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The Integrality of Tropical and Subtropical Flora and Vegetation*

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Abstract The Chinese flora came neither from the Pan-Arctic nor from the tropic. It is also not a mixture of the Pan-Arctic and the tropical floras. They originated on the Cathaysian ancient land during the early Mesozoic. After that period, the north border of the ancient land covered the south parts of North-East (South Manchuria), Inner Mongolia, North slope of Tianshan and Japan proper. The southern border, created by the Indo-China mountain movement which started at the end of Triassic, covered the Indo-China and Malay Peninsulas, Sumatra and Kalimentan, and may extended to Luzon Island and other place. Cathaysia is one of the origin centers of the flowering plants which originated after Triassic-Jurassic. It can be proved with the exist of many relics and primitive taxa as well as the flourish of relic gymnosperms and conifers. During that period, Malesean flora was a part of Cathaysian flora. The tropic and subtropics is an integration. After Cretaeous, there was a drought climate all over the Cathaysia, which can be proved with the exist of "red deposit" distributed over the ancient land, many of plants were compelled to change their areal. The heat-resistance plants, such as dipterocarps which originated after Cretaceous, became dominant in the tropical forest. And the older taxa, such as *Magnoliaceae* and *Hamamelidaceae* were forced to distribute on the tropical and subtropical mountain.

The deciduous trees originated in the tropic and subtropic owing to the drought climate, not in Pan-Arctic or temperature zone because of the lower temperature. Furthermore, the Coniferae also not originated in Pan-Arctic or temperature zone but at subtropic mountain. This can be indicated there are totally 10 genera of *pinaceae* and 8 of the 9 genera of *Taxodiaceae* distriduted at subtropical mountain.
Keywords tropic and subtropic, flora, vegetation, Cathaysian ancient land

The tropical flara is much complicated and flourished than those distributed in other regions. It is characterized with great number of endemics, which are not found in other place except the tropic. Tropical forests also have manifold physiognomy and structure, which are

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affected by the favorite hacitat condition. All of these are very attractive to the botanists

As to the origin of the tropical flora, many hypotheses were proposed by different botanists. One of these, the theory of Pan-Arctic flora Tertiary immigration, according to the exist fossils of certain tropical and subtropical taxa found in the Arctic region, suggested that the flowering plant originated in Pan-Arctic region. Then after the Tertiary, they were drove by the glaciers to the south region, where they acquired the survived refuge. Some of the other hypotheses insisted that the origin center of the flowering plant located at the tropical regions and then dispersed to the whole world. According to these hypotheses, the Chinese flora is a mixture of tropical and Arctic floras. As we can see from the world floristic regionalization, the northern Chinese flora belongs to Pan-Arctic kingdom. and the southern Chinese flora belongs to Paleotropic. However, once the geological history of the Cathaysian ancient land from the period of Paleozoic to that of Mesozoic have been studied carefully, and the characters of fossils and the survived plants have been compared, togather wtih the paleoclimate, the phylogeny of the spermatophyte and the tropical and subtropical floras, we will have a quite different conclusion that the Chinese flora was originated on Cathaysian ancient land properly during Triassic or Jurassic. Meanwhile, at the end of Triassic, the Indo-China mountain movement happened on the south part of Cathaysia, combined both Indo-China Peninsula and Malay Peninsula with the Cathaysia. Furthermore, Sumatra and Kalimentan or Luzon Island also belong to the ancient land. However, the tropical flora in these regions seems much younger than those on the ancient land, although they are a part of the Cathaysian flora.

1 The Characteristics of Asian Tropical and Subtropical Floras

The Asian tropical flora, which has many endemics that are not found outside the tropic, another bearing broad range of ecological habitat which usually dispersed out and distributed to subtropic. The well known tropical endemic plants are *Dipterocarpaceae*, *Anonaceae*, *Myristicaceae*, *Hernandiacea*, *Lecythidaceae*, *Rafflesiaceae*, *Ancistrocladaceae*, *Guttiferae*, *Nepenthaceaed* and *Icacinaceae*, etc.

The endemics in subtropical region are *Trochodendraceae*, *Tetracentraceae*, *Eupteleleaceae*, *Cercidiphyllaceae*, *Eucommidiaceae*, *Bretschneideraceae*, *Coria-*

riaceae, *Circaeasteraceae*, *Saururaceae*, *Sargentodoxaccae* and *Styracaceae*, etc. Most of their areal limit in subtropic, and rare extend to tropic or temperate zones.

Many other families, which have broader range of adaptation, distribute on both tropic and subtropic. Among these, some are particularly concentrated at tropic, and others on subtropic mostly. The species of *Piperaceae*, *Elaeocarpaceae*, *Sterculiaceae*, *Tiliaceae*, *Datiscaceae*, *Moraceae*, *Euphorbiaceae*, *Flacourtiaceae*, *Myrtaceae*, *Menispermaceae* *Saurauiaceae*, *Melastomaceae*, *Dilleniaceae*, *Pittosporaceae*, *Meliaceae*, *Sapindaceae*, *Olacaceae*, *Anacadiaceae*, *Sapotaceae*, *Loganiaceae*, *Ebenaceae*, *Rubiaceae* and a number of genera of *Lauraceae* are concentrated in tropic, although some of them disperse to subtropic. on the other hand, the species of *Magnoliaceae*, *Hamamelidaceae*, *Theaceae*, *Fagaceae*, *Chloranthaceae*, *Urticaceae*, *Aquifoliaceae*, *Ulmaceae*, *Rhamnaceae*, *Rutaceae*, *Aceraceae*, *Myrsinaceae* anb *Verbenaceae* are mostly concentrated at subtropic, although some of them can be found in tropic.

The endemics and dominant families in tropic, such as *Dipterocarpaceae*, *Myristicaceae*, *Icacinaceae* and *Guttiferae*, have complicated genera and species. They are young in phylogeny. The endemics in subtropic, such as *Trchodendraceae*, *Tetracentraceae*, *Eupteleaceae*, *Cercidiphyllaceae*, *Eucommiaceae*, *Circaeasteraceae* and *Sargentodoxaceae*, are monotypic and relics in phylogeny. They did not come from *Magnoliaceae* as suggested by some phylogenists. The evidences of morphology and structure clearly shown they are much primary than *Magnoliaceae* and came from the much older and primitive taxa which were perished in the past. As a relic taxon, it declined in ontogeny and phylogeny, and not be a dominant in subtropical forest any more. This means it has given the way to those younger taxa for a long period. such as *Magnolicaceae*, *Hanamelidaceae*, *Theaceae*, *Fagaceae*, *Aquifoliaceae*, *Lauraceae*, *Symplocaceae* and *Euphobiaceae*. But some of these are also going to be the decline taxa. For example, the genera of *Hamamelidaceae*.

Dipterocarpaceae, one of the dominant family in tropic, perhaps came from *Dilleniales* or *Theales*. Other dominant families, such as *Meliaceae* and *Sapindaceae*, might come from the discifloral ancestor such as *Saxifragales*. All of them are younger than those subtropical dominant families such as *Magnoliaceae*, *Hamamelidaceae*, *Lauraceae*, *Theaaceae and Fagaceae*. In short, the dominant families in tropic is much younger than those in subtropic.

There are special physiognomic and structural characteristics in tropical forest, particularly in the low-land rain forest and montane rain forest. These characteristics include buttress, cauliflory, epiphyte, naked buds and woody lianas, especially the climbing bamboos and ferns. All of these are symptomatic characteristic of tropical rain forest and hardly found outside the tropic. Even the subtropical forest rarely show such a physiognomy and landscape, This is owing to the tropical climate but not the characteristics of the tree species. For example, the trees of *Quercus*, *Lithocarpus* of *Fagaceae*, and *Litchi* of *Sapindaceae*, as well as *Schima* of *Thaceae*, show very prominent buttress in tropical forest. But it is hardly to find such phenomena in subtropic.

2 The Characteristics of Vertical And Horizontal Distribution in Tropical and Subtropical Floras

Temperature is one of determinate factors which limit the plant distribution. Regularly, the temperature is getting lower as the altitude increases. This is also true when we move from the lower latitude area to the higher one. The flora and the vegetation compositions change to correspond the variation of temperature. For example, in tropic, there are four or even more vegetation types from the low-land to high mountain. The low-land rain forest distributes on the low-land area, which is dominated by the species of *Dipterocarpaceae*, *Anonaceae*, *Podocrapaceae*, *Verbenaceae*, *Euphorbiaceae*, *Meliaceae*, *Sapindaceae*, *Flacourtiaceae*, *Samydaceae*, *Caesalpiniaceae*, *Mimosaceae*, *Dilleniaceae*, *Sterculiaceae*, *Datiscaceae*, *Apocynaceae*, *Sapotaceae*, *Ebenaceae*, *Loganiaceae* and the others. Above 1000m, there is the montane rain forest dominated by the species of *Magnoliaceae*, *Fagaceae*, *Hamamelidaceae*, *Elaeocarpaceae*, *Tiliaceae*, *Theaceae*, *Myrtaceae*, *Lauraeae*, *Papillionaceae*, *Aquifoliaceae*, *Araliaceae*, *Symplocaceae*, *Rubiaceae* and *Palmae*, etc. Since the affection of the mountain, most trees in mountain rain forest are prominent with lowland rain forest structure, such as buttress, epiphyte, cauliflory and woody lianas, particularly the climbing bamboos.

From 1400m and upward, the tropical montane evergreen broad-leaf forest distribute above the tropical mountain rain forest. The dominant trees are usually the same allies as those of the montane rain sfrest, and co-dominant by the species of *Ericaceae*, *Rosaceae*, *Berberidaceae*, *Pinaceae*, *Betulaceae*, *Aceraceae*, and occasionally the *Populus*. No typical rain forest structure can be found in this type of vegetaion. Although the humidity

is higher than that in the rain forest area, the temperature is quite lower as the altitude increases. Obviously, the rain forest structure and the landscape are mainly caused by the temperarure but not the humidity.

Above the montane evergreen broad-leaf forest, that is the tropical high montane scrub, which is dominated by the species of *Theaceae*(*Ternstroemia*), *Ericaceae*, *Vacciniaceae*, *Clethraceae*, *Buxaceae*, *Thymelaceae* (*Wikstroemia*), *Pyrolaceae*. At the uppermost part of the mountain, the mountain grassland distributes. The common species are those from *Carex*, *Primulaceae*, *Saxifragaceae* and *Gentianaceae*.

In subtropic, there are also four to five zonations from the lowland to the high mountain. The evergreen broadleaf forest exists on the lowland. It composed of the species of *Magnoliaceae*, *Hamamelidaceae*, *Lauraeae*, *Theaceae Fagaceae*, *Elaeocarpaceae*, *Tiliaceae*, *Araliaceae*, *Aquifoliaceae*, and *Symplocaceae*. On the southmost part of the subtropical, the species of *Euphobiaceae*, *Moraceae*, *Myraceae* and some tree ferns grow on the underground of the forest. Near the temperate zone, deciduous trees suc as *Tiliaceae*, *Aceraceae*, *Betulacaee*, *Corylaceae* as well as the deciduous *Fagus* compose the mix-forest with the evergreen trees, or form a deciduous forest.

Above the evergreen forest, there is a bamboo or needle-leaf forest, which is composed of *Pinus*, *Keteleeria*, *Tsuga*, *Cryptomeria*, *Picea* and *Abies*. Above the needle-leaf forest, it is the montane scrub composed of *Ericaceae*, *Clethraceae*, *Berberidaceae*, exceptionally, in the south-west part where it is dominated by *Rhododendron* in the high mountain. The mountain grassland, which distributes on the uppermost part of the mountain, is dominated by *Saxifragaceae*, *Gentianaceae*, *Primulaceae*, *Scrophulariaceae* (*Pedicularis*), *Pyrolaceae*, *Compositae* (*Saussaurea*), *Carex* and *Kobrossia* of *Cyperceae*, and *Poa of Poaceae*.

In China, the tropical dominant species of *Dipterocarpaceae* never exceed the line of tropic of Cancer, since the extreme cold current of the Arctic usually flows southward and exceeds to the tropic of Cancer in the winter. If there is a shelter, they will extend northward and exceed the tropic of Cancer. As we have seen on the south slope of Himalaya, *Dipterocrpus* (*Shorea*) extend to 29°N and 1000m by altitude. some other tropical composition, such as the species of *Moraceae*, *Euphobiaceae*, *Myrtaceae* as well as the tree ferns *Cyatha*, distribute to about 28°N in subtropic and form underneath synusia.

The tropical montane rain forest is similar to the subtropical ever-

green forest but characterized with more prominent rain forest physiognomy and structure. However, unlike the subtropical forest, there is no needle-leaf forest or deciduous zone above the montane rain forest in tropic, but occasionally some needle-leaf trees and deciduous trees distribute scatterly amid the evergreen broad-leaf zone.

The composition of the subtropical mountain evergreen broad-leaf forest is almost the same as that is tropical montane rain forest. Most of the subtropical dominant species usually distribute southward and disperse to tropical montane region. They also dominant in tropical montane rain forest and mountain evergreen forest with some other tropical composition. The florisic history has proved that the tropical montane rain forest and the subtropical evergreen forest have the same origination. However, it is not suitable to consider that the subtropical evergreen forest derived from the tropical forest. Present evidence has supported such an idea that *Magnoliaceae*, *Hamamelidaceae*, *Theaceae*, *Fagaceae* were originated from subtropical mountains. On the other hand, the subtropical dominant species are not often dispersing to the temperae zone as expected. This is because the temparature in the temperate zone is not so favorable. And only some of the deciduous species, which include *Quercus*, *Tilia*, *Fraxinus*, *Picrasma*, *Liquidambar*, *Juglans*, *Alnus*, *Populus*, *Acer* and *Ulmus*, disperse to the higher altitude area.

3 The Integratson of Tropical And Subtropical Floras

During the Paleozoic period, the sea transgression frequently flowed over the Cathaysian ancient land. And the sea water made the ancient land divide into many landmasses. During that period, the Cathaysia situated at the east, including the south part of North-east (south Manchuria), Inner Mongolia, North slope of Tianshan in Xinjing. The evidence with fossils shows that the ancient land also cover Japan, east and south China and extend to Malay Peninsula and Sumatra. The west part of Cathaysia includes Xichuan, Huai-yang, Jiang-nan, Kang-dian and other landmasses. And the south part includes North Vietnam and Indo-China landmasses. Until Mesozoic, the sea transgression was ceased by the mountain movement. Cathaysia and other landmasses combined into a unity which had almost the same area as the present territory of China except the utmost west part. At the end of Triassic, the Indo China mountain movement happened and it prolonged until the early Cretaceous. This movement combined the Indo-China and Malay Peninsulas,

as well as Sumatra and kalimantan, with the Cathaysia together.

The flowering plants might be originated at the period of Triassic. And Cathaysia was one of the origin center. This can be proved with the existence of relics and primary taxa which we listed above. The components of Cathaysian flora dispersed southward at the same time and occupied the tropical regions. For example, *Magnoliaceae*, *Hamamelidaceae*, *Fagaceae*, *Lauraeae*, *Theaceae* are Cathaysian endemics. Some of their descendants have been found in Malesian flora and become the dominant species in the tropical montane rain forest. As we know, 11 of the 13 genera in the family *Magnoliaceae*, i.e., *Liriodendron*, *Talauma*, *Magnolia*, *Manglietia*, *Michelia*, *Tsoongiodendron*, *Kmeria*, *Parakmeria*, *Paramichelia*, *Pachylarnax* and *Alcimandra* distribute in south China. And only 6 genera, i.e., *Talauma*, *Elmerrellia*, *Michelia*, *Alcimandra*, *Aromadendrom*, *Pachylarnax*, were found in Malesian flora. moreover, all the subfamilies of Hamamelidaceae, especially the five primitive sebfamilies i.e., *Disanthoideae*, *Rhodoleioideae*, *Exbucklandioideae*, *Mytilarioideae* and *Liquidambaroideae* are naturally the Chinese endemics. While only three genera, i.e., *Altingia*, *Exbucklandia*, *Rhodoleia*, in Maleslan flora, each is represented with one species only. As to *Theaceae*, especially the primitive subfamily *Theoideae*, there are 11 genera in Asia, and 9 of these genera and more than 300 species were found in south China. But in Malesian flora, only 5 genera and quite a small number of species exist.

As to the primitive taxa, such as *Trochodendraceae*, *Tetracentraceae*, *Eupteleaceae* and *Cercidiphyllaceae* did not disperse to Malesia. It is supposed that relic taxa were lesser vigorous on competition with their successors such as *Magnoliaceae*, *Hamamelidaceae*, *Fagaceae*, and *Theaceae*. On the other hand, the dominant taxa of the tropical flora, such as *Dipterocarpaceae* did not disperse to the subtropical. Perhaps *dipterocarps* were originated at the end of Cretaceous or even Tertiary, during that period the seasonal variation was much serious and became an obstruction for the heat-resistance plant to enlarge their areal and oppressed them to retain on the tropic.

It has been assumed that the other taxa, such as *Gentianaceae*, *Primulaceae*, *Pyrolaceae*, *Ericaccae*, *Clethraceae*, *Saxifraganccae* and *Scrophulariaceae*, were originated from Pan-Arctic or north temperate. Actually, this is not true and they were subtropical mountain origin, since there are many species of these taxa were found in the subtropical mountain regions than that in the temperate region. For example, considering the well known

genus *Pedicularis* of *Scrophulariaceae*, about 600 species have been reported on the north hemisphere, and more than 80% of these species distribute on subtropical mountain, particularly in Yunnan, Xichuan and Himalaya. they were originated from subtropical mountain and extended to temperate region, but not originated from the Pan-Arctic and then drove to the south mountain region by the glaciers.

4 The Flora Differentiation Caused by the Climatic Change

During Jurassic, the climate on Cathaysia was quite moist and homogeneous, and the seasonal variation is not so serious. At that period, Cycas dominated in the forest and occupied all over the Cathaysia ancient land. Almost all the Triassic and Jurassic coalbeds on the south China were formed by Cycas. Recently, there are still Cycas forest existed along the Jinshajiang Valley in yannun and Xichuan border. After the mid-Cretaceous there was a drought climate on the Cathaysian ancient land, and this can be proved with the "Red deposit" on the Cathaysia. Such a serious climatic change was very catastrophic and harmful to the survive of the plants. They were compelled to regulate their habitat and adaptation. Therefore, the forth differentiation reaction happened with various originated taxa. Those taxa adapted to the moist climate immigrated to the mountain or the valley. Other taxa, which had broader range of resistane or created during the period of Cretaceous, could endure the disaster climate. There were still some taxa which were compelled to change their ecological characteristics in order to adapt the new environment, otherwise they might be eliminated in the areal. The so-called "Laurisilva" or "Laurignosa", which is very common in the East Asia, might be the result of this adaptation. The survived *Cycas* forist also showed the same adaptation. On the other hand, many tropical and subtropical deciduous species, such as *Bombax*, *Tectona*, *Albizzia*, *Antiaris* and *Liquidambar* have another adaptive pattern. This is easy to explain why the relics like *Tetracentron*, *Coriaria* and *Rhoiptelea* are deciduous, and they did not distribute to tropic as the same as *Trochodendron*, *Euptelea*, *Circidiphyllum* or as the dominant taxa in the subtropical forest. As to the dipterocaps dominated in the tropical forest, which were created at Cretaceous, have very strong vitality and hot resistance. Under the conditions of drought weather, the species of *Magnoliaceae*, *Hamamelidaceae*, *Fagaceae*, and *Theaceae* could not but evacuate from the lowland to the mountain area with higher humidity and dominated in the subtropical montane

structure than those subtropical dominant taxa, their ancestor might come from the more primitive taxa of the subtropic. As to those dominant taxa tion of the floristic composition also continued. The cold current from Arctic during the winter limit the tropical plant moving northward. In south China, the tropical plants such as dipterocarps never exceed the tropic of Cancer. If there was no cold current from Siberia, dipterocarps, the Dominant species in the tropic, would disperse northward to the subtropical region. As we can see on the south slope of Himalaya, *Shorea robusta* extends to 29°N and disperse to the mountain with 1100m height. The tropical and subtropical deciduous trees, which could adapt to the lower temperature during the winter, usually extend to the temperate region. These include *Picrasma*, *Liquidambar*, *Betula*, *Toona sinensis*, *Quercus variabilis*, *Q. acutinssima*, *Magnolia liliflora*, *M. denudata* and *M. parviflora*. Such a phenomenon could be proved by the anatomical evidences which show that the deciduous species of *Magnolia*, *Quercus*, *Celtis*, *Salix* and *Tilia* have very advanced and secondary woody structure than that of the evergreen species.

5. Discussion and Conclusion

(1) Essentially, the flora in Asian tropic and subtropic is an integration. They originated at Triassic on the Cathaysian ancient land. The hypotheses of Pan-Arctic origination and the Arctic Tertiary flora immigration cannot be supported with the reality of the Chinese flora and also unable to resolve the problem of the Chinese flora origination. We believe that the tropical and subtropical plants did not come from the Pan-Arctic. Also other taxa such as *Ericaceae*, *Aceraceae*, *Betulaceae*, *Corylaceae*, *Juglandaceae*, *Primulacae*, *Gentianaceae*, *Borraginaceae*, *Caprifoliaceae*, *Pyrolaceae*, *Dipensiaceae* and *Monotropaceae*, which were supposed to come from the pan-Arctic, actually immigrated from the subtropical mountain. For example, nearly 80% species of *Pedicularis* of *Scrophulariacea* distribute on the subtropical mountain. Particularly the primary taxon of this genus was found in subtropic.

(2) Geologically, the Asian tropical peninsulas and archipelago arose during the late Mesozoic but it was unstable. There is not primitive taxa found in this region. Nearly all the species are secondary in phylogeny and might derive from the subtropical primitive taxa. The dominant taxa in tropic came from or derived from the taxa in subtropic. Therefore, the so-called "tropical origin" is subtropical origin in fact. Since the dominant taxa in tropic, such as *Dipterocarpaceae*, have much advanced

rain forest. Such a situation of the adjustment is kept until today.

After Tertiary, the climate zonation was going on and the regula- in the tropical montane rain forest, such as *Magnoliaceae*, *Hamamelidaceae*, *Fagaeae*, and *Theaceae*, were not tropical origin, but derived from the descendants of subtropical dominant taxa during the late Cretaeous since the drought condition. Then they invaded into the mid-mountain area in tropic.

(3) The deciduous trees were not induced by the low temperature but the drought climate. therefore they did not come from the temperate zone. For example, many tropical deciduous trees, such as *Bombax*, *Tectona*, *Albizzia*, *Antiaris* and *Lannea*, were clearly induced with the arid climate. Those trees which can distribute or extend to temperate zone, such as *Quercus*, *Juglans*, *Betula*, *Corylus*, *Alnus*, *Celtis*, *Acer*, *Fraxinus* and *Populus*, were originated from subtropical mountain, They were also induced with the Cretaceous drought climate and than extended to the temperature zone. Wood anatomy has provided the evidence that the xylem structure of evergreen trees, such as *Magnolia* and *Celtis*, are much primitive than those of deciduous. Researches on *Coniferae* also support this. *Pseudolarix* is limited in sudtropic, its deciduous characteristic was not induced with the low temperature. Those common needle leaf genera in temperate, such as *Pinus*, *Picea*, *Abies* and *Larix* were subtropical origin and then extended to the temperate zone.

(4) *Coniferae* did not come from the temperature zone and then drove south ward by the glaciers as the hypthesis supposed by the traditional viewpoint. For example, let us consider the family *Pinaceae*, which is very common in the temperate zone. Four of the ten genera in this family, were found in north temperate zone. These include *Pinus*, *Picea*, *Abies* and *Larix*, and each genus only has a few species in the north region. However, all the 10 genera in this family can be found on the subtropical mountain. Except those 4 genera listed above, the other 6 genera, *Keteleeria*, *Cathaya*, *Pseudolarix*, *Cedrus*, *Tsuga* and *Pseudotsuga*, are subtropical endemics. The last two genera distribute on the subtropicalmoun tain between Asia and north America. All of them were not originated from the north temperate zone nor drove by the glaciers between Tertiary and Quaternary. The situation of *Taxoidiaceae* is nearly the same as *Pinaceae*. All of the 9 genera in this family, *Cryptomeria*, *Cunninghamia*, *Glyptostrobus*, *Taiwania*, *Metasequoia*, *Sciadopitus*, *Taxodium*, *Sequoia* and *Sequoiadendron*, were originated from the subtropic. Among the 17 genera in the family *Cupressaceae*, only one or two species extend to Arctic region. As to *Podocarpaceae*, all the genera and species were originated from subtrepic

in north and south hemispheres.

(5)The flora of tropic and subtropic have the same origin. Both floras combine into an integration. They arose on the Cathaysian ancient land during the period of early Mesozoic. During that period there was no more sea transgression. The Mesozic mountain movement forced all the Cathaysian land mass and its neighbour landmasses combined together. The north border included south Manchuria, Inner Mongolia, North slope of Tianshan and Japan proper. The southern border included Indo-China, Malay Peninsulas, as well as Sumatra and Kalimentan. When the flowering plants originated during the period of Triassic or Jurassic on the ancient land, they could inevitable and commonly distributed on the Cathaysia. After Cretaceous the drought climate happened, and the flora were compelled to regulate its areal. This can be proved with the red deposit commonly covering the Cathaysia during Cretaceous and Tertiary. Since that time the seasonal variation of climate became more prominent, and there was a differentiation between the tropical and subtropic floras.

亚洲热带—亚热带植物区系与植被的整体性*

张宏达**

摘　要　(1)中国植物区系不是来自北方，也不是来自热带，不能把中国植物区系看成是南北植物区系的混合体，它是在中生代起源于华夏古陆。自中生代以来，由于造山运动把华夏古陆与康滇古陆，四川古陆、淮阳古陆、江南古陆、塔里木古陆，华北古陆，北越古陆及印支古陆等联结成一片完整的古陆。北部包括东北南部，内蒙，天山北麓，还有日本本部及朝鲜半岛。南达苏门答腊及加里曼丹。整个亚洲热带和亚热带是一个完整的体系。原始的有花植物从三迭纪以后逐渐在华夏古陆发展起来，白垩纪以后并遍布于现在的热带地区。所谓北极起源的假设不能解析中国植物区系的组成和来源。不仅现代分布于热带和亚热带的植物不可能来自北方，连那些被视为温带成分的，如槭树科，杜鹃花科，忍冬科，榛科，桦木科，胡桃科以及报春花科，龙胆科，紫草科，鹿蹄草科，岩梅科等，都是亚热带山区起源的，例如马先蒿属*Pedicularis*有80%分布于亚热带山区。

(2)中国植物区系不是由热带地区扩展过来的。热带地区分布的专性科及优势科，如龙脑香科等在系统发育方面都是后起的，它来自亚热带起源的更原始的科。再从地史上看，亚洲热带的地史既不稳定又是中生代晚期才升起的，那里不可能产生现在占优势的许多热带科属的远祖，至于热带山地雨林占优势的壳斗科，山茶科，木兰科，金缕梅科等，它们不是热带起源，而是亚热带起源，再扩展到热带，由于白垩纪后期的干旱以及气候分带加剧，才转移到

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(3)落叶树不是由低温起源的，当然更不是来自北方或起源于北方，它是由于南方的干旱气候促成的，如木棉，柚木，合欢，厚皮树，苦木，箭毒木等都是证明，那些分布到北温带的栎树，枫香，胡桃，榛，榆，朴树甚至杨树等，都是亚热带山区起源，经过白垩纪后期的干旱而形成的，木材解剖的证据说明了常绿的木兰及朴树等的木材结构比落叶树的木兰及朴树原始得多，针叶树也有类似的现象。落叶松*Larix*是亚热带起源的，分布于亚热带的金钱松*Pseudolarix*只局限于亚热带，它的落叶肯定不是低温促成，也绝对不是来自北方，而是白垩纪后期的干旱造成的。

(4)针叶树的起源问题，历来都认为起源于北方，再向南方迁移，现在看来，也是难以置信的，以北温带最常见的松科为例，松科有10属，全都分布于中国亚热带山区。而在北温带只有冷杉*Abies*，云杉*Picea*，落叶松及松4个属，因此，亚热带山区10个属的松科植物，不可能由于冰川的作用，和用第三纪北极区系迁移论的假设来解释。因为南方的特有属油杉*Keteleeria*，银杉*Cathaya*，雪松*Cedrus*及金钱松，以及分布于东亚及北美亚热带的铁杉*Tsuga*和黄杉*Pseudotsuga*都是当地起源的，*Abies*见于湘南及浙南，亦有花粉见于5万年前的韩江沉积。再从杉科的柳杉*Cryptomeria*，杉木*Cunnighamia*，水松*Glyptostrobus*，*Metasequoia*，台湾杉*Taiwania*以及北美落羽杉*Taxodium*，红杉*Sequoia*及*Sequoiadendron*都是亚热山区起源，不可能从泛北极或北温带迁来的。再以柏科为例，绝大部份的属都是分布于亚热带，能够到达北极圈附近的，只有一些匍匐状的*Juniperus*等个别种类。至于紫杉类的紫杉*Taxus*，粗榧*Cepholotaxus*，穗花杉*Amentotaxus*当然都是亚热带起源的，而南洋杉*Araucaria*，罗汉松*Podocarpus*及陆均松*Dacrydium*等则更不必说了。

(5)亚洲热带与亚热带是一个整体，这里的植物区系在起源上是统一的，华夏古陆在三迭纪就已经完整地包括印支半岛，马来半岛，苏门答腊及加里曼丹等地。三迭纪以后，有花植物区系兴起，必然遍布于整个华夏古陆。由于白垩纪以后华夏古陆南部气候变干旱促使植物分布出现重新调整，中国从南到北普遍存在的红层，为这种干旱气候的存在提供佐证，再加上第三纪以后，气候分界和季节分化日趋剧烈，形成了现代热带与亚热带植物分布的格局，喜热的种系留在热带地区，喜温或能抗低温的种系则分布于亚热带和温带，及热带的中山和亚高山。那些白垩纪以后才出现的热带成分如龙脑香科等就只能留在热带，而白垩纪以前的植物如木兰科、金缕梅科，山毛榉科等退到了热带山地，仍有强烈的生命力。至于更古老的种系如昆栴树、水青树等，已处在衰退状态，而残存于一隅。

关键词 亚洲热带—亚热带，植物区系，植被，华夏古陆