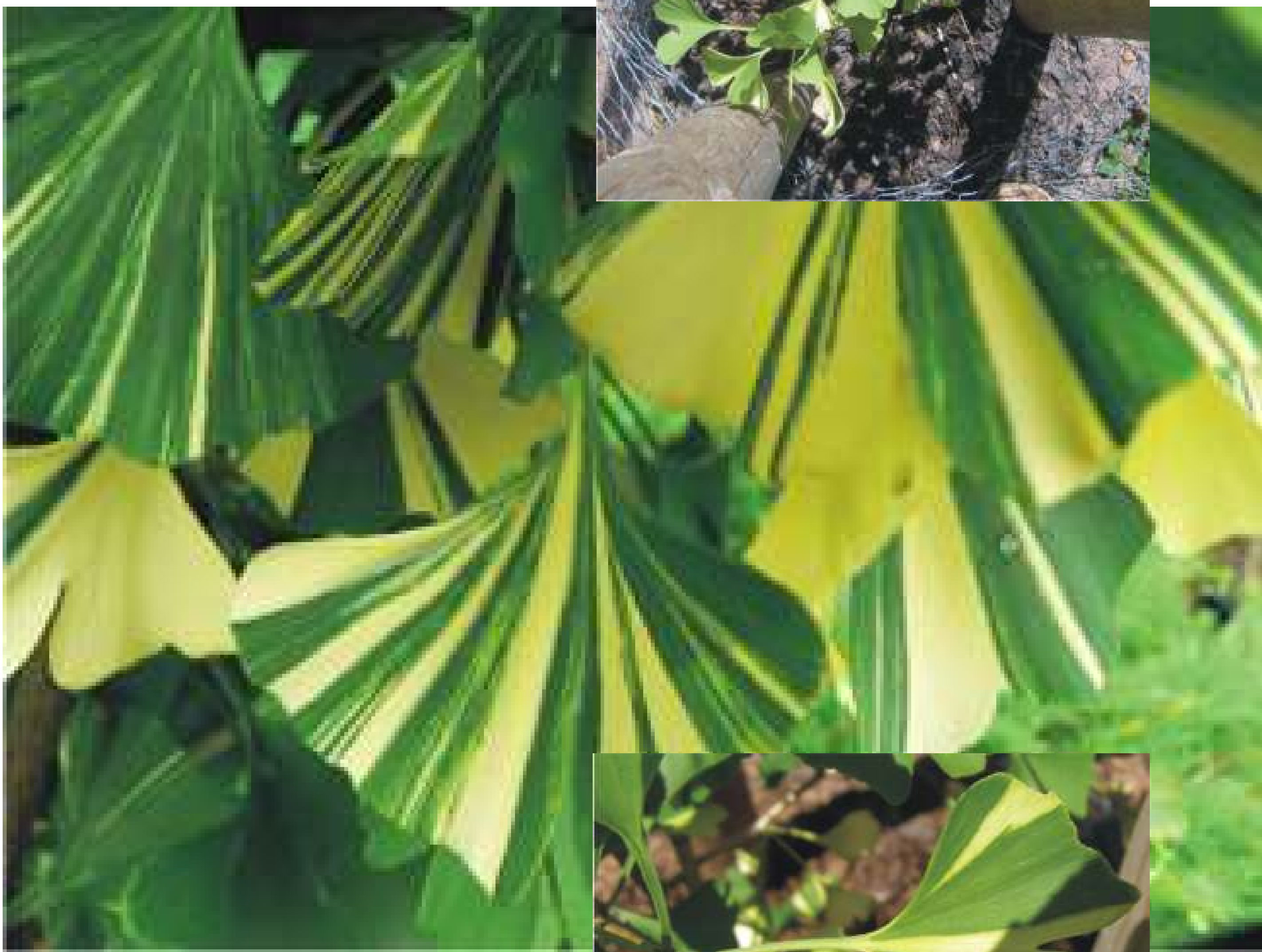
2.5

Ginkgo biloba 'Variegata'. (83) Maybe 'White Variegata' (?). Photo by Tood Schaner, USA.

Ginkgo biloba 'Variegata'. Photo by Bömer, Netherlands. (33)

Ginkgo biloba 'Variegata'. Photo by Bruce Jordan, UK. (63)

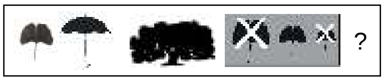
Ginkgo biloba ‘Variegata’. Photo by Edwin Smits, Netherlands. (56)

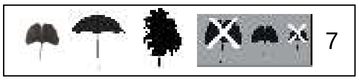


Ginkgo biloba ‘Variegata’. Photo by Dušan Horák, Czech Republic. (55)

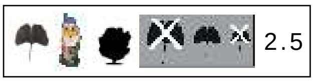
Ginkgo biloba ‘Variegata’. Right and right up: photos by Arboretum Žampach, Czech Republic. (78)

Left: *Ginkgo biloba* 'Weeping Wonder'. Photo by Rich's Foxwillow Pines Nursery, Woodstock, USA. (102)



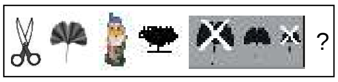


Ginkgo biloba 'Wiener Walzer' ('Hettich') in Winter. Photo by Orlóci László, Hungary. (66, 103, 106)



Ginkgo biloba 'WB' ('Witches Broom'). Photo by Edwin Smits, Netherlands. (56)

Ginkgo biloba ‘Yellow Dragon’. This is new form of cultivar 'Variegata' (?). Photo by Edwin Smits, Netherlands. (56)



(A) Frank S. Santamour, Jr., Shan-an He, and Alice Jacot McArdle, 1983. Checklist of cultivated ginkgo

(Quotes reprinted from Journal of Arboriculture 9 (3): March 1983, p. 88-92)

Even though it is not "probably the most esteemed street tree in this country" as stated by Li (3), Ginkgo biloba L. has proved to be a reasonably useful tree for planting in urban areas of the United States. Its reputation as a "troublefree" tree is based more on the myth that this classical monotypic "living fossil" should have no pests than on valid scientific observation. While there are no dramatic defoliations, wilts, or blights that befall ginkgo, there must be reasons for the breakage of main trunks and premature tree death that have been observed.

Ginkgo is native to eastern China, most likely in an area of southern Anhui and northern Zhejiang provinces just north of the 30th parallel (3).

Whether any truly "wild" trees have existed in the past 100 years is a matter of debate. It is, however, a fallacy that the preservation of the species was the result of its significance in the Buddhist religion (3).

Ginkgo was probably introduced to Japan more than a thousand years ago, and, in fact, the name "ginkgo" is of Japanese origin. The tree was introduced into Europe about 1 730, to England in 1754, and to the United States, from England, in 1784.

Ginkgo is generally considered to be dioecious, with individual trees being either male or female. Monoecious trees, having flowers of both sexes, have been reported (5), and our own study of sex expression in ginkgo will be the subject of a separate paper. The production of fruit and viable seed by isolated "female" trees has also been noted (4).

The pulp of the fruit of ginkgo produces an odor, mainly from butyric acid, that may be considered drsagreeable or obnoxious. Therefore, male cultivars have been selected for planting in Western countries. In the Orient, however, particularly in the People's Republic of China, the seed of the ginkgo is a prized food delicacy, and female cultivars have been selected for larger seed and abundant fruit production.

The translation of the Chinese name for ginkgo (yinxing) is "silver apricot" and the seeds are indeed edible. In China, the fruits are harvested by beating them down with a bamboo pole in October or November, when they have become brownish yellow. They are kept in a container or piled in some cool place outdoors until the pulp ferments. It is best to wear plastic or rubber gloves when handling the fruit at this stage, since the pulp contains a skin irritant not unlike that in poison ivy. The seeds are removed from the pulp by stirring or agitating in water and washing them clean of pulp. The cleaned seeds are what is sold in the market as food.

Ginkgo seeds must be cooked, boiled or roasted, before they are eaten. The outer seed coat is first cracked and removed and the thin paper-like inner layer can be peeled after a brief soaking in hot water. After peeling, the seed may be boiled for 10 or 15 minutes or roasted, with oil, in a pan. Ginkgo seeds are usually used in desserts, especially in sweet soups with Chinese dates (*Zizyphus jujuba* Mill.).

Maunsell Van Rensselaer, Director (1951-1966) of the Saratoga Horticultural Foundation, Saratoga, California, was a champion of ginkgo in the United States. Many of the cultivars in this checklist were only known from the test plots of that Foundation, although some plants did "escape" into arboreta, and many names were contained in a survey made by the American Horticultural Society. We are indebted to Mr. Barrie D. Coate, Director of Horticulture at the Foundation, for data on these cultivars. The Saratoga Horticultural Foundation does not propagate or sell any ginkgo cultivars at the present time.

The U.S. National Arboretum, as temporary International Registration Authority for unassigned genera of woody plants, has assumed the responsibility of preparing authoritative cultivar checklists of important landscape tree genera in accordance with the provisions of the International Code of Nomenclature for Cultivated Plants (1). Cultivars selected and grown for fruit production in the People's Republic of China are listed in a separate section and, we believe, are published here for the first time in any language other than Chinese pictographs.

Although *Ginkgo biloba* L. is currently the accepted scientific name for this species, the English botanist J.E. Smith considered the name "uncouth and barbarous" and renamed it *Salisburia adiantifolia* in 1797. Some of the earliest ginkgo cultivars were selected and named under this botanical epithet. It is of great interest that there are virtually no ginkgo cultivars presently in the nursery trade that exhibit well-formed open crowns with evenly spaced branches. Such trees do exist, and some nurseries have attempted their propagation. However, trees propagated from lateral branches or branch buds often continue to develop as branches rather than assume an upright habit. Until we can solve these propagation problems, we will not be able to utilize the best germplasm in this species.

As in previous checklists (6, and others), VALID CULTIVAR names are given in boldface capitals and INVALID CULTIVAR names in lightface capitals.

.....(See table - pages 284-313 this book)

Chinese Cultivars

M.C. Tsen in 1935 (7) was perhaps the first Chinese botanist to attempt a scientific classification of the various cultivated types of ginkgo. He proposed three botanical varieties, under which the cultivated types could be categorized: (a) var. typica, the Meihe-Yinxing group or plum-stone shaped ginkgo, with round fruit; (b) var. huana, the Fushon-Yinxing group or finger citron ginkgo, with elliptic or oblong fruit; and (c) var. apiculata, the Maling-Yinxing or horse's-bell shaped ginkgo, with a fruit shape intermediate between the other two, and with a small apicula on the top of the fruit.

The Latin epithets for the botanical varieties erected by Tsen are invalid because Latin diagnoses were not provided, but the Chinese group names for these varieties are very useful and have been followed by subsequent authors. The cultivar names proposed by Tsen and others are hereby validated, according to the Code (1), by transliteration into the Roman alphabet, i.e., Pinyin. The authority for each cultivar name does, however, remain with the first published work. Because of the very detailed descriptions for valid cultivars that exist in the Chinese literature, our descriptions in the listing that follows will be much abbreviated, or even limited to a translation of the cultivar name.

A. Meihe-Yinxing - plum-stone shaped ginkgo.

DAMEIHE -large plum stone (7, 10, 11).
MIANHUAGUO - cotton-fruit like; often with twin fruit (8, 10).
NANHUIWUXIN - Nanhui inembryonate; fruit without embryos (11).
SUANPANGUO - abacus-bead like (8, 10).
TONGZIGUO - tung-tree fruit like (8, 10).
XIMEIHE - small plum stone (7, 12).
YUANZHU - round beads. There is some question whether this is a collective name for several cultivars with round fruit. We are considering it a valid group name with the described variations probably derived from this cultivar; DAYUANZHU - large round beads, XIAOYUANZHU - small round beads, YAPIGUYUANZHU - duck's buttocks (9, 11).

B. Fushon-Yinxing - finger citron shaped ginkgo.

CHANGBING-FUSHON - long petiole finger citron (7, 8, 10, 12).
DAFUSHON - large finger citron (9, 11).
DONGTINGHUANG - King of Dongtingshan Mountain, fruit largest, 500-year-old tree is 16 meters tall (8, 9, 10, 11).
FUZI - Buddha's finger (2, 11).
GANLAN-FUSHON - Chinese olive-like finger citron (8, 10).
JIAFUSHON - domestic finger citron (2, 8, 10) = DAFUZI, large Buddha's finger.
JIANCHU - sharp pestle; poor quality (7).
JIANGHO-FUSHON - sharp-top finger citron (7, 12).
JINGUO-FUSHON - golden-fruited finger citron (7, 8, 10, 12).
LUANGUO-FUSHON - ovate-fruited finger citron (7, 8, 10, 12).
XIAO-FUSHON - small finger citron (9, 11).
YUANDI-FUSHON - round-bottom finger citron; superior type (7, 8, 11, 12).
ZAOZI-FUSHON - Chinese date-like finger citron; name reported (8, 10) but without description.

C. Maling-Yinxing — horse's-bell shaped ginkgo.

DAMALING - large horse's bell (7, 10, 12).
LONGYAN - dragon's eye (2, 11).
HUANGPIGUO - yellow peel fruit (8, 10).
QINGPIGUO - green peel fruit (8, 10).
XIMALING - small horse's bell (7, 1 2).
ZHONGMAUNG - medium horse's bell (7, 10, 12).

Literature Cited

1. Brickell, CD., A.F. Kelly, F. Schneider, and E.G. Voss. 1980. International Code of Nomenclature for Cultivated Plants — 1980. Regnum Vegetabile Vol. 104, 32 p.
2. He, Feng-ren and You-wei Zhao. 1957. Investigation of Ginkgo in Taixing county. Bull. North-Jiangsu Agric. Coll. 1: 39-51 (In Chinese).
3. Li, Hui-lin. 1 963. The origin and cultivation of shade and ornamental trees. Univ. Penna. Press, 282 p.
4. Meehan, T. 1882. Fruiting of Ginkgo biloba. Proc. Acad. Nat. Sci. Philadelphia, p. 9-10.
5. Miyoshi, M. 1931. Merkwurdige Ginkgo biloba in Japan. Mtt. Deutsch. Dendr. Ges. 43: 21-22.
6. Santamour, Frank S., Jr. and Alice Jacot McArdle. 1982. Checklist of cultivated maples. I. Acer rubrum L. J. Arboric. 8: 110-112.
7. Tsen, M.C. 1935. Ginkgo in Zhuji county, Zhejiang province. Hortus 1; 157-165 (In Chinese).
8. Tsen, M.(C.) 1960. Ginkgo. In Fruit Culture of China, Fruit Tree Inst, Chinese Agric. Acad., Agricultural Press, p. 742-757 (In Chinese).
9. Tsen, M.(C.) and 11 others. 1960. Fruit Trees in Dongtingshan Mountain, Taihu Lake Area. Nanjing Bot. Gard. Mem. Sun Yat-Sen, Academica Sinica, 48 p. (In Chinese).
10. Yu, Te-Tsun. 1979. Fruit Tree Taxonomy of China, Agricultural Press, p. 274-276 (In Chinese).
11. Zao, Dao-xun, Jia-xi Wang, and Yu-he Zhang. 1964. A Comprehensive study on Fruit Trees in Jiangsu Province, Shanghai Sci. and Technol. Press, p. 154-157 (In Chinese).
12. Zhang, Mian-xin. 1960. Illustrated Description of Main Fruit Trees in China, Shanghai Sci. and Technol. Press, p. 187-196 (In Chinese).

Respectively' Research Geneticist, Visiting Scholar, and Biological Technician, U.S. National Arboretum, USDA Agricultural Research Service, Washington, D.C. Professor He is Deputy Director, Nanjing Botanical Garden Mem. Sun Yat-Sen, Nanjing, People's Republic of China.

Ginkgo biloba 'Praga' (or 'Pragensis') in Botanic Gardens of Carls University in Prague. Photo by Jan Purkrábek, Czech Republic.

Beautiful *Ginkgo biloba* ‘Pendula’ (leaves).
Ginkgo biloba ‘Mariken’. Photos by M. Šavorić, Croatia (2010).

Ginkgo biloba ‘Chi-chi’ (or ‘Icho’) in bonsai form. Created by Susumu Nakamura, Japan. Age: 35 years. Photo by Lloyd Gross, Westmount, QC, Canada (2007).

2

Ginkgo biloba bonsai

Foreword

As Ginkgo is very resistant and slow growth plant it is very covinient for growth in bonsai form in all bonsai stiles and forms. So today there are examples of bonsai trees that are more hundreds year old and not taller than 50 cm. Although bonsai originate from East throught the time it is expanded.

During past growth of bonsai forms is expanded throught the world. So we have many persons, green gardens and clubs that grow Ginkgo in miniature bonsai form.

Although the largest growth of Ginkgo bonsai is still oriented on countries of the East (China, Japan, South Korea) there are organized growth in other World countries too.

Besides typicall species as bonsai are grown some cultivars too. The largest production of Ginkgo comes from East from where bonsai originates.

1
Ginkgo bonsai

Ginkgo is usitable for bonsai since itgrowth is slow and live long. Besides tolerate extreme ways of life that are required in this kind of growth. In East bonsai is considered an art form that offers philosophical and estetic unity with nature. Bonsai came on West from Japan at the end of 19th century and in Japan it was brought beetween 8 and 12 century from China (Cheenese period Heian).

Bonsai trees can be formed in varius ways and there is more than 100 styles dependable on plant type. Ginkgo can be formed an almoust every known style but most of them are in form of free or clasical form. Here you will find examples of few basic styles together with some plants of classic style that breath with beauty through or 4 seasons. There are two basic groups of bonsai trees: that lives all life outdoors or containered ones. Since the form of Gingkos treetrunck itself is very specific (related to other species) we must consider that Ginkgo bonsai is different from other bonsai's. In general they brake through some standards prescribed by this kind of growth. The most common growth style for Ginkgo bonsai are: Classic style (白果古典 - Chin.), Semi-cascade, Cascade, Leaning, Formal Upright, Informal Upright, Roots-over-rock, Double Trunk, Raft, Windswept, Group, Multilevel and Forest.

Special conditions required by this kind of growth needs large patients and special tools needed in bonsai forming. Growth starts in plant youth and it is based on various rooth cutting, specific fertilization, forming the smallest rooth possible, leaf defoliation in vegetation to get the smallest leaf possible, diferent branch wiering, brumming of branches, etc. The final result must be the smallest plant possible gracefull form with all characteristic as plant that lives in wild. This is growth for conteinered bonsai plants. Containers are especially made for those purposes. Each container is basically from cheramic or porcelan with holes for dreinage with special form to adapt rooth to form tree. There is whole set of rules conected with growing of bonsai trees just as for Ginkgo as for any other plant species.

Basically growing ginkgo bonsai is no different from growing bonsai of any other species. It demands large quantity of patience and results can be seen very soon. It all depends with wich form of bonsai growt we deal.

Abouth bonsai growth there are large amount of litereture (paper and digital). Here we will try to show growth of Ginkgo bonsai form as clear as possible.

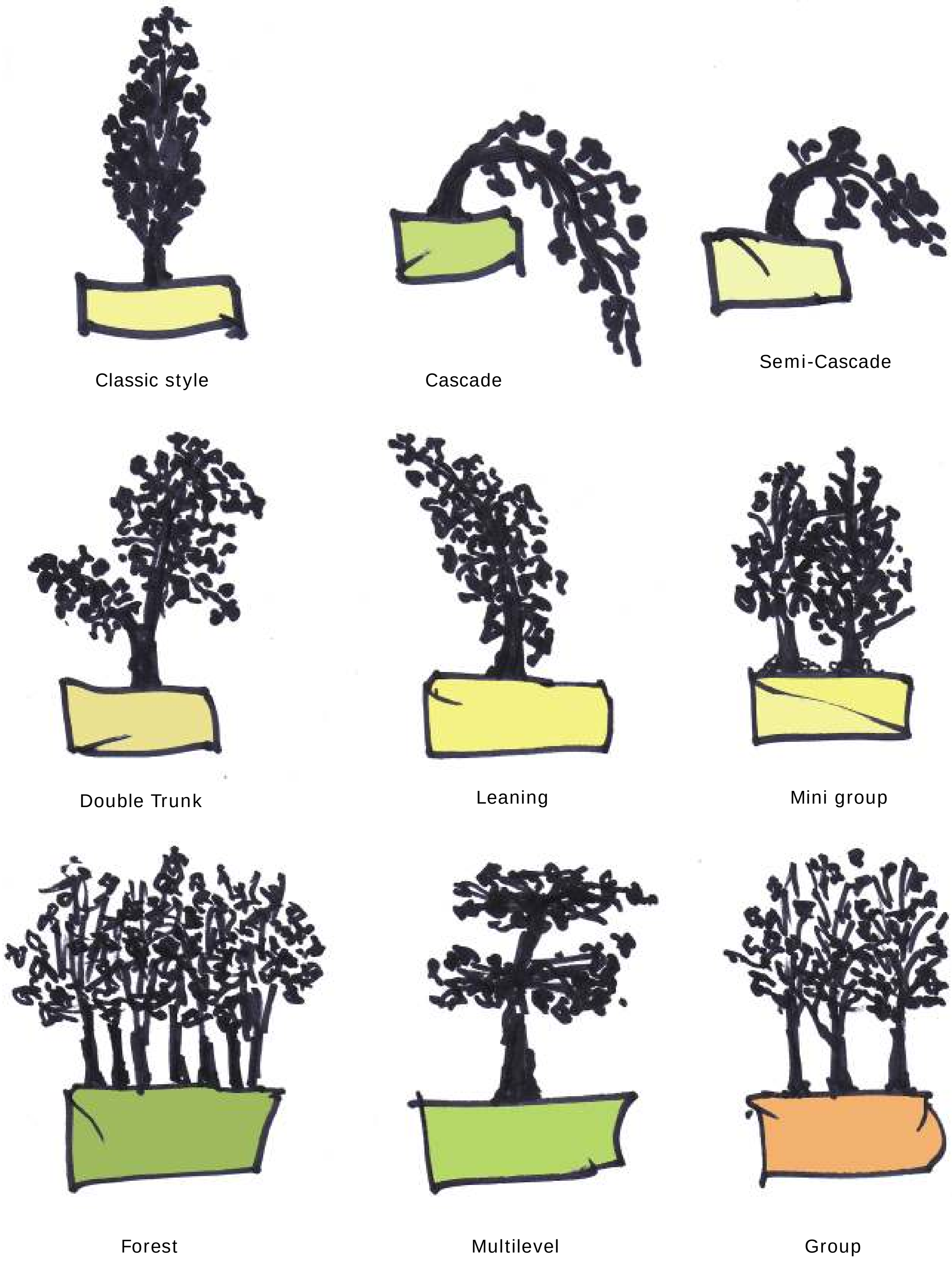
There is one important rule in growing bonsai form: plant is not bonsai if you do not put some human soul in her i.e. plant and human must be melted together – if you leave bonsai to grow as it wonts then this plant is no longer bonsai.

Page 352:
Ginkgo bonsai -
65 years old. Photo by Lloyd Gross, Westmount, QC, Canada (2007).

One of the typical form of bonsai Ginkgo biloba - outside the vegetation. Photo by Bonsai Center Ginkgo, Belgium.

Chinese stamp with Ginkgo bonsai. Serial: “Set of six” by Shu Zhuang Pen Jing, China. 31 March, 1981.

Photo by Paul Goff, Bonsai Center Ginkgo (Private collection), Belgium. (101)



Drawings: basic styles - forms Ginkgo bonsai.

Page 357: Ginkgo plants in the preparatory phase for bonsai.
Young Ginkgo plants are sensitive to bark damage.

Demonstration:
making ginkgo bonsai (style: wood).
Created by Vladimír Ondejčík, jr., Nitra, Slovakia
(2008).
Photo by www.bonsai-slovakia.sk.

Ginkgo bonsai in the nursery.
Photos by Bonsai Center Ginkgo, Belgium.


IN GALLERIA

Page 360:
around 100 years old Ginkgo bonsai - “Euroflora” exhibition the 2006th, Genova, Italy. Photo by Mattia Nicoli, Italia (2006).

Ginkgo bonsai 155 years old. Created by China. Photo by Lloyd Gross, Westmount, QC, Canada (2010).

40 years old Ginkgo bonsai. Photo by Lloyd Gross,
Westmount, Canada (2008).

40 years old Ginkgo bonsai. Style: forest. Photo by Lloyd Gross, Westmount, Canada (2006).

Photos by Dax Herbst, USA (2006). (72)

- Form of *Ginkgo biloba*, as a typical species as bonsai is beautiful in itself.

- Ginkgo under controlled conditions can be replanted during growth season.

- Very young Ginkgo plants do not tolerate pruning during growth season.

- Ginkgo is very susceptible to damage bark.

- Ginkgo biloba dislike pruning of leaves during growth season.

Ginkgo bonsai 70 years old.. Photo by Lloyd Gross,
Westmount, Canada (2008).

Ginkgo bonsai 155 years old. Photo by Lloyd Gross,
Westmount, Canada (2008).

Ginkgo bonsai 40 years old. Style: forest. Photo by Lloyd Gross, Westmount, Canada (2008).

Ginkgo bonsai 45 years old. Created in China. Photo by Lloyd Gross, Westmount, Canada (2010).

Ginkgo bonsai 30 years old. Photo by Lloyd Gross,
Westmount, Canada (2008).

Ginkgo bonsai 40 years old. Photo by Lloyd Gross, Westmount, Canada (2010).

40 years old Ginkgo bonsai. Photo by Lloyd Gross, Westmount, Canada (2008).










Pages 370-371: young Ginkgo bonsai from Japan. Photos by Macha531, Japan (2010/2011) - http://plaza.rakuten.co.jp/machasan.



Ginkgo bonsai 15 years old. Photo by Lloyd Gross, Westmount, Canada (2008).

Right: Ginkgo bonsai 40 years old. Photo by Lloyd Gross, Westmount, Canada (2008).

Down: young Ginkgo bonsai from Japan. Photos by Macha531, Japan (2010/2011) - http://plaza.rakuten.co.jp/machasan.

Down: young Ginkgo bonsai from Japan. Photos by Macha531, Japan (2010/2011) - http://plaza.rakuten.co.jp/machasan.

Ginkgo bonsai 40 years old. Photo by Lloyd Gross, Westmount, Canada (2008).

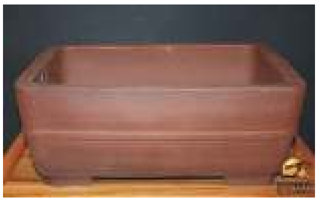

Ginkgo bonsai in the nursery.
Photos by Bonsai Center Ginkgo, Belgium.




Beautiful Ginkgo bonsai 40 years old. Created by China. Photo by Lloyd Gross, Westmount, QC, Canada (2010).

For example: several types bonsai pots.

Made in China. Photos by www.e-bonsai.eu, Slovakia.



Ginkgo bonsai. Photo by Liné1, Italy (2007). (www.commons.wikimedia.com)

References

(correction approach to web sites 2011/05/30)

1. http://xs4all.nl/~kwanten
2. http://www.greergardens.com/conifers_Ginkgo-Picea.htm
3. http://www.naturehills.com/product/princeton_sentry_ginkgo.aspx
4. http://www.coxgardens.com/october.htm
5. http://www.burncoose.co.uk/site/category.cfm?search=maidenhair
6. http://www.davesmock.com/blog07sep/
7. http://s585.photobucket.com/home/coniferjoy
8. http://www.ginko.cdfoto.net/ginkgo_tree.htm
9. http://commons.wikimedia.org/wiki/File:Enghien_AR3bJPG.jpg
10. http://www.herrenkampergaerten.de/Liste/Katalog%202009_7.pdf
11. http://palmenwaeldchen.eu/index.php?searchStr=ginkgo&_a=viewCat&Submit=Starten
12. http://www.trompenburg.nl
13. http://www.planet-weimar.de/
14. http://www.ginkgomuseum.de/, http://www.ginkgomuseum.com/ginkgopflanzen/ginkgo-zuchtformen/ginkgo-horizontalis.php
15. http://plants.alsipnursery.com/NetPS-Engine.asp?CCID=12120002&page=pdpprint&PID=3558
16. http://www.forestfarm.com/product.php?id=2037
17. http://www.pijanitvor.com/downloads.php?do=file&id=604
18. http://www.herrenkampergaerten.de/Liste/Ginkgoliste.pdf
19. http://yesicaalfaro.fastpage.name/ginkgobilobatoddsdwarf/
20. http://www.urbanforestrysouth.org/resources/library/selected-ginkgo-forms-cultivars/file_name
21. http://www.esveld.nl/~laur/index.php?lan=eng&q=search&key=Ginkgo&word_search=exact&category_search=pln&s=plant
22. http://www.architex-ljh.com/cgi-bin/cob?CPN=patrend&SID=02756&SKU=90056
23. 2010. Mesterházy, Z., Conifer Treasury of the World 3.0, Budapest (CD, 2010.)
24. http://davesgarden.com/guides/pf/go/77227/
25. http://www.saathainer.de/home/liste-nadelgeh%F6lze.htm
26. http://www.esveld.nl/catalen/conifereng.htm
27. http://www.bomen-online.nl/Assortiment/Details.asp?Soort=Ginkgo%20biloba%20%27Barabits%27%20Fastigiata%27&PlantNr=906434&Lang=DE
28. http://www.bomen-online.nl/Assortiment/Search.asp?sKeyword=Ginkgo&Lang=DE
29. http://www.bigplantnursery.co.uk/Ginkgo-biloba-Barabits-Nana.html
30. http://www.liebschwitz.de/cms/index.php?id=49
31. http://www.sylvestris.hu/Feny%C5%91f%C3%A9l%C3%A9k
32. http://www.bluebellnursery.com/catalogue/conifers/Ginkgo/G/1200
33. a) http://www.biloba.nl/ or b) David and Chantal Bömer, http://www.boomkwekerij-bomer.nl (E-mail info@boomkwekerij-bomer.nl Date: 10/10/2011), Boomkwekerij Bömer v.o.f., Netherlands.
34. http://www.shop.herrenkampergaerten.de/wbc.php?sid=4065788e8e&rid=15&page=1&tpl=produktliste2.html
35. http://sunnyraysnursery.com/plants/bernheimbroom.html
36. http://stauden-diamant.de/download/1/Gehoelzsammlung2010.pdf
37. http://www.girardnurseries.com/category-s/208.htm
38. http://www.japanesemaples.com/catalog/index.php?id=4#193
39. http://www.geefarms.com/catalog/2010/CONIFERS.pdf
40. http://www.coxgardens.com/SignificantCollections.php?filter=ginkgo
41. http://www.arrowheadshopping.com/
42. http://www.tomszak.pl/galeria_cm.php?wyraz=&page=2
43. http://www.arrowhead-alpines.com/retail_catalog_2010.pdf
44. http://www.buchholznursery.com/plant_library_search.html?text=ginkgo&x=19&y=7
45. http://www.lappen.de/en/assortment/?tx_sksimplegallery_pi1[id]=8&tx_sksimplegallery_pi1[single]=191&cHash=1c3a6d107a
46. http://www.foxhollowgarden.co.uk/ , http://www.foxhollowgarden.co.uk/Foxhollow_Garden_Collection_list_.pdf
47. http://www.ddg-web.de/Texte/100_Jahre_Gerd_Kruessmann.pdf
48. http://www.tlamp.in-berlin.de/wordpress/?p=849
49. http://www.burntridgenursery.com/products.asp?dept=64
50. http://www.learn2grow.com/plant-guides/trees/shade-trees-page-42
51. http://smg.photobucket.com/albums/v280/Cultivar/Chub%20Harper%20Conifers%202006/
52. http://www.foxhollowgarden.co.uk/Plants_for_sale.Sep2010.doc
53. http://www.flickr.com/photos/cork3000/3839527132/lightbox/
54. Marjan Šavorić, photos ginkgo cultivars, Sveti Ivan Zelina, Croatia. (http://jumbo.iskon.hr/dl/13rnwan7eyyju9iu/)
55. E-mail dusan@skolkyhorak.cz Date: 11/30/10 20:23 and Date: 11/30/10 20:23 http://www.skolkyhorak.cz/ (Dusan Horak)
56. http://www.edwinsmitsconifers.com/lijst.asp
57. http://www.lindenlandscapedesign.com/design/a-couple-of-gnomes-in-the-garden/attachment/ginkgo-biloba-gnome/
58. http://www.greenmediaonline.com/ME2/Audiences/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=5A2A9F232A3A49B8B60ED9C95F81C26F&AudID=AC361F5928F54864BFCBBD93E5B8624D

59. http://www.halkanursery.com/Gingo_biloba_Halka.htm
60. http://www.halkanursery.com/pdfs/Ginkgo%20biloba%20Halka.pdf
61. http://zauber-pflanzen.de/ginkgo.htm
62. Begović, B., 2009. Svijet ginka, Croatia (Manuscript).
63. http://www.bigplantnursery.co.uk/ginkgos.html
64. http://www.bonsai-bci.com/species/ginkgo.html
65. http://davesgarden.com/guides/pf/go/190708/
66. http://plant-quest.blogspot.com/2007/10/during-our-visit-to-hungary-we-were.html
67. http://davesgarden.com/guides/pf/go/79862/
68. http://www.beavercreeknursery.com/plantdetails.cfm?ID=737
69. http://redwood.mortonarb.org/ScinameLookup?qid=16&id=1447
70. http://www.iseli-nursery.com/Plantdescriptions/BLTrees09.html
71. http://www.rideauwoodlandramble.com/WhatsNewNameDisplay.asp?searchname=Ginkgo+biloba+%27Korinek%27
72. http://forums.gardenweb.com/forums/load/conif/msg0622231231394.html, http://forums.gardenweb.com/forums/load/conif/msg081754103314.html
73. http://www.drzewa.com.pl/mi%C3%82%C5%82orz%C3%82%C4%85b-dwuklapowy-leda-p-1546.html
74. http://home-and-garden.webshots.com/photo/1210445105055029205pObZXW
75. http://www.songsparrow.com/2010/plantlist.cfm?type=all&startrow=1&pageType=plantlist
76. http://www.lindenlandscapedesign.com/design/a-couple-of-gnomes-in-the-garden/
77. http://www.commercial-nursery.com/price.pdf78
79. http://www.esveld.nl/dialijsten/dialistgGinkgo.html
80. http://www.mobot.org/gardeninghelp/plantfinder/plant.asp?code=C881
81. http://davesgarden.com/guides/pf/search.php?q=ginkgo+biloba&Search=Search+PlantFiles&offset=0
82. http://www.handynursery.com/catalog/product_info.php?products_id=511&osCsid=7f56103aef89a0f2125260f7dd0e0afd
83. http://sunnyraysnursery.com
84. http://www.hiddenhillnursery.com/pdf/ornamental.pdf
85. http://www.portkellsnurseries.com/plantdb.php?view=m&sortby=common
86. http://www.kertpont.hu/index.php3?menu=cikk&cikkid=199
87. http://www.treemail.hu/fenyok/ginkgo_biloba_obelisk_oszlopos_pafranyfenyo
88. http://www.darob.pl/IMGallery/galeria.php
89. http://www.shop.herrenkampergaerten.de/wbc.php?pid=1663&rid=244&recno=4&page=3&order=data.produktid&cmd=lang&lc=1&tpl=produktliste1.html
90. http://plantexplorer.longwoodgardens.org/weboi/oecgi2.exe/INET_ECM_FindPl?PLANTNAME=GINKGO&DETAIL=1&FINDPLANT=Go
91. http://www.jfschmidt.com/introductions/
92. http://www.babicka.info/galerie/jinan/ipage00023.htm
93. http://newplants.tripod.com/gink3888.html
94. http://davesgarden.com/guides/pf/b/Ginkgoaceae/Ginkgo/none/cultivar/0/
95. http://www.liebschwitz.de/cms/index.php?id=49
96. http://www.shop.herrenkampergaerten.de/ginkgo,rid,15,page,1,kl.html
97. http://de.wikipedia.org/wiki/Liste_von_Naturschutzgebieten_und_Naturschutzobjekten_in_Wien
98. http://www.matthis-pflanzen-forum.de/t2660f4-Ginkgo-biloba-quot-Simon-quot.html
99. http://www.nasto-symphonie.com/index.php
100. http://www.wavecrestnursery.com/Prop%20list.htm
101. http://ginkgo-biloba1771ginkgoeu.blogspot.com
102. http://www.richsfoxwillowpines.com/catalog/search/index.php?&page=1
103. http://forums.gardenweb.com/forums/load/conif/msg0821132730966.html
104. http://davesgarden.com/guides/pf/imagesbyuser.php?user=dybbuk
105. http://www.zszp.pl/index.php?id=222&ltr=&adv=0&rodd=&grp=1&sco=ginkgo&lang=2
106. E-mail orloci@yahoo.com Date: 02/14/2011 (Orlóci László), Budapest, Hungary. (ELTE Botanical Garden) http://www.fuveszkert.org
107. http://smg.photobucket.com/albums/v280/Cultivar/US%20National%20Arboretum%20May%202006/#!cpZZ10QQtppZZ20
108. Brickell, CD., A.F. Kelly, F. Schneider, and E.G. Voss., 1980. International Code of Nomenclature for Cultivated Plants — 1980. Regnum Vegetabile Vol. 104, 32.
109. Coder, K.D., 2003. Selected Ginkgo Forms & Cultivars. School of Forest Resources. University of Georgia Sept. 1-6 (http://www.urbanforestrysouth.org/resources/library/selected-ginkgo-forms-cultivars/file_name).
110. http://www.qscaping.com/NetPS0 Engine.asp?CCID=20000012&page=results&Keyword=ginkgo+biloba&Category=&Type=&Spread=Any&SpreadDim=feet&FallColor=&FallColorJS=&Hardiness=7&Height=Any&HeightDim=feet&FlowerColor=&FlowerColorJS=&SunShade=&Submit=Search
111. http://www.ginkgobonsai.be
112. http://www.bonsai-slovakia.sk/8galery06.htm
113. Dieck, H., 2010. Ginkgo - Das Sortenbuch. Publisher Herrenkamper Gärten, Germany.
114. Hatch, L., 2007. Cultivars of Woody Plants. Vol 1 (A-G).
115. He, Feng-ren and You-wei Zhao., 1957. Investigation of Ginkgo in Taixing county. Bull. North-Jiangsu Agric. Coll. 1: 39-51 (In Chinese).
116. Houtman R., 2004. Variegated trees & shrubs: the illustrated encyclopedia.
117. Jacobson, A.L., 1996. North American landscape Trees. Ten Speed Press.
118. Kelsey, H.P. and Dayton, W.A., 1942. Standardized Plant Names. p. 274.
119. Li, Hui-lin., 1 963. The origin and cultivation of shade and ornamental trees. Univ. Penna. Press, 282.
120. Meehan, T., 1882. Fruiting of Ginkgo biloba. Proc. Acad. Nat. Sci. Philadelphia, 9-10.
121. Mesterházy, Z. et al., 2010. Conifer Treasury of Hungary 1.0, Handbook for Hungarian Conifer Breeders. Budapest. (http://www.garden-kerteszet.hu/ma_files/magyarfenyok.doc)

122. Mesterházy, Z., 1995. Conifer Treasury of the World 1.0, Budapest.
123. Mesterházy, Z., 2010. Conifer Treasury of Poland 1.0, Budapest.
124. Mesterházy, Z. et al., 2010. Conifer Treasury of NZL & AUS, Budapest.
125. Miyoshi, M., 1931. Merkwurdige Ginkgo biloba in Japan. Mtt. Deutsch. Dendr. Ges. 43: 21-22.
126. Nelson, J.N., 1866. Pinaceae, 1866, p.164 etc.
127. Nelson Nursery, San Leandro, California, Price List, January 1959, p. 6.
128. Van Rensselaer, M., 1956. Jour. Calif. Hort. Soc. 17: 100-101.
129. Santamour, F. S., Jr. and Alice Jacot McArdle., 1982. Checklist of cultivated maples. I. Acer rubrum L. J. rboric. 8: 110-112.
130. Santamour, S.F. et al., 1983. Checklist of cultivated ginkgo. In Journal of Arboriculture 9(3): March 1983, 88-92.
131. Seneclauze, A., 1867. Les Coniferes. Paris, p. 81.
132. Tsen, M.C., 1935. Ginkgo in Zhuji county, Zhejiang province. Hortus 1; 157-165 (In Chinese).
133. Tsen, M.C., 1960. Ginkgo. In Fruit Culture of China, Fruit Tree Inst, Chinese Agric. Acad., Agricultural Press, 742-757 (In Chinese).
134. Tsen, M.C. et al., 1960. Fruit Trees in Dongtingshan Mountain, Taihu Lake Area. Nanjing Bot. Gard. Mem. Sun Yat-Sen, Academica Sinica, 48 (In Chinese).
135. Wang, L., et al., 2006. Genetic Relationships of Ornamental Cultivars of Ginkgo biloba Analyzed by AFLP Techniques. Acta Genetica Sinica, November 2006, 33 (11):1020–1026.
136. Wang, F., et al., 2009. The radial variation trend of tracheid morphology of branches from Ginkgo biloba L.cultivars. Journal of Nanjing Forestry University (Natural Sciences Edition) 2009, 3.
137. Yu, Te-Tsun., 1979. Fruit Tree Taxonomy of China, Agricultural Press, 274-276 (In Chinese).
138. Zao, Dao-xun, Jia-xi Wang, and Yu-he Zhang., 1964. A Comprehensive study on Fruit Trees in Jiangsu Province, Shanghai Sci. and Technol. Press, 154-157 (In Chinese).
139. Zhang, Mian-xin., 1960. Illustrated Description of Main Fruit Trees in China, Shanghai Sci. and Technol. Press, 187-196 (In Chinese).

Epiloque

Up to day we do not have located in one place all known and cultivated cultivars of this exeptional plant species (*Ginkgo biloba*). Similar can be said for bonsai forms. As beauty of cultivars and bonsai forms is precisely in it visual effect we have tried to introduce the most of the known ginkgo's cultivar and bonsai forms. In shape of a table general informations and basic growth characteristic for large number of them are added.

We hope that in this manner we have made a contribution in getting to know cultivars and bonsai for this magical and misterious plant that is beeng grown throught the world in larger number from year to year. Have we succeded? Judge yourself.

Branko M. Begović Bego (2011/10)

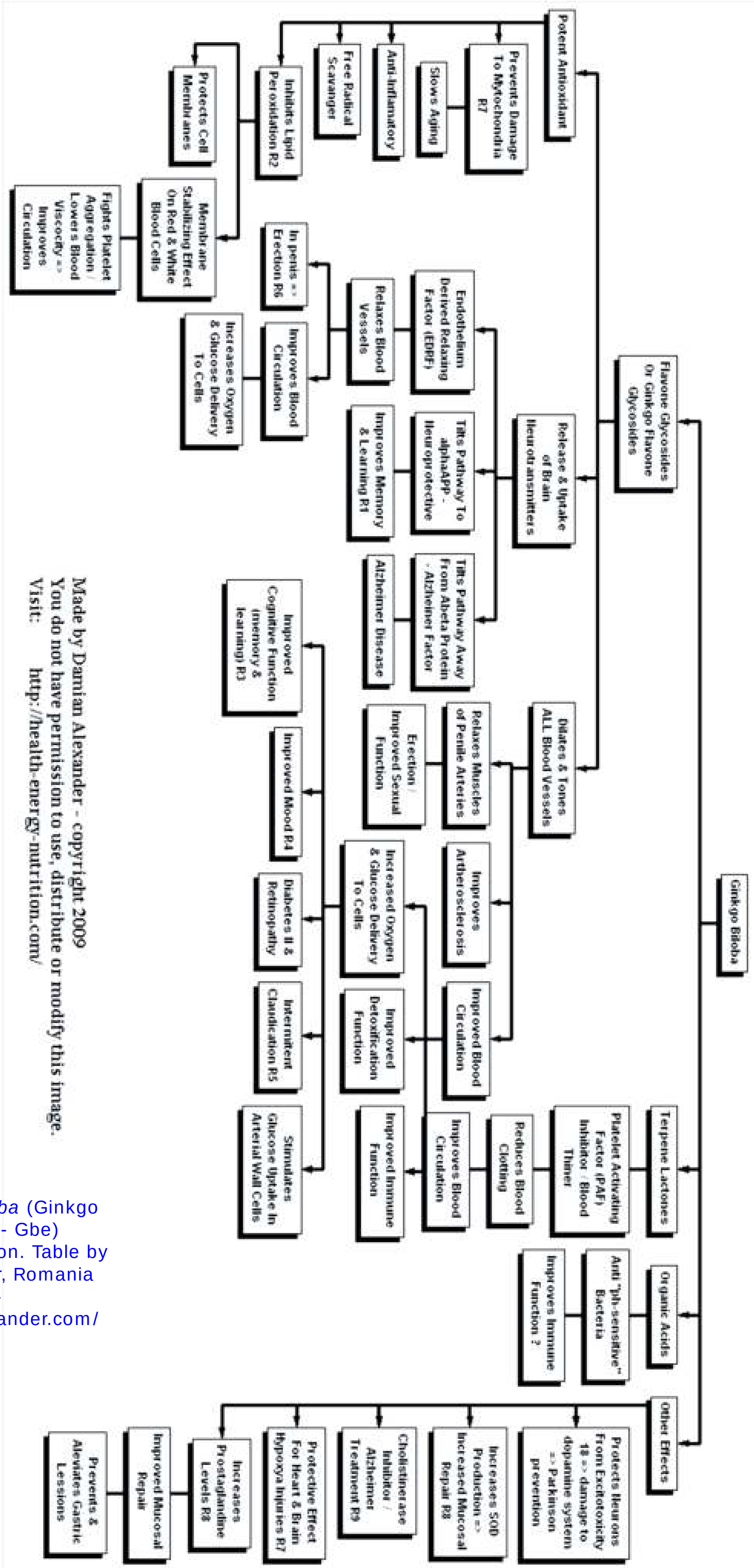


Table: *Ginkgo biloba* (Ginkgo biloba extract - Gbe) Mechanisms of Action. Table by Damian Alexander, Romania (2009) - http://damianalexander.com/

Special Thanks

I have to take this opportunity to thank especially to the many collaborators; friends, acquaintances, many state and private institutions, associations ... without which it would be impossible to make this work. Special thanks to all those good people and institutions who have often without a lot of questions allowed the use of their data and illustrations even they did not even know me (and do not want special thanks), but they believed and what was most important to them, that their information and materials would contribute to better and clearer presentation and knowledge of these specific plants.

Special Thanks:

Mr. Zhi-Yan Zhou, State Key Laboratory of Palaeobiology and Stratigraphy, and Department of Palaeobotany and Palynology, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, China.

Mrs. Elvira Koić, General Hospital Virovitica, Head of psychiatry, Virovitica, etc., Croatia.

Mr. Hubert Steed, New York, NY, 1 Washington Square Village Apt. 9A, USA.

Mr. Kaori Yamamoto & Kawasaki Midori Kenkyuusyo, Kawasaki Green Investigation, Japan.

Mrs. Laura M. Ferguson, Scientific Equipment Group, Olympus America Inc. Market Strategy and Olympus America Inc., USA.

Mrs. Blanka Capić, Lekenik, Croatia & web site www.pijanitvor.com

Mr. Marijan Begović, Pitomača, Croatia (Foto-video Begović).

Mr. Zsolt Mesterhazy, Member of ACS as „The Mesterhazy Pinetum" 1082 Budapest, Baross utca 109. I. 6., Hungary.

Mr. Eric Clark & National High Magnetic Field Laboratory, The Florida State University, USA.

Mr. Lu Lav, Taiwan, China.

Mr. Josip Barišić, Zagreb, Croatia.

Mrs. Katie Archer, Brooklyn, NY, USA.

Mr. Daniel Kraly, Nürnberg, Germany.

Mr. Pavel Hrubík, Slovak College of Agriculture, Faculty of Horticulture and Landscape Engineering, Department of Green Biotechnics, Nitra, Slovakia.

Mrs. Katarína Ražná, Dept. of Plant Physiology, Fac. Of Agronomy, Slovak Agricultural University in Nitra, Slovakia.

Mr. Peter Del Tredici, Senior Research Scientist Arnold Arboretum of Harvard University, Boston - Lecturer, Harvard Graduate School of Design, Cambridge, USA.

Mr. Rade Rakić, Croatian Forests of Croatia, Head of botanical nursery (Hrvatske šume), Križevci, Croatia.

Mr. Tomislav Jakupec, Croatian Forests of Croatia, Head of botanical nursery (Hrvatske šume), Pitomača, Croatia.

Mr. Marjan Šavorić, Sveti Ivan Zelina, Croatia.

„Dr. Willmar Schwabe GmbH & Co. KG, International Division", Willmar-Schwabe-Str. 4, 76227 KARLSRUHE, Germany.

Mr. Roger D. Magarey, Senior Researcher, North Carolina State University and Cooperator with USDA-APHIS-PPQ-CPHST-PERAL 1730 Varsity Drive, Suite 300, Raleigh, NC, 27606, USA.

Mr. Edwin Smits ("coniferjoy"), Boomkwekerij Edwin Smits, Volkel, Netherlands.

Mr. Antony Williams & Royal Society of Chemistry, UK. www.chemspider.com.

Shane Kelley/Kelley Graphics, USA.,Kelley Graphics, 14902 Kamputa Dr., Centreville, VA 20120, USA.

Natural Resources Canada (Canadian Forest Service) and Agriculture and Agri-Food Canada. Reproduced with the permission of Natural Resources Canada, Canadian Forest Service." The image of the map will include the following: © Her Majesty the Queen in Right of Canada, 2007.

Mr. Dax Herbst ("gardener365"), Illinois, USA.

Mrs. Becker H.G. & Ginkgo Museum, Weimar, Germany.

Mr. Ewen Brown, Nottingham, England, UK.

Mr. Christian Lappen (Pflanzenhandel Lappen Inh. Christian Lappen e.K.), Nettetal, Germany.

Mr. David and Mrs. Chantal Bömer, Boomkwekerij Biloba v.o.f., Vagevuurstraat 6a 4882 NK Zundert, Netherlands.

Mr. Ender Stewart, Arrowhead Alpine, Fowlerville, Michigan, USA.

Mr. Stephen Grubb ("bluespruce53"), Foxhollow Garden, Old Sandpit Lane, Beacon Hill, Poole, Dorset, England, UK.

Mr. Harold Greer, Greer Gardens, Inc. 1280 Goodpasture Island Road, Eugene, Oregon, USA.

Mr. Dirk and Cor van Gelderen, PlantenTuin Esveld, Rijneveld 72, 2771 XS Boskoop, Netherlands.

Mr. Lloyd Gross ("fotoproze"), 310 Victoria Avenue #402, Westmount, QC, Canada.

Mr. Darko Domitrović - Miki, Pitomača, Croatia.

Mr. Dusan Hòrak, HORÁKOVY ŠKOLKY, BYSTŘICE pod Hostýnem, Czech Republik.

Yima City & Yima Coal Industry Group Co., Ltd., Henan Yima City, China.

Mr. Gert Fortgens & Trompenburg Tuinen & Arboretum, Honingerdijk 86, 3062 NX Rotterdam, Netherlands.

Mrs. Tatyana Shulkina, Associate Curator, Former Soviet Union (the Caucasus) Projects Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166-0299, USA.

Mr. Bruce Jordan, Big Plant Nursery, Hole Street, West Sussex RH20 3DE, Ashington, England, UK.

Mr. Vladimir Ondejcik - Bonsai centrum Nitra & Tea House of Good People, Pri synagoge 3, Nitra, Slovakia. www.e-bonsai.eu, www.e-tea.eu, www.bonsai-slovakia.sk, www.bonsajacaj.sk.

Mrs. Katerina Sloupenska and Domov pod hradem Žampach, Žampach Ch Republic. č.p.1, 564 01 Žamberk (and Dir. Mr. Luděk Grätz), Czech Republic.

Mr. Lester Kallus, the president of The International Aroid Society, PO BOX 43-1853, South Miami, FL 33143, USA.

Mr. Marcin Krakowiak, Poland.

Family Štefanović, Daruvar, Croatia.

Mr. Vanja N. Stamenković, Botanical Garden Zagreb, Croatia.

Mr. R. Oreški, Varaždin, Croatia.

Mrs. Ivana Simić, Beograd, Serbia.

Mrs. Irene Franseda, Singapure.

Mr. Ivan Rešetar, "Četinjače Rešetar 1977.", Đurđevac, Croatia.

Yima Coal Industry Group Co., Ltd., Henan Yima City, China.

Mr. Ivica Stožicki, Croatian Forests of Croatia, Head of botanical nursery (Hrvatske šume), Kutina, Croatia.

Mr. Masahiro Hayata ("Mr.Hayata" or "mrhayata"), Tokyo, Japan.

Mr. Marijan Jergović, Pitomača, Croatia.

Mr. Mirko Klinžić, Pitomača-Zagreb, Croatia.

Mrs. Gordana Sekulić, Daruvar, Croatia.

Mrs. Lidia Asl, Veli Lošinj, Croatia.

Mr. Chris Backe, Seoul, South Korea.

Mr. Vincent Mauritz, Netherlands.

Mr. Mladen Tudić, P. Sesvete, Croatia.

Mr. Zhou Peng & web site www.zszs.cn, China.

Mr. Yuming Xie, Department of Environmental Science and Engineering, Gradulate School at Shenzhen, Tsinghua University, Tsinghua L building room 112, University Town of Shenzhen, Nanshan District Shenzhen, China.

Mr. J. Iwan, Paris, France & www.jholm4525.wordpress.com.

Mr. "naoK", Tokyo, Japan.

Mr. Feng Changping, China & Chanchun Ginkgo Co LTD, China.

Mr. Dalibor Rohlik & City Administration Daruvar, Croatia.

Mr. Mark Derowitsch, The Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410, USA.

Mr. Orlóci László, (ELTE Botanical Garden), www.fuveszkert.org H-1083 Budapest, Illés u. 25. Hungary.

Mrs. Ivana Plažanin Vuković & Tourist Board Daruvar-Papuk, Turist office Daruvar, 43 000 Daruvar, Croatia.

Mrs. Kathrin Backhaus, Jelitto Staudensamen GmbH, Am Toggraben 3, 29690 Schwarmstedt, Germany.

Mr. Steve Grob, USA.

Mr. Daniel Wieczorek, Mitaka-shi, Tokyo, Japan (www.danwiz.com).

Mr. Todd Schaner („dybbuk"), Chicago, IL, USA (Dave's Garden).

Mr. Hans Arne Nakrem, Natural History Museum, University of Oslo, Pb.1172 Blindern, N-0318 Oslo, Norway (www.nhm.uio.no & www.folk.uio.no/hanakrem).

Sir Peter Crane, Yale School of Forestry and Environmental Studies at Yale University in New Haven, Connecticut, USA.

Mr. John Mackay, Creation Research (www.creationresearch.net/research/Jurassic-Ark-Project1.htm), Australia.

Mrs. Vanlommel Ingrid & Bonsai Center Ginkgo, 9270 Laarne - Belgium, www.ginkgobonsai.be

Mr. Paul Goff, Bonsai Center Ginkgo, 9270 Laarne - Belgium, www.ginkgobonsai.be

Studio SHIFT Chihiro Suzuki Photo Office: 803Takashimadaira Gloria Heights, 1-82-1 Takashimadaira, Itabashi-ku, Tokyo, Japan.

Mr. Yong Yi Zhen, Acting Collection Manager, Palaeontology & Australian Museum, 6 College Street Sydney, NSW, Australia.

Mrs. Katarina Loso and Yvonne Arremo - Department of Palaeobotany, Swedish Museum of Natural History, Stockholm, Sweden.

Mr. Dominic Sedgwick, Northbrook Road, London, England, UK.

Mr Mark P. Widrlechner, Ph.D. USDA-ARS Horticulturist, North Central Regional Plant Introduction Station, Iowa State University, Ames, Iowa 50011-1170, USA.

Mr. Les Park, Virginia, USA, http://www.atidewatergardener.blogspot.com.

Mr. Matt Opel, University of Connecticut, USA.

Mr. John H. Wiersema, Ph.D., Curator of GRIN Taxonomy (www.ars-grin.gov), United States Department of Agriculture/Agricultural Research Service National Germplasm Resources Laboratory, Bldg. 003, Beltsville Agricultural Research Center (BARC-West), Beltsville, USA.

Mr. Wolfgang Michel-Zaitsu, Japan. www.qir.kyushu-u.ac.jp.

Mr. Li Shi-mei, Li Bao-jin, Xing Shi-yan & Wang Fang, Shandong Agricultural University, Shandong, China.

Mr. Mattia Nicoli („icefenix"), Italia.

Mr. Jing-Xi Wang and Hong-Sheng Li & Linyi (Tancheng) Association for Science & Technology, China, www.lyast.org.cn.

Mr. Christian Scheuer, Karl-Franzens-University, Institute of Plant Sciences (Dept. of Systematic Botany & Geobotany), Holteigasse 6, A-8010 Graz, Austria.

Mrs. Nancy Rose, Editor, Arnoldia, The Arnold Arboretum of Harvard University, 125 Arborway, Boston, MA 02130, USA.

The Arnold Arboretum of Harvard University, www.arboretum.harvard.edu, USA.

Family Pernarich, Belgium.

Mr. Ivan Derežić - Bazara, Pitomača, Croatia.

Mr. Tim Copeland, USA.

Mr. Roger Perkins & The Virtual Fossil Museum, www. fossilmuseum.net.

Mr. Zhou Xiaolin, China & www.youduo.com.

Mr. Tony Kirkham, Head of the Arboretum, Royal Botanic Gardens Kew, England, UK.

Mr. Kim D. Coder, University of Georgia, Athens, Georgia, USA.

Mr. David Mitchell, USGS/BIP, ITIS Data Specialist, National Museum of Natural History, Washington, USA.

Rich's Foxwillow Pines Nursery, Inc. Woodstock, IL, USA www.richsfoxwillowpines.com.

Mrs. Afsana Rashid Bhat, Global Press Institute, Kashmir, India.

Mr. Ben Sherwood & The Linnean Society of London, London, UK www.linnean.org.

Mr. Yin Kaipu, Chengdu Institute of Biology, Chinese Academy of Sciences, Sichuan, China.

Mrs. Yoko Takemoto, University of Tokyo, Tokyo, Japan.

Mr. Aaron H. Bynum, AUF, ISA, Editiorial & Production. IL, USA.

Mr. Charles H. Michler & R. P. Karrfalt, USDA Forest Service, USA.

Mr. Darko Mađar, Croatia.

Mrs. Yabette Alfaro (Swankety Swank), San Francisco, www.swanketyswank.com, USA.

Mr. Charles Swinford, USA.

Mrs. Ivona Pankaz, Croatia.

Mr. Fernando Nogal, Museu da Lourinha (GEAL), Portugal www.museulourinha.org.

Mr. Paul Gordon, USA www.pauloutwest.com, www.pauloutwest.wordpress.com.

Mr. Jan Purkrábek, Czech Republic www.proginkgo.org.

Mr. Michael Pop, Kentucky, USA www.louisvillefossils.blogspot.com.

Mrs. Janet Goh, Singapore www.homediningfoodblog.com.

Mr. Robert Lovett, USA www.lovett-pinetum.org.

Mr. Robert Salvo & Carol Jones, Charleston, USA.

Tancheng Xinsheng Ginkgo Co., Ltd , Locus of Xincun Government, China www.ginkgohometown.com.

Mrs. Jeanine M. Davis, Ph.D. Associate Professor and Extension Specialist Dept. of Horticultural Science, NC State University, USA www.ncherb.org, www.ncspecialtycrops.org, www.ncorganic.org, www.ncalternativecropsandorganics.blogspot.com.

Mr. David Petersen & Mandy Conti, Japan.

Mrs. Lyn Stoll, USA www.lynstoll.com.

Mr. Eric Walravens, Athénée Fernand Blum, Belgium www.afblum.be.

Mrs. Carla Resnick, California, USA http://permacal.blogspot.com.

Mr. Aleksandar Novak, Croatia.

Mr. Qin Gang, China.

Heredity, Nature - www.nature.com, Department of Agriculture - USA, Arnold Arboretum of Harvard University - USA, University of Georgia - USA, North Carolina State University - USA, Journal of Arboriculture - USA, Acta Genetica Sinica - USA, www.cn-ginkgo.com.cn - China, Kew Gardens - London, UK, Pasadena Beautiful Foundation, California - USA.

Mrs. Christine Mytko, www.mytko.org, California, USA.

Mrs. Joan and Mr. Lex Lane, Illionis, USA www.habitathome.blogspot.com.

Mrs. Sue Capon (Prince Edward County News), UK www.countylive.ca.

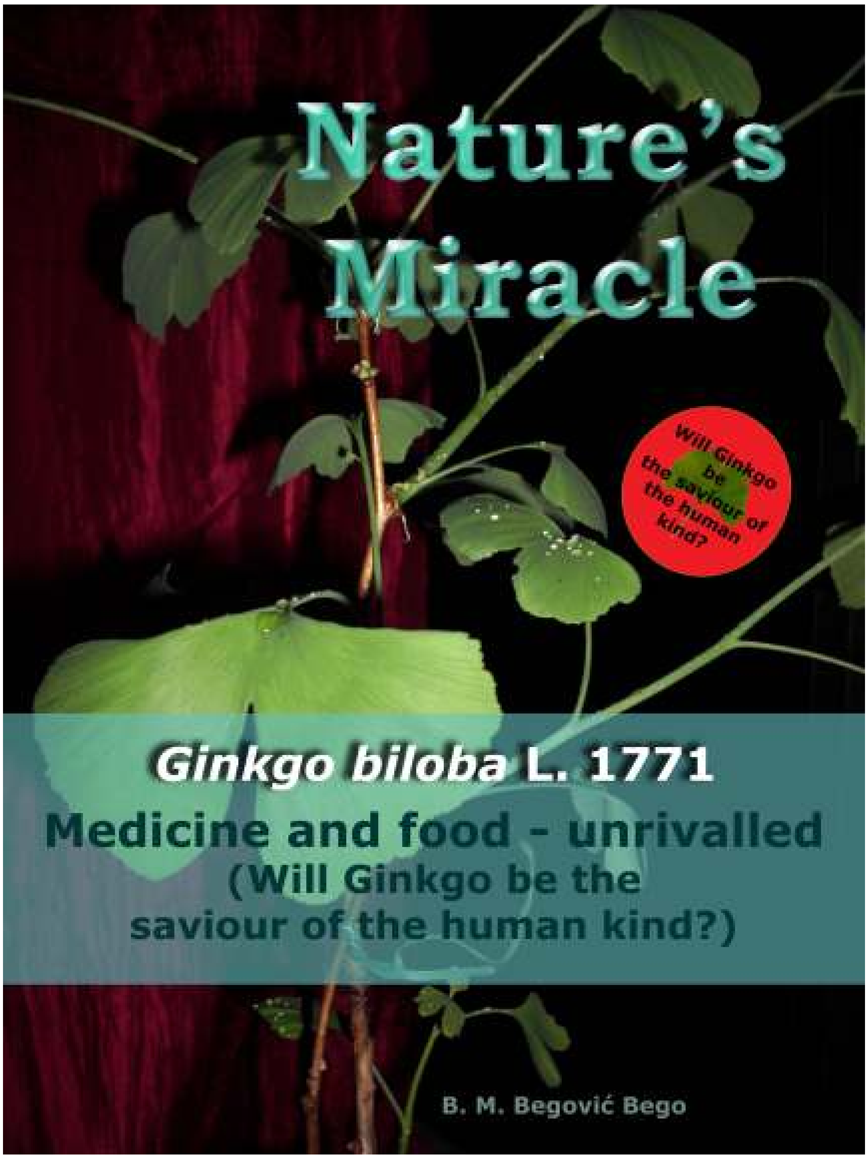
Mr. Shouta Azumi (or “Bachstelze”), Japan.

Mr. Macha531, Japan.

Department of Botany, Faculty of Science, University of Tokyo, Japan.

Mr. Damian Alexander, Romania.

Mr. Kamatsuka, Japan.



The next part

Nature's Miracle

Volume 3: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)"

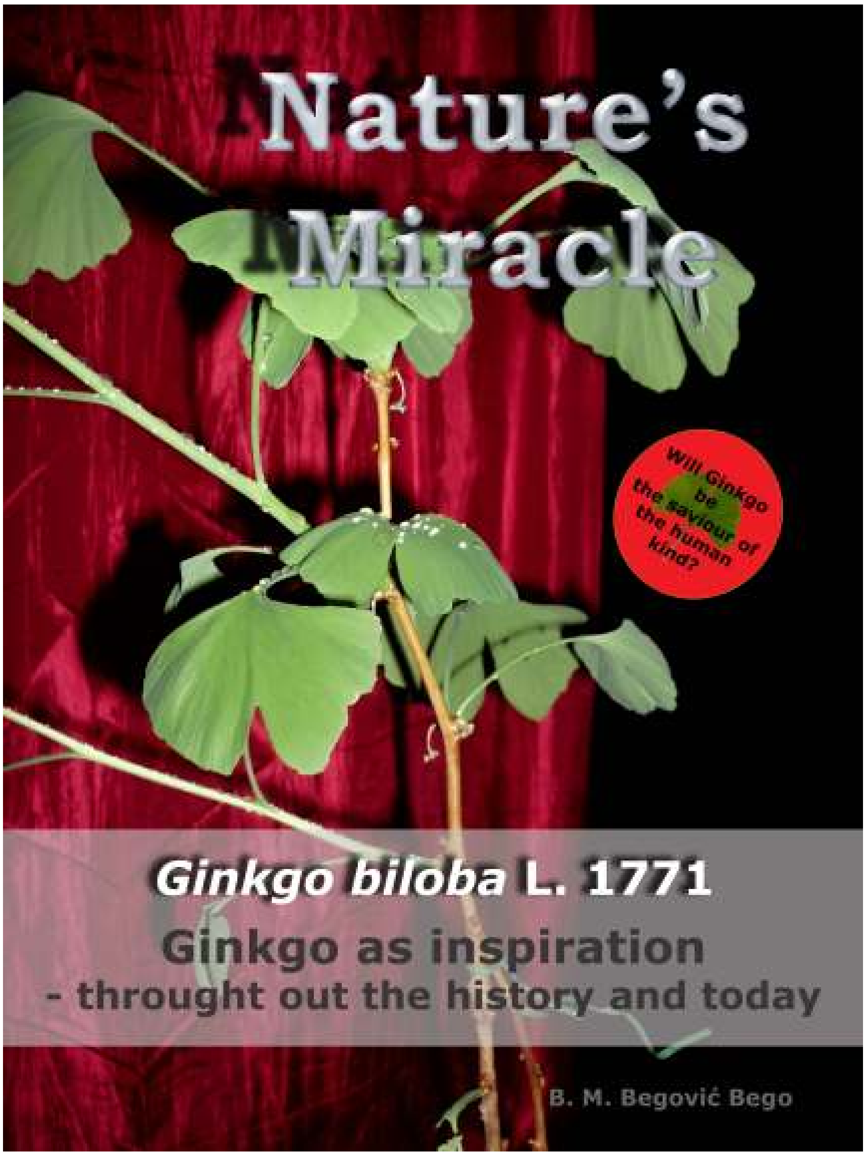
- Medicine and food - unrivalled (Will Ginkgo be the saviour of the human kind?)

1. Chemical composition, chemical compounds etc.

2. Ginkgo in alternative or tradicional medicine

3. Ginkgo in official medicine

4. Ginkgo in the nutrition



The next part

Nature's Miracle

Volume 4: "*Ginkgo biloba* L. 1771 - All about Ginkgo (or Maidenhair tree)"

- Ginkgo as inspiration - through out the history and today

ISBN 978-953-56963-0-8