馬先蒿屬的新系統（續）

鍾 补 求
（中國科學院植物研究所）

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三．馬先蒿的地理分佈

在專著性的工作中，因為一個雙重的理由，地理分佈部分的注重，是不會被認為過份的。第一個理由是在工作中這一部分的研究，有它自己的責任要盡的，那就是研究的植物的現在分佈面積，也可能涉及它們的歷史分佈。此外還有對於地理分佈的其他項目，如所佔面積的地區特點，高度，生長等，也就是生態情形等等方面的分析。但是在上述各項中的成就，只能作為研究它們的理由的一方面，而這裡還應該有另外一個很重要的方面，那就是第二個理由；它的研究，應該提供一個工具，借以把分佈的各个方面，來與被提議的新系統中的分類安排，作一核對，看看兩者之間是否存在着一些相互聯繫；這種聯繫的存在与否，是很有用來印証或者反証到底這個系統是否如所聲稱的那樣地表示著親緣關係。

至於為什麼這兩者之間會存在聯繫的呢？那我們就必須涉及羅納爾德・戈德的忍耐性學說了。1）

這裡可以把他的六條原理中的三條提出來；

“各個和每一個植物種，僅僅能在某一個固定範圍的氣候和土壤情況下生存和繁殖。

一個種的忍耐性是一個屬於種的性格，和形態上的性格同樣地為生物進化的規律和步驟所支配，

但是這兩個並不一定經常發生聯繫。

一個大的活動單位的忍耐性是它所包含的種類的忍耐性的總和。”

我們應該心中有數那個忍耐性學說基本上是一個涉及於種的分佈，而不很關於對種的活動的分佈的學說，雖然表面上給出的最後一層原理，也多少提到它對於較大的活動單位的關係。其實，我們在這裡提到它的目的，並不是想在已經深刻研究過的種的對於種的分佈的研究來增加些什麼，而是想把它們的對於較高活動階層的關係的方面加以闡明才這樣做的。

照推斷，某一一定的種的忍耐性的性質，是與進化和遺傳的規律密切和諧的；換一句話說，一個一

1) 羅・戈德：有花植物的地理分佈，二版(1953)，頁361—377
定的种的忍耐性，是由它的历史背景塑造而成。这一忍耐性一般想来是应该暂时地稳定的，一直等到一些外面情形的变化偶然发生，或者在迁移的道路上，与一些新的环境相接触的时候为止。很明显地，这种促使发生关联的忍耐性变化的环境变化，它自己也必须还在这一植物的忍耐性范围之内的。虽然这种变化以后的环境，一定是会与此植物原生的环境有所区别，因为无疑地当一个变化是这样剧烈，以至于超出这一植物的忍耐性变化度的时候，那末，这一植物会在它有时间来调整自己以适应新环境之前，已经死亡。这样就可以推想由新环境刺激而形成的忍耐性的改变，是不应该以太突然的情况发生，而很可能以比较慢而渐进的方式进行的。按照这种理论，我们可以得到结论，在任何一个较早的分类单位中的相近种类的忍耐性，在理论上来说应该是较相似的，而且属于两个相同的，或者是相隔不太远的“进化世代”的祖先和它的后代之间，在普通情况下，应会有相似的忍耐性变化度。在忍耐性发生变化的情况下，它也一定会表现出来，而且会很容易地被发现于，相和而来的垂直分布、土壤性质和生物环境的由老至新的变异中的。而这些正是我们研究分类的在研究中所看到的情形。下面便是我们于研究中得到的一些成果。

（一）依分类次序排列的福先蒿类的现代分布

在研究一个属的地理分布的时候，种的现时分布面积，是应该被认为有一定重要性的。因为所有对于这一类目的其他方面，是要完全或者至少部分地依赖它做基础的。为了在写作中避免累赘，聪明的办法是把较大的分类单位的总分布趋势和种的分布分开来阐释，而把后者放在分类部分的各自的位置中，而它在所做的有相当大的情形下，尤应如此。虽然很清楚这一点，而且更面临着把本属中这样浩繁的种的分布述说出来的难题，我于是采取了与上述的相反的方法，因为我相信这样做会得到对指出具有与分布密切关联的细常点的好处，而且对于进化和迁移之间的内在关系的更深刻的了解，也是有所帮助的。

泽兰氏是第一个尝试将本属分布叙述的人。以特有百分比的统计为基础，而以构造的分布和颜色的分布为辅助，他把这个世界分为六个特之省区，它们的名字是环极、欧洲、西伯利亚—土耳其斯坦，日本、美洲、高加索、西藏—中国本部以及喜马拉雅—云南等省区。用同一根据，他还主张迁居是由四条路线（南北）联络进行的，那就是欧洲经向线、西伯利亚经向线、美洲经向线和日本经向线。随此而来的，他又假定了从这些经向线线路上延伸出来的一定的授射路线。这些授射路线有些方面是与我们研究中注意到的事实不相符的，以后在适当的地方还要提及。但是这些分布的经向路线和特之省区是可以有利地应用到我们的地理分布的叙述中来的。下面便是各群及偃枝中种的分布。

1. RHIZOPHYLLUM 羣——这一互生叶的群似乎最有可能是本属中的最老的群了，而它的环极省区内的原属，几乎是可以溯源的。这一群是被分成以下四个亚群的。

（1）EURHIZOPHYLLUM亚群——被想像作最先发生，这一亚群在它的范围内包含了许多

1）在这一部分的研究中，虽然似乎难于确切的分辨，也是可以在福先蒿的繁殖、分化和进化里，看出有三种不同的“世代”来。第一种就是“世代”这一字眼的通常的意思，而它的作用就是单纯而短暂的繁殖；由这样生出来的后代，隶属于与其根本相同的物种。第二种是“分化世代”，以这一名目，我描绘地意味着一种特殊的子代，由于它，物种将自己分为相近的植株种；由这种方法中出来的后代，常常和它们的先世同属于一个进化阶层，虽然它们之间一定会有种的差别，例如，P. flamma L. —— P. Oderti Vahl —— P. ortho-coryme Li —— 等等。第三种是“进化世代”，意思就是它的作用，是生出在与它们根本的关系上亲和到进化上的差别的后代来。如麦哲伦在后面的附图中所见的一般，P. Oderti Vahl —— P. Pseudovescicolor H.-M. —— P. habachanensis Bonati —— P. rhyncholonta Franch. —— 等等。

後面的 Macrorcholype 系以具有類似 Excelsae 系的特小的管和極長的管的花冠而標誌著另一旁支發展。這一系是單模式的：P. macrorhyncha Li 是雲南西北部的土著。從 Ficulca 進化而來，具有較大花葉的 Robustae 是完全屬於東部和中部喜馬拉雅的：P. nepalensis Prain 是在錫金和尼泊爾東部發現的，而 P. Daltonii Prain, P. robusta Hk. f. 和 P. Garkeana Prain 則僅見於錫金喜馬拉雅。再後續的是 Macrantheae 系，含有4種和許多變型。它的分佈地域自生有 P. insignis Bonati 的西藏南部和雲南西北部擴展到南面的 P. nobilis Bonati 的家緣種甸北部，東經 P. Sculliana Prain 所居的西藏南部。錫金和尼泊爾以達本系現在所被最西點名卡毛恩（Kumaun），那裡有 P. Klotzschii Herus.（P. macrantha Klotz.）。Pumiliones 系，大概是 Robustae 系進化而來，是一個兩型和一大群變型的小系。P. Przewalskii Maxim. 的原型和它的
許多族種佔一個自甘肅南部和青海北部經西康，東達藏西北而西達西藏南部（即東喜馬拉雅山下的帕里）的分佈面積。P. bella Hk. f. 分佈較西，它居住在西康、錫金喜馬拉雅和西藏西部。

如像它的名稱所表示的，Longiflorae 是一個含有尊基化了的具有長管的種類。這是這一亞族中最大族種的類，面積不占不 22 種，而分佈面積也相當的廣。它的開始的中心似乎是一個包括甘肅北部，甘肅中部，南部和四川北部的地區中，那裡所見的，大部是具有黃色的花和不捲曲的苞片的種類，如 P. bidentata Maxim.，P. armata Maxim.，P. cranolopha Maxim. 和 P. decorissima Diels.，P. chinensis Maxim. 和 P. longiflora Rudolph.。在這些種之中，P. decorissima 和一個 P. cranolopha 的變型，就是 var. longicornuta Prain。也在西康發現，而 P. chinensis 和 P. longiflora 則是兩個廣布的種類；前者東向伸展到山西與河北，而後者呢，除了也在山西省發現外，更向北延伸至喜謎山脈（Sayan），自此經由新疆至新疆、烏蘇、錫金和外貝加爾地區；向南呢，它的面積於它的變種 var. tubiformis Tsong 擴展到西康云南，而後進入那條大的山脈西向侵佔，最終達到它的現在最西的前哨，西喜馬拉雅的巴爾提斯坦。

在西康與藏西北的大量的紅花而具扭曲苞片的種類，表示這一系的最大演化中心是在這個区域内。那裡共有 18 種，除了 3 種外都是紅花的。其中 6 種，就是 P. Crozetiana Li（黃花），P. Paxiana Limpr. f.（白花），P. tenuituba Li.，P. variegata Li，P. leptophyton Li 和 P. latiflora Bonati。是西康所發現的而最後一種最近也在不丹被見到；另外 6 種，P. humilis Bonati，P. dolichantha Bonati，P. fastigiata Franch.，與 P. sigmoidea Franch.。是藏南的種類，而還有 3 種，P. Garneri Bonati（黃花），P. Delavayi Franch. 和 P. dolichosiphon Li。是西康云南所共有的。再向西，在錫金和尼泊爾東部 P. spiphonantha Don 代替了陝南的 P. Delavayi。再有兩種就完成了一系的名單，那就是生於中喜馬拉雅自尼泊爾至西姆拉的 P. Hookeriana Wall.，而生在西喜馬拉雅自巴夏爾（Bashahr）至東阿富汗的 P. punctata Deccen。

最後的一個系，Megalanthes，是一般靠西分佈的。P. pauciflora Pinnell 和 P. megalantha Don 是東喜馬拉雅的，前者只在不丹和錫金看到而后者則自不丹至東尼泊爾。其余的種類則生在西喜馬拉雅，P. Hoffmeisteri Klotz.，自卡毛恩至察熒，P. elephantoides Benth.，自克什米爾至哈薩拉而 P. bicornuta Klotz.，則自德哈里延至東阿富汗。

(2) RHIZOPHYLLA STRUM 亞族——这一亞族分明是由前面一個進化而來，分別只在花數很少而常為向心的花序。在孤立的兩個分向分佈部系——歐洲的和西西伯利亞的——之間，可以看出到很接近的種類，大有可能撫各自地由 P. Oederlii Vahl 傳下來的。它的第一單位，Roseae 系包含 3 種；P. rosea L.，P. orthantha Griseb. 和 P. oederlii Vahl。主要生在巴爾幹半島的高山上，而前者一種也見於西阿爾卑斯山。P. muscoides Li 是屬於西康和西藏南部的。這一亞族系的後續者是對應的 Merrillianae 系，它的單種 P. Merrilliana Li 見於甘肅西南部，西康東部和不丹，顯見是直接由 P. muscoides 演進而來。在歐洲，這種在“無齒型”和“有尖型”之間的一環是見不到了。

跟随而來的是有齒的 Asplenioideae 系，面積包含 7 種。在那些種中，P. gernatu Portensch. 和 P. asplenifolia Florke 是生在東阿爾卑斯的，而 P. tsarungensis Li.，P. Meyana H.-M.，P. umbelliformis Li 和 P. Yui Li 是生在西康和藏西北的。只有一种分佈在西南的是 P. longipedicellata Tsong，見於不丹。這裡有一個在分化位置上不易確定的系，那就是單模式的 Odontosphora，而它的 P. odontophora Prain 是在錫金和附近的西藏境內被發現。Paucifoliatae 是一個由 6 个有相当长的叶的种类合成的，而里面有 4 种是局限於云南西北部的，这是 P. tsangchanensis Franch.，P. Forrestiana Bonati，P. yunnanensis Franch. 和 P. mic-
rantha Li。另外两种是 P. microcalyx Hk. f. 和 P. pseudoheydeyi Tsoong，前者居于西藏西南部、西藏东南部和不丹，而后者为在缅甸的特产。*Paucifoliatae* 系后面的两个系是单型模式的，产于西藏西南部 *Mythophila* 系和见于四川西南部、西康东部和云南西北部的*Francelianae* 系，里面包括原始和几个变型。

大花的*Pseudomacrantha* 是一个有 3 个种的系，里面的两种 P. aschistorrhyncha Marq. et Shaw 和 P. Fletcheri Tsoong 是生长在较小的西藏西南部分的，而第三种 P. Elwesi Hk. f. 和几个变型呢，却一直从藏西北经由西藏南部与喜马拉雅的东端而达锡金和西藏南部。*Albiliora* 系的分布是比较靠西的。除了西康东部的 P. tapaoensis Tsoong 之外，在一个大概包括上缅甸、西藏南部、不丹、锡金和邻近的西藏的区域内，分布着 7 个种类，它们是 P. rhizomatosa Tsoong、P. porpusilla Tsoong、P. Hsii Tsoong、P. petrophila Li、P. Tayloriana Tsoong、P. Regeliana Prain 和 P. albiflora Prain。除了上述者外，还有和种是尼泊尔产的，那是 P. Cooperi Tsoong 和 P. pseudoregeliana Tsoong。最后还有那变种侵卷、长掌而且长管的*Neolitobae* 系，分明是 *Mythophila* 和 *Francelianae* 系的大大地前进了的类型；它也只有一种，为康东特产。

2. DOLICHEPHYLLUM 羣——这一个对生叶的群被分为四个很短的亚群如下；

（1）EUDOLICHEPHYLLUM 亚群——这一个亚群要比其他三个亚群都更靠近 *Eurhizophyllum*。它是由两个各有两律的系，双叶型的 *Curnae* 和有掌型的 *Tatsienenses* 所组合的。前一系的 P. cernua Bonati 与 P. myriantha Li 和后一系的 P. tatisienensis Maxim. 是原限于西藏南部和藏西北部的，而一系的第二种 P. chenocephala Diels 则分布在北，是由在甘肃西南部和青海西北部的。

（2）BRACHYHYLSTACHYS 亚群——是与 *Rhizophylliastrum* 亚群相接近，同是极高山上的低矮植物。那个多数的 *Collae* 系有两种，P. Bietii Franch. 和 P. collata Prain，前者居于西藏而后者则生在不丹与锡金。第二个有掌的 *Pseudoasplenifoliales* 系是由局限于锡金喜马拉雅的 P. schizorrhyncha Prain 和 P. exigua Li 两种所组成。

（3）DOLICHEPHYLLISTRA 亚群——这第三个亚群里面有 21 个系，*Atrovirides, Remotilobae* 和 *Sikkimenses*。前一系的双叶的 P. atroviridis Tsoong 和 P. Sherrifii Tsoong 是只有西藏西南部有的。第二系的单叶的种 P. remolitoba Re-M. 则仅见于云南西部。第三个系的 3 个具有较长掌的种类分布略宽，P. atuntsiensis Bonati 生云西南部，P. Elliottii Tsoong 生西藏西南，而 P. sikkimensis Bonati 除了与前一种同生外，也见于锡金喜马拉雅。

（4）DOLICHEOSTACHYS 亚群——三个系，*Pilostachyae, Tantalorhyncha* 和 *Metolothyranhcha* 合起来组成这个亚群。第一系的 P. pilostachya Maxim. 与 P. ternata Maxim. 所有的分域面积是在青海和甘南（包括老窝夏的阿拉善），第二系的具有中长的掌的 P. tantarorhyncha Franch. 在是云南西北部而它的近亲 P. tantarorhynchoides Tsoong 则生在藏西西南部。那个居于第三系的最专化了的、长掌的 P. meteoroehyncha Li 则限于丽江雪山。

3. BRACHYPHYLLUM 羣——本处于亚群内的种类，很自然地形成两个亚群如下；

（1）EUBRACHYPHYLLUM——此亚群是以四系合成的；它们是双叶和多叶的 *Lyratae,* 具有中长掌的 *Brevifoliae* 和 *Debiles* 以及长掌的 *Integrifoliae.* *Lyratae* 系的 7 种是西藏东部和西南的 P. stenocorys Franch. 和 P. polyodontia Li，云南西北部的 P. laxistips Li 和 P. tomentosa Li，和两省共有的 P. cymbalaria Bonati，P. deltoidea Franch. 和 P. lutecens

（2）BRACHYPHYLLIASTRA——这个亚属有三个类， Binariae, Pectiniformes 和 Urecolatae。那个第一系中单模式的具有短窄的 P. binaria Maxim. 是四川北部的特産。第二系中较長的 P. pectiniformis Bonati 則为西康东部的土著, 而它的可能的先範, 那具有较短部的 P. Komarovii Bonati, 在报告時没有确証的, 猜想大概是同一地区而來。两个种连合起来组成 Urecolatae 系, 它們是西康东部的 P. urceolata Tsoong 和不丹的 P. xylopoa Tsoong。

4. APOCLADUS 亚属——这是本属中的最发达的亚属中的一个面是五生叶的。它的种类可以归入两个亚属如下；

（1）EU-APOCLADUS 亚属——这一亚属以 Foliosae 系中的具有“無齒脣”花的种类开始的, 那些是欧洲 Rosae 系的后代。在欧洲陆上凡有 7 种。在欧洲経向分佈線上, P. foliosa L. 于西阿尔卑斯山、庇尼尼山和靠近的西班牙北部, P. sumana Spreng. 则分佈在东阿尔卑斯山和阿那拿山, 而 P. Wilhelmsiana Fisch., P. condensata M. Bieb. 和 P. atropurpurea Nordm. 则居住在高加索、外高加索及小亚细亚的蓬塔斯地区。在东面西伯利亚経向分佈線上则僅有 1 种, 那就是在西伯利亚南部被記載的 P. sajanensis Steph.

有三十种以上归入到后脸的双齒型的 Comosae 系中。它的原始中心分明是在 Foliosae 系的同一区域內, 但是由于経向分佈, 它的成员就把它們的分佈面積远推到欧洲大陆的大部分去。一个次成的中心后来又在阿尔泰－天山山脉中形成, 那里的种类反比欧洲原始中心所有的更多了。那个分佈最广的种就是与系同名的。它的分佈面積给自最西的点依里安（西班牙）半岛的那达大山中。向东北, 它經由庇尼尼山、奥良山和马骏阿尔卑斯山而达意大利西部和北部的阿尔卑斯山, 从这里一条直竪趋向东南至阿平拿山, 但其幹线仍东向経由南斯拉夫的堤那立克阿尔卑斯山, 远拉斯山, 蓬塔斯而至亚美尼亚和乔治亚。向北经过苏联中部而达乌拉尔山脈；向南它也分佈至伊朗北部。在东西伯利亚, 它的面積是从和拿河起南下至贝加尔, 从此东向経由外貝加尔至黑龍江（阿穆尔河）, 为其分佈的最东点。自贝加尔向南, 伸展至科索哥尔湖再西至阿尔泰。

其余的种类, 欧洲約有 11 种, 内中只有两种生长的地点离地中海比较远些, 它們是喀尔巴阡山东部和南部, 和臨近的烏克蘭西南部和罗马尼亚东北部的 P. campestris Griseb. et Schenk., 和高加索的 P. daghestanica Bonati。其余的种类中, 有两种是分佈西北的, 那是卡斯提尔的 P. schizocalyx

1) 参阅本文原 21 中 Euhosphyllum 亚属下的附記 1。
Lange 和卡塔拉尼亚和庞里尼亚山的 P. asparagoides Lapeyr. 其他 7 种为 P. graeca Bun.,
P. Ferdinandii Bornm.、P. heterodonta Panc.、P. moesicaa Stadl.、P. leucodon Griseb.、
P. Fridrici-Augustii Tommas 和 P. petiolaris Ten。它们的总是在巴尔干半岛，包括一个自南
面的希腊和东边的土耳其的欧洲部分(色雷斯)开始，经由保加利亚，阿尔巴尼亚和南斯拉夫以及达伊斯特
立安卢山的这样一个面积，虽然在它们中间的前两种分佈得比较狭小，前者只在希腊而后者只在马
其顿(希腊北部、南斯拉夫南部)发现，而最后两种则又延伸到意大利的雷吉阿和阿普平山脉中去。

本系中的其余种类，亚洲大约有13种，虽然其中很有一些是与欧洲共有的。有很多种类是局限在
本系的显明的第二分佈中心土耳其斯坦与阿尔泰天山山脉的中間或周围，这些包括阿尔泰和塞林戈
斯的 P. altaica Steph., P. Fedtschenkoi Bonati 和 P. Krylowii Bonati，准噶尔和土耳其斯坦的
P. breviflora Regel，和土耳其斯坦及帕米尔的P. dubia Fedtschenko。除了已述及的种类外，其
他或者有很宽的分佈区，或者它们的分佈面积是远离中心的。正那些种类中，只有两种是向南分佈
的，它们是 P. dolichorhiza Schrenk，自准噶尔经阿富汗至西喜马拉雅的嫩枝坡和哈密作為坡
至西藏的 P. brevirostris Pennell。在分佈中心的东北方，共有 5 种，就是从帕米尔经阿尔泰至
蒙古北部的 P. achilleifolia Steph.，在几乎同一区域见到而且更在西面的阿拉善及东面贝加尔与
外贝加尔分佈的 P. uliginosa Bun., 从土耳其斯坦經由阿尔泰，蒙古至外贝加尔的 P. flavescens
Pall.，自阿尔泰经贝加尔，外贝加尔至极北西伯利亚的利那河地区的 P. rubens Steph.，自东阿尔
泰至堪察加的 P. venustus Schangin 和日本北海道的一个白花变型，局限在贝加尔和外贝加尔的
P. fissa Turch.，朝鲜半岛上特産的 P. nigrescens Nakai 和本州、库页岛北的 P. apodochila
Maxim.。最后还有三种是既在西又在东分佈的，那是 P. physocalyx Bun., 它的分佈面积自
土耳其斯坦和阿尔泰，向东至贝加尔加，西向经基尔坡西坡草地至乌拉尔山，此外也在極北的西伯利亚
發現，P. lasiostachys Bun., 自阿尔泰稍向东北至蒙古的乌苏鲁湖 (Ussia Nor)，但主要地是西
向在高加索的達斯坦和烏克蘭的基輔附近，和 P. laeta Stev.，东边在阿尔泰，准噶尔，蒙古北部被
發現，而西边则經由西伯利亚草原至乌拉尔，复沿南乌拉尔至伏尔加和顿涅次江流域。

那具有中长的嘴部的第三个科，Rostratae, 包括库自前一科進化而来的后代凡 13 种，几乎全
部产於欧洲。它们的分佈中心，显然已由前一科的巴尔幹至阿尔卑斯山中了，这是从南斯拉夫北
部(克罗西亞)經由奥地利，意大利北部，瑞士以达法國的东南端。这里有 P. gyroflexa Vill., P.
Barrelleri Reichb., P. elongata A. Kern., P. rostrata L., P. cenisia Gaud., P. caespitosa Sieber 和
P. tuberosa L., 虽然最后的两种也在西班牙北部生存。除了这些外，P. elegans Tenore 是只在阿平寧山脉中部發現， P. flavissima Gandog., P. pyrenaica Gay。和
P. mixta Gren et Godr. 是僅见於西班牙北部的，P. Beamungetii Smk。生於南喀尔巴阡
山和特朗西尔维尼亚，而 P. Nordmanniana Bun. 則生於分佈面积的东端而在小亚细亚。

大約与 Rostratae 在进化位置上相近似第四个科 Strobilaceae，因为它的四种 P. gracili-
caulis Li, P. strobilea Frech., P. pseudocephalanthi Bonati 和 P. dichrocephala H.-M. 均为云南西北部的特産，而在云南与 Conosae 系中种类所占的自帕米尔至贝加尔的一条西-南
东-北的分佈线之间的地区中，没有发现相近的种类而使这一现象发生了分佈面积中断的现象。第
五个系，具有稍长的嘴部的 Oligantaethe 也主要是云南西北部的，那里住着 P. tahainensis Bonati,
P. dissectifolia Li, P. Fengii Li, P. oligantha Frech., P. campylophana Bonati, P. cep-
phalanthia 和 P. longi petiolata Frech., 虽然最后两种也在邻近的西康境内發現。只有一种分
佈得稍稍向西，那是阿塞密的 P. cephalanthoides Tsoong。那十个粘合成后而一个吸器的嘴常常
扭卷的 Oxyacarpa 系的种，佔着比前兩系大得很多的面积。在那些种类中，*P. subulatidens* Tsoong 是西藏南部的，*P. stenophylla* Li 和 *P. lancefolia* Tsoong 是上缅甸的。*P. Stevandii* Li 是貴州的，*P. tibetica* Franch. 是西康的。*P. macilenta* Franch. 是云南西北部的，而 *P. Monbeigeiana* Bonati 和 *P. oxyacarpa* Franch. 佔見於云南西北和西康东南。最后的著者比较靠近分佈的是 *P. torta* Maxim. 和 *P. Davidii* Franch. ，生於甘肃南部和四川北部，而前者也見於四川，后者亦生在陝南。第七个系 Dissectae 中的 4 种中，有 3 种是居見於西康的，它们是 *P. Souliei* Franch., *P. Petitmenginii* Bonati 和 *P. sparsiflora* Bonati。再稍向东北，可以找到最后的一种，那是陝南和河南南部的 *P. dissecta* Pennell et Li。

那个親缘关系不清楚的單模式的 Amplitudae 系是云南西北部的特產。最后的一系 Rhinanethoides 包含两种，*P. cyclorhyncha* Li 和 *P. rhinanethoides* Schrenk；前者是云南西北部的特產而后者和它的几个變型是廣佈的。原型自准噶尔下来经帕米尔而至西喜馬拉雅，而它的其余的变型呢则从阿富汗经由全部喜馬拉雅而至云南-西康区，再至甘肃，陝西和内蒙。

(2) Pseudopolegladus 亚屬——不像前面一亚屬一样，而且也不像本屬中其他的亚属一样，这一亚属在欧洲經过分佈線上几乎没有发展，而在西伯利亚和日本按分佈線上也不很清楚，但是在美洲經过線上則变得大大进化而且十分繁複，在那里它又向南迁移，超越了赤道进入南美。

按照规定，这一亚属包含着自最原始到最进化的六个种。第一个 Limnogenae，是一个仅有 3 种的小系，那 3 种是 *P. recutita* L. 生於自奥地利盐法蘭西东部的阿尔卑斯山中，*P. limnogena* Kerner 生於自喀尔巴阡山至中欧北部的巴尔幹半岛上和産於北西欧的奥林匹山上的 *P. olympica* Boiss.。

第二系是双翼的 Sudelicae 系。那个代表系的种，*P. sudetica* L. 在现时已经在三个經向分佈线的北極地区找到，但是它的原産地似乎是欧洲中部苏台德山中1)。从这一地方，它的分佈路線擴展到拉普蘭德，经由卡寧牛島，科尔古耶夫和诺瓦森伯拉岛而至北乌拉尔山。在它的亚系的地域中，它是沿着葉尼塞、鄂霍次克、利那、科利马等流域以达於安那捷尔河与堪察加半岛；經过了聖勞倫斯岛，进入美洲經向分佈线而到达阿拉斯加和極北的加拿大；沿着利那河，它也南向分佈到外貝加尔。在欧洲子午線中，没有这一種的翼屬被找到，但是在伊朗东南部却有一种 *P. lairesensis* Bornm.，而在西伯利亚和鄰近的日本省区中，还有五种。那是 *P. villosa* Ledeb. 见於利那及科利馬兩河流域（也在庫頁島？），鄂霍次克和堪察加的 *P. nasuta* M. Bieb.，庫頁和北海道两岛的 *P. Koidzumiana* Tatew. et Ohwi，从托姆斯克至外贝加尔的 *P. elata* Willd. 和在阿拉斯加与天山的最后一种，*P. songarica* Schrenk。

美洲，*P. sudetica* Willd. 分佈在阿拉斯加和極北加拿大。向南就有两种極近的种类出生在落机山中，一种 *P. cystopteroidifolia* Rydb. 是限於黄石地区，而另一种 *P. scopulorum* Gray 佔着怀俄明和科罗拉多的山地。

1) 这是沒有怀疑的 *P. incarnata* Jacq. 是由 *P. recutita* L. 进化而成。但是按照 Flammia 型發展規律，那在這兩者——無翼和有翼——之間，还少著一个有翼的阶段，而 *P. sudetica* Willd. 似乎正好补入这个缺中。而且，这一翼属的远在南美的分佈路線也使人想到它的开始的祖先，是在較低的地方生活的，对於这一特征沿海是一个合乎邏輯的答案。这里还要提请注意的就是在前面討論雜交问题的时候（卷四，页 141—142），曾把 *P. recutita* L. 所在的 Limnogenae 系放在 Rhyzophyllum 而把 *P. incarnata* Jacq. 放在 Rostrate 系归於 *Apoladus* 種的 *Eurapolorus* 系属中。現在呢，我已经改变意見，把 Limnogenae 从 Rhyzophyllum 内提到 Pseudopoladus 系属的开始處，而把 *P. incarnata* Jacq. 也从 Rostrate 系提到 Compacta 系里来，以归入 Pseudopoladus 系属中，像在麒麟蕨中所见一样。
那个第三个有嘴的 *Compactae* 系也同样地为几个逐渐分布线所共有。在欧洲，这一系因与一种所代表，那是生於西班牙的加利河亚和利利尼中的 *P. incarnata* Jacq.，也见於自法蘭西西部至奥地利北部的阿尔卑斯山中。在西伯利亚则向分布线， *P. compacta* Steph. 佔着一个广泛的地区，那是从西边的乌拉尔，东至那雷姆、东南至色隅山脈，再东至贝加尔；复南至阿尔泰与准噶尔。 *P. uncinita* Steph. 有一个很狭小的分布面积，仅从南阿尔泰至外贝加尔。在美洲省区中，那前一系发生在落矶山中的两种进化成很多种类。这些里面有蒙塔那和怀俄明的 *P. Halili* Rydb. 为怀俄明所独有的 *P. lunata* Rydb. 和 *P. antilopes* Pennell，新墨西哥摩哥龍山中的 *R. mogollonica* Greene 和自怀俄明至科罗拉多、攸塔和阿利桑那的 *P. Parryi* Gray；在西边，它在加利福尼亚被发现。在最后提到的两州中，还发现了两种，那就是 *P. similis* Heller 和 *P. Howelli* Gray 分生在两州中。在本系所占的最南据点中生有 3 种，其局限於墨西哥的一个小面积内，那是希尔达哥的 *P. Orizabae* Cham. et Schl.、哈利斯科的 *P. Jonesii* Brand 和墨西哥（省）与瓦哈卡的 *P. mexicana* Zucca。

两个多少有親緣关系而又不同的种类， *P. pedicellata* Bunge 和 *P. ornithorhynchae* Benth. 组成第四个 *Ornithorhynca* 系；前一种在西特卡岛而后的住处是在華盛頓的黑尔山山上，

本项組中，最高的花部進化僅为新世界种类所达到，像为 *Incurva* 和 *Surrecta* 两系所表示的。那一个单模式的 *P. incurva* Benth. 不在哥倫比亞和安地斯山上生长。而且越过赤道以达厄瓜多的克汪卡，所以已超过 *Cladomania* 羣中的 *P. Zeylonica* Benth. 的南向范围了。后一系是以三种合成的，那是 *P. contorta* Benth.， *P. attorrellsii A. Gray* 和 *P. groenlandica* Retz. 第一种的范围是在華盛頓和俄勒岡的卡斯开德山上和爱达荷，怀俄明和蒙塔那的落河山中；第二种是在加利福尼亚州的内华达山中。那最后的一种，是本项群中的較高类型中分布得最早的一种。是与第二种一样地生在内华达山，那里很可能是它的原始中心。从这里，它向东发展到新墨西哥；东北方，它穿过西面的英屬哥倫比亞和东面的英赫特地区与拉不拉多而最终成为格陵兰的移民1）。

5. **ORTHOSIPHONIA** 羣——这个对生叶的群是本属中最大的群之一。以现有事实推证，本群一定是有两个原始分佈中心。一方面，在近东积累着很多的原始無蕊类型，表示高加索为一个原始中心，那里的种类亦是由现存的或已死亡了的 *Limnoenae* 系中的种类中衍生出来的。这一中心，虽然在原始种类的数目上佔着优势，然而反过来说在进化上来说却是次要的，因为那里的种类对于这一方面是没有什么进展的。另一方面，在 *P. pyenantha* Boiss.，一个似乎是本群的真正原始种类的种类，和 *P. Albertii* Regel.，它属于 *Hirsutae-verae* 系的最可能的互生叶的前代之间的形态上的相似和分布区域的靠近，迫使我们以西伯利亚—土耳其斯坦省区为第二原始中心。

在分类上，这一群是由 15 个系结合而成。这里面，那繁复的系 *Caucasicae* 包括约 10 种。少数以上的种类是集在近东区，那是在土耳其南部道拉斯山脉中的 *P. cadmae* Boiss. 和 *P. Jankaei* Stein.，土耳其北部，外高加索以及伊朗北部厄尔布鲁斯山中的 *P. caucasica* M. Bieb.，遂塔斯的 *P. pontica* Boiss.，和亚美尼亚的 *P. Beaugeanae Maxim.*。

在此系的第二中心，共有 2 种，天山中部的 *P. Maximoviczii* Kras. 和与几个变型共佔极大面积的 *P. pyenantha* Boiss.。从它在西土耳其斯坦中心，这一种向西分佈至伊朗，在那里分出了两个改名 *P. Mohayennesii* Pesa 和 *P. Hausknechti* Boiss.，再西而止於现在的波西士土耳其的庫提斯坦。自同一中心，它也向南分佈至阿富汗，转向东而入西喜馬拉雅的巴歇哈（庫那格），这里

1）参阅拙著的关于格陵兰种类的討論（页 43，44）。也可参阅拙文“馬先龍的年代”一節中的討論。
標誌着現在分佈的最東點。

直接由 Caucasicae 進而來了是含有 7 個代表物種的種分類的 Abrotanifoliae 系。可能為本系的先幹的 P. abrotanifolia M. Bieber。是以兩個型代表的，var. altaica 和 var. mongolica Maxim.，前者自阿拉善至額爾齊，再轉向西北，至烏拉爾可以見到，后一則在於蒙古的東邊山和科索亞爾湖附近地區。第一種的次幹 P. leporoticha Rupr. 是見於額爾齊、天山及西土耳其斯坦（馬吉蘭）。在天山的科克蘇谷中，有在 P. tenuiicalyx Tsoong。在南額爾齊還有具一種和 P. abrotanifolia 相見的 P. moschata Maxim.，除了這些生得比較弧西北的種分類外，其他的種分類所佔地域是也是很遠的。P. brevilabris Franch. 是見於四川西北部和西藏東部的；P. obscura Bonati 为云南西北部特產，以及 P. densispica Franch.，它的原始是西北北，四川南部和西藏西南部產的，而它的亞種 subsp. Schneidleri (Bonati) Tsoong 則產在西藏西南和雲南西北部。這同一類型的在西藏發現，在有管布地的另一新種 subsp. viridescens Tsoong 表示一種不侖包在西藏發展，而且還在活動地演化中。在東喜馬拉雅，有三個來源不明的系；Gibberae, Denudatae 和 Molles 被發現。單管模式的第一系中的 P. gibbera Prain 與第二系中的 P. denudata 和 P. polygaloides Prain 是集中地在西藏喜馬拉雅和極西南的西藏的一部分。單管模式的 P. mollis Wall. 的高山型產於西藏南部的帕定附近而它原始則向东分佈至西藏東南部及不丹、西向到尼泊爾。

後續的雙管的 Sarawscanicae 和 Platyrhynchae 系包含著 Caucasicae 和 Abrotanifolae 系的各自的進化的后代，而它們的中心，也在土耳其斯坦。僅僅向前進一步，P. sarawscanica Maxim. 几乎只是一个雙管的 P. Maximoviczi Krassn.，而它的住處已由它的種名清楚地表示出來了。至於 Platyrhyncha 系內的六種之中，只有一種 P. Strausi Hausk. 是從伊朗西部來的。在土耳其斯坦，P. pulchra Pauls. 是帕米尔的種類，P. platyrhyncha Schrenk 是基努散草原的，P. Waldheimii Bonati 是科坎的，P. interrupta Steph. 是斐迦那的，但也北行至阿尔泰和南阿尔泰，而 P. chortogossica Regel 則屬於科爾基斯。

有管的類型，起自單管的 Simae 系，顯示 Abrotanifolae 系的一個旁支；P. sima Maxim. 局限於甘肅西北和四川北部的。此外在西藏，Caucasicae 系發展成一个小系 Crassirostres，包含兩種，P. Bungei Tsihat 和 P. crassirostris Bunge，而後者是以几个型類代表的。那些管限制在高加索和外高加索。在东方，Platyrhyncha 系的后面同聚成 Myriophyllae 系。它們共有 7 种，佔着一個極大的面積。分散得最廣的種類是 P. myriophylla Pauł., P. alaschanica Maxim. 和 P. Chamissonis Stev。第一種可能最先在喀爾爾出現，從那里它北行至西伯利亞的東阿爾泰，賽姆山脈，蒙古北部的科素郭爾湖、貝加爾及外貝加爾和蒙古中部，它的 forma purpurea 也在科素郭爾發現，更在河北小五台山山看到。第二種自蒙古西部，青海湖邊分佈至甘肅（包括以前的寧夏省）；从这里向南，它的位置就被它的亞種 subsp. libetica (Maxim.) Tsoong 所代替了。這—亞種見於青海、阿塞克郭爾湖和西藏南部（東喜馬拉雅）的拉薩、江孜和帕里。第三種 P. Chamissonis 也是為兩個型類所代替，subsp. japonica (Miq.) Tsoong 和 subsp. genuina Tsoong。

1) P. pilostachya 和 P. ternata Maxim. 是兩個从前在 Abrotanifolae 系中的種，但是因為它們的相位和休態，一方面和 Histrurseae 中的種類相類，另一方面又与 P. tantorhyncha Franch.，和 P. metelorrhyncha Li 近似，所以我就把它們前面所說的兩種合成為 Dolichophylle 系中的一個新種 Dolichostachys。現在看到 Abrotanifolae 系地理分佈上的斷開——在阿爾泰-天山和四川北部之間地區的缺少種類——這也許更合理些它們仍複在 Abrotanifolae 系內像其他作者所做的——這樣做時，它們就能以它們的所佔分佈面積 (P. ternata Maxim.; 蒙古南部，青海，甘肅西部; P. pilostachya Maxim.; 西南東部及甘肅西部) 來作為連接的環節來填充這一系內面積的不同程度了。
那个原种的分佈区是从塔隆加和千島島開始的，東南經由阿留申群島而到阿拉斯加西南部的西特
摩。至於日本亜种的來源是可疑的，它的現在的分佈区是在本州的中部，和九州的中西部，它也許是
由千島群島的原種而來，也可能是從中國北部的 _P. myriophylla_ 独立地形成的；不过無論怎样，
分佈还是有間断的。除了这几个亜种外，一个 _P. alaschanica_ 的近种 _P. scolopax_ Maxim.
是住在青海东部和甘肃东部的； _P. cristatella_ Pennell et Li，生在甘蔗西南部和四川北部；
_P. Tatarinowii_ Maxim. 和 _P. Provotii_ Franch. 是中國北部各省的，前者为河北北部的特産，
而后者也在内蒙和山西北部發現。

在不丹，我们看到了 _P. Ludlowiana_ Tsoong.，是來歷和親緣不明的 _Ludlowiana_ 系单模式
的种。那个長嘴的 _Gyrorhyncha_ 系是统三个類型的种 _P. Duclouxi_ Bonati.，_P. gyrorhyncha_
Franch. 和 _P. Wangii_ Li 所組成。这里面第一种是西康的而第二，第三种則屬於云南西北部。含
有约 8 种的具有更長的卵状的 _Pectinatae_ 似乎是由 _P. alaschanica_ subsp. tibetica 進化而來。
它的分佈面積在喜馬拉雅中向西推進很遠。这一区域所佔较大的地点是西藏的宫殿省，也就是 _P. rhyn-
chotricha_ Tsoong 的家郷。除了此种外，其他 7 种完全是西北馬拉雅的种类。其中 _P. pectinata_
Wall. 和它的几个亜种是从庫毛毛至懿巴爾脱和哈察拉，_P. teniurostris_ Bentth. 从德哈里至阿
富汗边境，_P. Stewartii_ Pennell 从達巴至哈察拉，_P. pyramidalis_ Royle 从拉荷至赤特拉
尔，_P. kashmirica_ Pennell 和它的 subsp. ornata Pennell 从巴尔提斯坦至拉达克而它的原
型則从西藏的西北部分至阿富汗东部，_P. multiflora_ Pennell 住在克什米尔，最后 _P. cytrorhyn-
chaa_ Pennell 是限於赤特拉尔。

最後的一系 _Semitortae_ 生有扭卷的盗部却相反地佔着比前一向北向东的分佈区域。它的五
种是西藏的（帕里和曲藏布江自拉康至拉孜）_P. Oliveriana_ P a i n，西康的 _P. muniensis_ H.-M.，
甘肃西部和四川北部的 _P. Roborowskii_ Maxim.，甘肃西南部和青海东部的 _P. semitora Maxim.
和天山东部的 _P. Fetissowii_ Regel。

6. SIGMANTHCA 亚——似乎是從不同的來源——Orthosphonia 和 Cladomania——而形
成的。这一个对生叶卷类种类，可以分为三个亜级如后：

（1）NOTHOSIGMANTHA 亚——这一个小的亜级只有三个系， _Cheilanthifoliae, Curti-
vitae_ 和 _Tensianchae_。第一个含着六个種的然而似乎微微有嘴的种类，这里面 _P. ophioc-
ophala_ Prain 是住在喜馬拉雅中部自尼泊尔至庫毛毛， _P. globifera_ Hk. f. 生在錫金喜馬拉雅和
鄰近的西藏，在藏布江沿岸湿草地中極普遍。而 _P. cheilanthifolia_ Schrenk 的家郷是在阿拉邁和
土耳其斯坦，它的 var. isochila Maxim. 是在甘蔗和青海。另外三种都是前面最后一次的分化种，
也都生在西喜馬拉雅；它们是 _P. albida_ Pennell，自帕米尔边界至斯正塔， _P. Seenhedini_ Pauls.
自拉达克至達巴至巴歇拉，而 _P. purpurea_ Pennell 則从克什米尔至拉荷尔。在第二系中只有兩
种，那是甘蔗南部和四川北部的 _P. anas_ Maxim.，和在西康的它的 subsp. tibetica Tsoong，以
及甘蔗北部和青海的 _P. curtivitae_ Maxim.。最后，那个第三系的單模式的 _P. tienschanica_ Rupr.
的地点是在它的名称所代表的那个山脈的西部。

（2）EUSIGMANTHA 亚——很不相称地，这一亜级的种类分绽在三个系内，那是 _Plica-
tae, Verticillatae_ 和 _Microchilae_。代表第一系的两种是 _P. lutea_ Li 和 _P. plicata_ Maxim.，
前一种为云南西北部的特产，而后一种的两个亜种則見於西康，四川北部，甘蔗和陕西南部。

作为木属中的一个较小的分类单位，那第二个系 _Verticillatae_ 似乎是较为质樸的了，因为
它的所含分子離明地不是同一系统傳下来的。它的种类多至 30 种。也许是由前一系的种类中發生

（3）RIGIOCAULUS 亚 البريطاني——这一个小亚系似乎与 Cladomania 羣的关系最为密切。以三系組成, Salicifoliae, Rigidae 和 Ikomanae。第一个無齒的系中的單种是僅見於云南西北部的。双齒的第二系里共有 6 种, 其中的 *P. rigida* Franch. 見於云南南部和北部, *P. Mairei* Bonati 儘見同省的西北部, *P. comptoniaeolia* Franch. 在西康西南部, 云南省和西北部, 从这里又侵入到缅甸, 在那里又發現另一种 *P. atra* Bonati。在东边则有贵州特産 *P. rigidiformis* Bonati。最後的一系, 又是单模式的, 只有短翅的 *I. Ikomanae* Sasaki 是台灣島的特種。

7. CLADOMANIA 羣——这一个善於繁衍的互叶巢中的成员, 是比较単一的, 所以用不到分为亚群, 它所包含的 10 个系可以介绍如下: Hirsutae-centriptae, Palustres, Canadenses, Racemo-sae, Carnosae, Microphyllae, Polyphyllatae, Furfuraceae 和 Pseudo-erostres。这些成员中有很多是分佈極广的, 而它们分佈到环琐省区的各部的温暖半湿润地区。

那个唯一代表第一系的种 *P. Lansdorffii* Fisch. 在北西西伯利亚佔了一个面積, 从利那河至堪察加, 再經圣勞倫斯与阿留申而至極北美洲, 在这里它進化成双齒的 var. hians (Eastw.) Tsoong。第二系 Canadenses 是双模式的 *P. canadensis* L. 的区域是从撒克逊万与明尼托巴至諾瓦斯科
錫禾，由此西南行至科羅拉多的落基山，在那里发生了一个新种 P. crenulata Benth.，但它自己的
领域则向南延伸至墨西哥西，东入佛罗里达。

属于第三个 Palustres 系的共有很相近的 10 种。自 P. Lansdorffii 傳下来，P. palustris
L. 和 P. labradorica Wirsing 是本系的两个先锋种。很像是在北極圏内出生的，前一种已经侵入
欧洲的北，中和南部在亚洲，它分布于全部北極的和亚北極的西伯利亚，南下到蒙古，阿尔泰和准噶尔。
后一种在欧洲似乎佔的面积小些，仅在斯堪的那維亚半岛的一部分和南乌拉尔；在亚洲，它的地
盤几乎与前一种相等，但在南面则以贝加尔地区经外贝加尔，阿穆尔，北库页岛及千岛群岛一綫为界。
在再东南，它又经堪察加至阿拉斯加，加拿大至拉不拉多和格陵兰。在欧洲则向分佈线上，P.
palustris 出生 4 种来，即是 P. sylvestria L.，P. lusitanica Comn.，P. gredensis Gandog. 和
P. numidica PomeL。第一种分布极广，向北欧至南阿尔卑斯山，第二种和第三种是在伊比利亚半
島見到，而第四种則到非洲及利比亚而成在非洲所見的唯一馬先蒿的种类。

在东西伯利亚，除了 P. labradorica 之外，尚有 1 种，为 P. aduncum M. Bieb.，它的迁移路
线自塔尚加，南向沿鄂霍次克海岸，以达於库页岛。在美洲，除了 P. labradorica 外，也还有两种，
它們是 P. macroodontis Richards.，生於哈德孙海灣沿岸而 P. angustifolia Benth. 則生於墨
西哥的契瓦瓦西南部。

第四个系 Racemosae 僅含少数具嘴种类，然而在地理上説来，却佔着絶大的区域。作为一个有
趣的中间型來连接 Hirtseae-centripetae 和 Palustres 到 Racemosae 他其他种种来的是 P.
lapponica L.。它的面积也正北极的，在欧亚大陆上，西自挪威的多夫累，东达安那提尔和塔堪加，
而它的南边的界限则在蒙古；在美洲，它是在拉不拉多和格陵兰被发现。分明由 P. lapponica L. 進
化而来的是 3 种散布的种。在欧亚大陆上，那是 P. resupinata L. 和它的許多亚种和近種現在正
繁盛著。那个原產的亚种自利那河上的雅庫次克开始，东向擴展至堪察加，南向經千島羣島至北海道
与本州，在那里一种近種 P. yezoensis 被生出来；西南向，它沿鄂霍次克海岸和斯坦訥伏冰山脈至
阿穆尔地区，东北各省和朝鲜半岛，从雅庫次克南向，它也經由雅布罗那山脈至贝加尔和外贝加尔；自
此向西，它循賽揚，阿尔泰，托姆斯克，穿过烏拉尔，以达东欧的卡马河流域，从贝加尔以南，它経过
了蒙古，內蒙和华北各省，在越过泰階而产生出 P. galeobdolon Diels 之后，止于華中各省如四川，湖
北和安徽。它的最南的区域是在貴州和广西，那里它是以 subsp. crassicaulis (Vnt.) Bonati 出
现的。

在美洲經向分佈線上，另有两种十分發达，那是 P. racemosus Douglas 自英属哥伦比亞南至北
加利福尼亚州，和 P. lanceolata Michx. 分布於加拿大和合众国的东部。

在这一基南面的领域内，那个黑变的体色和棱形下唇的 Carnosae 代替了 Racemosae 的位置。
它分佈中心在云南貴州，那里共有 7 种；P. nigra Bonati，P. konynchenenensis Bonati，P.
Gagnepainiana Bonati，P. Tsiangii Li，P. crenularis Li，P. crenata Franch. 和 P.
veronicifolia Franch.，而最后一种也見於西康东南部。从这一中心，P. bifida Pennell 向西經
西部和中部喜馬拉雅而达西部喜馬拉雅的坎格拉，而且也在阿塞拜的卡齊亞山中看到。向西南，在上緬
甸发生了两种，P. Colletii 和 P. corymbosa Prain；向东南則在越南有唯一的 P. Evardii
Bonati，最后在德康半島的南端和緬甸島上，可以找到 P. zeylonica Benth.，极可能就是 P. bifida
的后代。

1）因为我們圖書館中沒有 Rees Cyclopaedia 一書，所以我無法由記憶來知道 P. parviflora Smith 的確切
產地。
从为 P. tenuisecta Franch. 所标著的在 Microphyllae 系中的转变点之后，这一群似乎以它的叶形返回到 Palustres 系的原状而重新开始它的进化了。它的中心似乎还在云南贵州地区，那里就有 3 种，P. tenuisecta Franch., P. Labordei Vnt. 和 P. Henryi Maxim.。虽然前面两种也见于相邻的西藏西南部而后面一种已经分布得很远，侵入到湖北、湖南、江西、江苏、陕西和广东诸省了。又从同一中心，分出两种去，那是 P. flagellaris Benth., 产在缅甸和锡金喜马拉雅，和后面一个地点所独有的 P. Gammieana Prain。


8. CYATHOPHORA 群——这一有趣对叶类是由四个系组合的，Reges, Cyathophylloides, Superbae 和 Cyathophyllae。第一系含有 4 个双齿的种，都集中在西藏东部和云南西北部的一个狭域内。它们是 P. cupularis Li, 只在前一地区所见，P. Lipskyana Bonati 和 P. thamnophila (H.-M.) Li 是两个省有的，而 P. rex C. B. Clarke 和它的几个变型则已经从这一中心分佈到了西藏的上缅甸和东喜马拉雅的一部分，和东面的贵州，表示着这一群的仍然很广阔的迁移。

第二系是单模式的，P. cyathophylloides Limpr. f. 具有一个膨大了而稍稍有嘴的壶部是局限在西藏东部的种类。Superbae 是第三个系，它的单模式的、花较大而嘴较长的 P. superba Franch. 生在云南西北部和邻近的西藏南部。最后是那十分专化了的长短管的 Cyathophyllae 系含有两种，西藏东部和东南的 P. cyathophylla Franch. 和西藏东部的 P. connata Li。

9. POLYSCHISTOPHYLLUM 群——为本属中最小的一个，这一对生叶的群是只有两个单模式的系，那是 Pentagonae 和 Dichotomae。在地理上说来，那对双齿的 P. pentagona Li 和具有中长嘴部的 P. dichotoma Bonati 是只见于西藏东部和云南西北部的。

10. DOLICHOMICUS 群——这一对五生叶类是以后两个亚群合成的。

(1) PTERIDIOIDES 亚群——这一亚群是以两个系，Pteridifoliales 和 Phacelliaefoliales 为基础的。前系是单模式的，P. pteridifolia Bonati 是四川峨嵋山上的特产。聚合为第二系的两种分佈得更宽；P. phacelliaefolia Franch. 见于四川西部和云南西北部而 P. Fargesii Franch. 佔着较东的地点，在川东彭县看到。

(2) EUDOLICHOMICUS——这一亚群在它的开端时表示了一些有趣点。一方面在欧洲的 P. acaulis Wulf 的存在，和它的近亲 P. Artselaeri Maxim. 在亚洲的存在和另一方面的中亚地区的缺少相邻的种类，使人猜想它是一种“同祖异地”的来源，因为它的推定的祖先 P. Sceptrum-carolinum L. 是从北越分佈到这二个地区去了。

在分类上来说，这一亚群是再分为六个系的。第一系，Acaules 含有 3 个无嘴种。P. acaulis Wulf 是见于东阿尔卑斯山的南部和第那利克阿尔卑斯山脉中，而 P. Artselaeri Maxim. 是生在中国北部自河北至陕西和湖北北部。后一种不像它的欧洲对种一样，表示着它的易变的性质在 var.
wutaiensis Hurus. 和在朝鲜的另一亚种 P. ishidoyma Koidz. 继 Acaules 之后的第二系 Vagantes 是灌木式的，有假的 P. vagans Hemsl. 是峨嵋山的特产。第三系 Infirmeae，也许与 Acaules 系中旁支发展，有着单独的 P. infirme Li，是云南西北部的土著。第四系 Longipedes 是代表主要的后缘缘的，里面共包 6 种；这些是湖北西部的 P. filicifolia Hemsl. 四川东部的 P. nasturtiifolia Franch.，两省均产的 P. laxiflora Franch.，四川西部的 P. longipes Maxim.，西康云南的 P. axillaris Franch. 和云南独有的 P. aquilina Bonati。

第五系的名称 Omianae 自身就表明了它所包的一个种和一个亚种的产地。第六系 Muscicolae 的中心明是在西康，所含总数 6 种之中有 5 种是在那里发现的，那些种是 P. gracilittuba Li，P. sorbifolia Tsoong，P. geosiphon Smith et Tsoong，P. pseudomuscicola Bonati 和 P. macrostiphon Franch.，但里面第一种和第五种也在云南西北部看到，而第五种更在四川被看到。

第六系 P. muscicola Maxim. 有着漫长的面积，它的家国一直伸展到湖北、陕西、山西、甘肃（包括宁夏）和青海。第七个也是最后的一系的灌木式的 P. balangensis Bur. et Franch. 是限于西康境内的。

11. CYCLOCLADUS 群——这一对叶的群现在已发展为三个亚群如下：

（1）ASTHENOCOALUS 亚群——只有两个模式种的系组成这一小亚群，那就是双齿的 Fragiles 和中长者部和直部的 Flexuosae（狭义的），它们的模式种的种的地理分布是分开在阿塞密和锡金喜马拉雅，而后者在较近的时候也在安多被看到。

（2）BRACHYCHILUS 亚群——这一亚群是由三系合成的，就是 Aloenses，Keiskeianae 和 Monpinenses，有着似乎不相连续的分部。第一系内共有 7 种，P. Legendrei Bonati 是在四川东北部的，P. Wardii Bonati 是在西康南部的，P. aurata（Bonati）Li 除了与前种同处外，还在云南西北部发现，而那里更有 P. aloensis H.-M.。P. brachychila Li 是上缅甸的土著，P. Kingii Prain 是在锡金喜马拉雅的而 P. Petraettii Tsoong 则是在云南南部靠近越南的某地采得的。

有着与前一系完全相同的体态，但有稍微进步的花序的是第二个系 Keiskeianae；P. Kunstn-zowii Komar. 是东西伯利亚阿穆尔地区北面的种类而 P. Keiskei Franch. et Savat. 则是日本中部本州岛上产品。

（3）EUCYCOCLADUS 亚群——这一亚群的分部是比较好集中的，而且完全是线形分部的。

第一系的靠中的，无齿的 P. salviaefolia Franch.，开始了本亚群的进化，它的分部现在是限于云南和附近的四川的一部分。由这一系进化来的是 Melampyriifora，Longicaules，Gracies 和 Coniferae。双齿的 Melampyriifora 严格地说来只含 3 种，那就是西康南部与云南西北部的 P. melampyriifora Franch.，西康东部和云云南西部的 P. pseudomelampyriifora Bonati 和西康所独有的 P. floribunda Franch。有齿的 Longicaules 只有两种，一种是云南北部的 P. longicaulis Franch.，另一种是 P. Dielsiana Bonati，它的产地是在中国西部，但是缺少确认地址。

长齿的 Gracies 系也是由两种组成的，虽然它所占的面积大大地超过其余的系并在一起。那个改良的 P. graciei Wall. 的一个类型是它的 subsp. stricta（Wall.）Tsoong，它从它的原始中心云南和西康西南部开始发展，经过整个喜马拉雅山脉而到远至的阿富汗斯坦的兴都托里（Shendtode）。在途中经过阿塞密的时候，它发出了一个近亲 P. khasiana Pennel.，而在尼泊尔喜马拉雅，它又在另一地点 subsp. genuina Tsoong 之上，反射出它对于它的祖先 P. salviaeflora Franch. 的关系来。单独地代表 Coniferae 系的是 P. Conijera Maxim.，它是一种稀少的种类，到现在为止只见于湖北西部。
12. NEOSCEPTRUM 羣——这一群是互生叶的，含有下面两个亚群：

（1）GEOPHYLLUM 亚群——这一亚群是巖生以一系为模式的，而这一系自己也是单模式的。具有双匐的 P. hirtella Franch. 是云南的特属。

（2）EUROCEPTRUM 亚群——这一亚群中包括 4 系，是双匐的 Striatae，短的或中长嘴的 Probosicae 和 Lachnoglossae 和那长嘴的 Recurvae。第一系像 Dolichomiscus 羣中的 Acaules 系一样地表示分佈面积的不连续性，极相近的种类，各佔著美洲和亚洲的不同地区。

在前一洲中，有佛培度、科罗拉多及新墨西哥的落机山中的 P. Grayi A. Nelson 和美南和加拿大的新布隆斯威克靠近的部分的 P. Furbishiae S. Watson。在后一洲中，有 P. striata Pall.，它的面积自外贝加尔南下经蒙古至华北西部的甘肃和东方的河北，还有落洲东部和朝鲜的 P. mandshurica Maxim。这些地理上距离而面貌上很近的种类大概是在各自的地区内由靠近 Sceptrum 羣而又有 Rhizophyllum 影响的不同种但却相近的祖先中，分别地而又并行地发展而来的。第二系是有嘴的 Probosicae，它是只在西伯利亞縱向線上存在的，它的两种 P. probosicae Stev. 和 P. brachystachys Bunge 主要是阿拉復和阿尔泰山系的。第三个系 Lachnoglossae 的独系 P. lachnoglossa Hk. f. 是从云南分佈到錫金喜馬拉雅。最后一系也是单模式的，P. recurva Maxim. 和它的 subsp. polyantha (Bonati) Tsong 从甘肅西南部，经西康东北至云南西北部。

13. SCEPTRUM 羣——照推論这一群是木屬中第二老的群了。它也被分为两个亚群如下：

（1）EURCEPTRUM——这一亚群是以下 14 个系合成的，这些断然是由下面一个亚群 Breutilabium 繁衍出来的，而那一亚群显然是更原始的。在第一个無瘤型的系 Gloriosae 中，我們看到有一种广佈的种，那就是 P. sceptrum-carolinum L.，它的在欧洲的分布是呈北界的斯堪的那維亚半岛和拉普兰地至南面的罗馬尼亚为止；在亚洲，它散布在北極和最北極的西伯利亞至东面的鄂霍次克海，南面至蒙古北部，中國东北各省和日本，而在后一地区中，它又分化成许多种类。这些是本州岛上的 P. gloriosa Bisset et Moore，P. nipponica Makino，P. iwatensis Ohwi 和九州岛南的屋久岛上 P. ochiana Makino。在大陆上，另一近种 P. odontochila Diels 是在美叐中被发现。第二个系是 Grandiflorae，它的单独的成员 P. grandiflora Fisch. 是处于外贝加尔至北滿的一个地区内的。第三系的 P. tsekouensis Bonati 是见于西康和云南西北部的。但最重要的系是第四个 Tristes 系，它的主要的种 P. tristis L. 最早在这东西伯利亞发生的，从那里南下至阿尔泰，贝加尔和外貝加尔，再下至蒙古的北部和南满的甘肃和山西，在那里发生了 P. shansiensis Tsong。在中國中部，它的地位是被它的亚种 subsp. macrantha Maxim. 所代替，这一亚种分佈在甘肏、湖北、四川西部和西藏。再向南就另有一近种存在，那是云南西北部的，单独的代表第五系的 P. galeata Bonati。

直接由前一种进化而来的是那具有舟形的和生有短嘴的罩部的第六系中的 P. dolichocymba H.-M.，它的面积是限於云南西北部和西康南部。第四个系 Rudes 包含 6 种有嘴的 Tristes 系的后代，它们是甘肏(包括寧夏)和四川北部的 P. rudis Maxim.，四川北部的 P. decora Franch.，西康的 P. princeps，西康和云南西北部的 P. Dunniana Bonati，上缅甸的 P. neofischeri Tsong 和西藏南部(东喜馬拉雅) 的 P. Prainiana Maxim。从 Galeatae 系系出的是第八个 Ingentes 系，具有短或中长嘴部。它的 8 种多集中於西康省，这是 P. Steiningeri Bonati，P. pseudosteiningeri Bonati，P. lophotricha Li，P. tongolensis Franch.，P. trichocymba Li，和
P. angustiloba Tsong。其他两种是青海东部和四川北部的 P. ings Maxim. 和云南西北部的 P. pseudoingens Bonati。

第九个系 Imbricatae 含有较长嘴的种类，从 Rudes 系进退而来，一起有 4 种。它们的中心是西移了，因为 P. platychila Tsong 是阿塞密的土著，P. imbricata Tsong, P. mucronulata Tsong 和 P. Clarkei Hk. ff. 都在不丹发现而最后一种更在锡金喜马拉雅。附近的西藏境内和尼泊尔遇到。第十系 Trichoglossae 是有两系从 Dolichocymbae 系进退而来，那是四川西南部、西康东南部和云南西北部的 P. rhodotricha Maxim. 和后一地点向西经由锡金，尼泊尔而现在已达康毛思的 P. trichoglossa Hk. ff. 第十一系 Lasiochyrides 是以三种组成，这是散布在青海东部、甘肃南部和四川北部的 P. lasiochrysis Maxim. 的两个亚种，四川西北部的 P. craspedotricha Maxim. 和西藏的 P. cinerescens Franch. Kongboenses 是从 Ingentes 系直接进下来的第十二系，内含两个长嘴的种，P. kongboensis Tsong 和 P. retingensis Tsong。前一种是生于西康西南部而后一种稍稍向北，是系发现远近处未被探得的。第十三系 Subscirretea 是柱管状的，单独的 P. Vialii Franch. 住在西康，云南和上缅甸。第十四系 Exscirresea 还是柱管状的，P. excelsa Hk. ff. 是东喜马拉雅从不丹到锡金的种类。最后的也是第十五个 Kialenses 是具有扭曲的盔而代表本亚属中的最高发展的系，里面包含两种 P. kialensis Franch. 和 P. streptorhyncha Tsong，二者均产西藏。

（2）BREVI LABIUM 亚属——这一亚属一定会比前一亚属更早生存，因为在 Sceptrum 群中，P. capitata Adams 無论从地理分佈或形态特征观察点看，都应该是较老的种类了。它的种类完全屬於西北部地区，在那里，尤其在它没有进化多少的。

那四个合成本亚属的系是 Capitatae, Brevislabres, Tripinnatae 和 Lunares。包在第一系中的是三个种，P. capitata Adams, P. semibarbata Gray 和 P. centranthera Gray。那里面的第一种是广佈於极北的西伯利亚和美洲。在前一地点，西方它到了泰米尔河而东面到达安那提尔，再从此到勘察加；再东，它在白令海峡的岛上和阿留申群岛岛上被看到，由这里进入阿拉斯加和格陵兰。第二和第三的分佈区是向南很多的，前一种见於加利福尼亚的那伐达山上和东边的那伐达州中，而后一种则见於加利福尼亚东南部、犹他南部、科罗拉多西南和新墨西哥西部等处的落机山上。

第二个系是管模式的，P. densiflora Benth. 是只生於加利福尼亚的。第三系的 P. tripinnata Mart. et Gal. 也是管模式的，是只生於墨西哥植物区系的种类。第四个也是最大系 Lunares 含有 12 种之多，而都是短或中长嘴的。第一种是僅有的本亚属的亚洲代表，就是朝鮮半岛的 P. lunaris Nakai。其余的 11 种都属于美洲经向分佈線，而它们都住在西面的落机山上。只有两种是在美国之外找到的，那是 P. bracteata Benth. 和 P. latifolia Pennell，两种均生在英属哥伦比亚，前者向东延伸至萨斯卡顿，再南向入达那和科罗拉多而后者直南入華盛顿和爱达荷。

其他 9 种，包括 P. padoensis Pennell, P. rainierensis Pennell et Thomps., P. atrosanguinea Pennell et Thomps., P. Thompsonii Pennell, P. Canbyi Gray, P. silihia Rydb., P. pachyrhiza Pennell, P. flacida Pennell 和 P. Paysoniana Pennell 都沿着華盛顿、蒙塔那、爱达荷、俄勒冈和加利福尼亚的落机山分佈。

在写完了各群和各亚属的分佈之后，我们还愿意在这里提出一个表格来，使得我们对於各个大单位的分佈和其相互关系，能得到一个更直接的印象。这里引用了三个记号，须要加以解释的，那就是加号(+)代表为一个群或亚属的原始中心的省区，减号(-)表示为对某一群或亚属只有一种或少数种代表的省区，和(×)号表示一个为一、群或亚属的最大演化中心的省区。
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* (y)表示原始中心，可能在环境内、可能在欧洲区。请参阅本卷页21中 Euxiphyllum 纲科下的附注。
（二） 馬先蒿的原始中心

在介紹了在各群和各亞群下的科的分佈之後，我們現在可以考慮一個最主要的本屬發生的原始中心在什么地方的問題了。

以前已經提及，泊爾氏的意見，以為馬先蒿的科的遷移，是隨着四條經向分佈線進行的，而這些經向分佈線当然是以經度省區為本屬原始中心的這一信念為基礎的了。這一觀念在後來 1918 年為庫納蒂氏所接受。到了 1920 年，林柏利許氏駁斥了這一意見，而著名以阿爾泰-天山脈為本屬的搖枒；李惠林氏在他最近的修訂文中接受了這一說法。來決定這兩個相反的見解中哪個比較適當，我們一定要在各群和各亞群的分佈事實中來尋求解答。為了得到比較直接的觀念，我們願意將上面的很長的敘述簡略為下列各條：


2. *Sceptrum* 羣也是在經度省區中發生出來的， *Eusceptrum* 的進化是在中國中部和西南部開始的，那裡最先發現有那些具有舟形的短臂的盔的種類像 *P. rudis Maxim.* 和 *P. dolichocymba* H.-M.; *Brevilabium* 的進化是在北美合众國開始的。

3. *Cladonia* 羣是在經度省區中以 *P. Lansdorffii Fisch.* 的出現而開始的。而這一羣曾抓住了時間來分化和進化，因為我們在歐洲和西伯利亞，甚至在北極地區內，不但找到了多少扈翅的 *Paelustres* 羣的種類，而且也有些像 *P. lapponica L.* 和 *P. resupinata L.* 那樣的 *Racemosae* 羣的有翅類型。

4. *Aplocadus* 羣也可能是於歐洲發生的 1; *Eu-aplocadus* 亞羣也許是從 *Rhizophylliastrum* 羣中的 *Rosae* 羣落下的，而無翅的扈翅的 *Foliosae* 和 *Comosae* 羣是以縱向分佈經由吐魯-伊朗（Turano-Iranean）地區和土耳其斯坦至西伯利亞，而後一系則一直東延至日本；*Pseudaplocadus* 羣也許由 *Limnogenae* 羣在歐洲開始的，後來因為 *P. sudetica L.* 在遷移上的強大能力而成為廣佈，它的子孫在西伯利亞和美洲的落基-安第斯山脈中繁衍起來。

5. *Dolichocinclus* 羣，也像 *Eurhizophyllum* 一樣，是在歐洲和亞洲各自地發生出來的，在前一地區由 *P. acaulis* Wulf而在後一地區則由 *P. Artselaeri Maxim.*，兩者皆歸於都是 *P. Sceptrum-carolinum L.* 的後代; *Pteridioideae* 是在中國西部發生的。

6. *Neosceptrum* 羣的兩個亞羣，也是各別地發展出來的； *Euneosceptrum* 是在亞洲和美洲兩地發生的，在西伯利亞和北美洲合众國各為 *Striatae* 羣極相關聯的種類所代表，可能都由同一親系傳下來的；*Geophyllum* 羣則在中國西南部出生。

7. *Orthosiophoria* 也是很有可能在兩個中心開始的，那就是高加索和阿爾泰-天山脈；這裡可以注意到有和 *Eusceptrum* 相同的輪向分佈的情形。

8. *Sigmantha* 羣中的 8 個亞羣，是在同一地點出生的；雖然它們的花冠特徵是相似的；*Noto-

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1) 參閱 Eurhizophyllum 亞群下的附注，見本文頁 21。
sigmantha 是在西伯利亚-土耳其斯坦省区中生的，部分和 Eu-apocladus 和 Orthosiphonia 两草有相同的分摊面积；Rigioaulus 是在喜马拉雅-云南省区中生的，和 Cladomania 羣中的有些种类的分摊相符合；Eusigmantha 是在西藏-中国中部省区中开始的，也可能还在喜马拉雅-云南省区之中。

9. 除了上面提到的包含着 10 个亚纲的 6 个习生叶和两个对生叶的亚纲之外，留下来包有 9 个亚纲的 5 个亚纲是对生叶的，而它们的原始中心和演化中心都完全在中国西南部。

在上面各集中和前面表格中所表示的，我们知道在西伯利亚-土耳其斯坦省区里生起阿尔泰-天山山脈的那部分是主要被 Apecladus (Eu-apocladus) 和 Orthosiphonia 两草主著优势，而这两个草具有十分明朔的特征，是不能算作本属中最原始之群的。除了这二个草的种类外，其他现存的草则只有 Sigmantha 和 Eurhizophyllum 了。因为同样的原因，我们对于在这些区内所发的几种 Sigmantha 草的种类，可以视为无足轻重的。对于我们因为它是前两纲而重视它的 Eurhizophyllum 羣，我们只找到了两种，那就是广佈的 P. Oederi Vahl 和它的近种 P. Albertii Regel。至於另一前两纲 Sceptrum，那么在此範围内连一种都找不到。

现在让我们来看一看中国省区内的事实怎样。对于 Eurhizophyllum，可以看到两种，P. Oederi Vahl 和 P. flammea L。还有三种疑似从杂交而来，然而还是很切近的种类，就是 P. hirsuta L., P. lanata Cham. et Schl. 和 P. Landoorfii Fisch。对于 Sceptrum 呢，我们有 P. capitata Adams 和 P. Sceptrum-carolinum L。在阿尔泰山系中一个前两纲的完全缺如，和另一前两纲的稀少的代表种，在与北极地带的这两个草有着完备的代表的生态对照之下，就差不多十分准确地告诉了我们到那里去寻找 Pedicularis 的原始中心去了。

更有加者，这是适切的在这里再提醒读者们关于 Rhizophyllum 羣草花的大小的进化是确定地前进的——种类愈近代，花就愈大——这一事实。这一规律对于进化上不同的种类是准确的，而对於相近的种类或或则至於一个种下的变型中也是同样地准确的。在现在这一事例中，我们在中国中部省区和喜马拉雅-云南省区中，不但有許多大花的，高度专化了的 Rhizophyllum 羣的种类，而且也有 P. Oederi Vahl 几个花冠较大的变型，如 var. heteroossa Prain 等等。相反地，我们在北極地区和阿尔卑斯山上所见的 P. Oederi Vahl 却只是普通的，和在阿尔泰-天山中所见的完全相同；而我们也不能忘记在北極的 P. flammea L。生有比 P. Oederi Vahl 小得很多的花。

当然，在南边的两省区中看到很大的花的事实，是合乎逻辑的，因为迁移和进化的趋势是倾向它们的。但是如果我们把阿尔泰-天山当作原始中心，那末，正像南边的两省一样，北極和欧洲两个省区，也将变成 Rhizophyllum 分佈中的次中心了。现在在北極省区中存在著小花的 P.flammea L。这一事实，就又要变成在这样一个假设的理论上的绊脚石了，因为这是很难於解说的。既然同为次中心，为什么原始的 Rhizophyllum 种类，南向就发生大花而北向则相反地发生小花呢？这是十分清楚的，阿尔泰山系是不配有一个本属中心的名称的，就是说一个次中心都不配，它最多也许在 P. Oederi Vahl 从它的在北極区的原始中心移向它的最大演化中心和进化中心的西藏-中国本部和喜马拉雅-云南省区的道路上的一个暂时歇足点而已，决不能再多於此了。

除了以上所説的理解之外，我們也还可以改法在生物统计上得到一些证据。柏木氏在他的第三表列里（在要分佈，頁 45），掌有别的种类来和这种的比较；在这种手册中，无香的种类就必然也包括那些具有灰灰的深色的衍生种了。这里就是为什么在西伯利亚-土耳其斯坦省区中，古老种类的百分比在无香中被提高了的缘故。

为了搞明白这一点，在这里把施纳蒂氏的八个表格（1918）简单成为一个表格。我們沒有再費事
去把从他以后所发表的种类写罗进来，因为觉得不包括它们也不会使这些统计变得不准确些的。1

翟氏以“进化花粉型”与叶序为基础，分本属为八组，而将它们放入表中。这些组如下：

AA＝Anodontae Alternifoliae（无齿互叶组）。
BA＝Bidentatae Alternifoliae（双齿互叶组）。
RA＝Rhyncholophae Alternifoliae（有喙互叶组）。
LA＝Lonicrestres Alternifoliae（长喙互叶组）。
AV＝Anodontae Verticillatae（无喙对叶组）。
BV＝Bidentatae Verticillatae（双喙对叶组）。
RV＝Rhyncholophae Verticillatae（有喙对叶组）。
LV＝Lonicrestres Verticillatae（长喙对叶组）。

虽然我们表示了以“进化花粉”来做我们系统的基础，但是上面代表翟氏的组的符号却可以用他示南北显示出来本属中清晰的前二阶段的组合型式。除了代表八个组的符号之外，还有有一些编选表中所必不可少的记号被介绍进来。它们还需要说明如下：

N＝各省区中所有种类的总数。
E＝各省区中所有特有种类的总数。
P＝各省区中特有种类的总数，对所有种类的总和的百分比，＝(100E/N)
(N)＝各省区中八种组合型式中每一型式的数目。
(E)＝各省区中八种组合型式中每一型式种数的特有种数。
(P)＝各省区中每一型式组合的特有种数的数目，对同一组合型式的总数的百分比，

(100E/N)。

(PN)＝各省区中八种组合型式中的每一型式种类数目，对各省区内所有种类总和的百分比，

100(N)/N)。

(PE)＝各省区中每一组合型式的特有种数，对同一省区中所有特有种数总和的百分比，

100(E)/E)。

如表中看，于N项下，环毘省区在八省区中占着第六的位置，种的总和为22种，而北纬利川－土耳其斯坦则占第三位，有着一个63的种的总和。其特有种对所有种的总和的百分比P则在前一省区中为50%而在后一省区中则为68.7%，这无疑地是李博士认为前者作为一个省区是已经十分清晰的界划，因而拒绝以它为未被发现的一个重要原因（修订第二部239页）。在检查表中(N)项下AA时，我们看到这两个省区有着相等的数字，两个为7种。在AA中的特有种项下，这两个省区又巧合地各具5种。这两个相同的数字，使得(P)项下的百分数又成相等，均71.4%。现在，如果我们在反过来检查一下(PN)和(PE)两项下面的数字，我们会立刻注意到前一省区在AA中所表示的极高的比例数，它们达到31.8和45.4之高，而后一省区则在这方面不成比例地缩减下来，成

1）从翟氏的文章发表以后，在环毘省区内发表的种类，多属於无齿和双齿类型，而在他一省区中新发现的种类，尤其是靠南的省区中，多属於有喙和有管类型。这很明白，把它们放进去是不会反对我们的见解而有于它有利的。
为11.1和11.9了。这些数目肯定地表示了环纹省区内最古老的和最类型的很高的特级率。

而且，如果我们会注意到第一在(PN)项下的那组组合的数目——那些表示断省区内，在某一进化水平上的种类的数目(N)，与这一省区的总数和N相对比的百分率——时，我们就不大会不看到凡一个省区距环纹省区愈远，那来原始类型的数目就愈小，而同时，前类类型的数目也愈大。反过来也是一样。这种古老类型向和性与低化类型的离心性质不是偶然的一种现象，它一定表示一种事实，那就是在本质的进化和分布之间，保持着一种天然的和相。

但是上面的统计所告诉我们的，特别是马先蒿的分布现象而已，它在决定原始中心，主要还是要看我们怎样来解释这些现象。在现时的植物地理学的圆地里，似乎有两个对照区别的见地。第一个是科马罗夫的，他的研究方法曾由吴尔夫的摘要如次：“先发现在亲缘上最原始的类型，它们的进化的方向，这些原始类型中心性的的中心，它更孤立的方向；这不过是一个一般的想法，以为大古是古老类型集中的中心，那里就找到了原始中心。第二个是由马修的提出的，要找它的原始的中心，我们最好引用巴学考克的话：“……从一个共同的中心，那些较老的类型放射地四面分布，伴随着中心的较前的类型的分化的”和“在某一固定的时间内，在表现出最原始的亲缘关系的一组有机体中，那些最保守的将被发现于离原始中心最远的地方，而那些较近的则最近中心”。

这是很明显，所有曾经设法或者正在设法找出马先蒿原始中心的作者，连现在的一个计算在内，大家都在心中存着一个，或者是科马罗夫的，说的要旨，而所达到的自然结果，不是归到北极圈，就是阿尔泰—天山山脉，却没有一个人曾经发生过一丝一毫的以西藏—中国西部或喜马拉雅—云南省区来作木属原始中心的意念过。我想，至少在这里对马先蒿属来谈，马修的见解是难于应用的。

(待续)

1) 与此相关的，我们必须不要忽略了一个事实，那就是在从前的马先蒿著作中，在决定了一种断阶的古老型式的花果——不管它为单植型或者是双株型——之后，凡所有生有这样花果的种类，都被一般同地作为原始，不管它有其他形态特征上的表现如何。这明地看着是不一致的结论的事实来判断任何种类的年代老幼。举例来说，虽然P. soleaeflora Franch. 有著隐密的花冠，但它已经在它自己的身上，因为对生的叶序、分枝很多的茎等等而著入一些现代性的。同样的一些例子可以在任何一个派生的朵中找到，这意味著在部形状所代表的价值，只是相对的，并非绝对的。就是在同样的。“双株型”中与其他特征的不同组合，可以代表不同的价值。现在如果我们要来看一下北疆省区的“断轴多叶”的种类，就会很容易看出那些不但花部构造原始而且其他特征也同样原始的种类，是集中在这里的。

2) 科马罗夫，V. L.: 中國及蒙古植物誌的字音（越彼得羅植物誌雜誌二十九卷，1908）。
3) 吴尔夫，E. V.: 对於历史的植物地理的一个介绍，第38页（英譯本，1950）。
4) 木修，W. D.: 气候与进化，纽约科学院年鉴二十九卷（1915），171—313；二版，纽约科学院专刊，第一卷（1933）。
5) 巴学考克，E. B.: 黄酮类化合物，第一部，加列利福尼亚大学植物学刊，二十一卷（1947），页125与75。
A NEW SYSTEM FOR THE GENUS PEDICULARIS

Tsoong Pu-chiu
(Institute of Botany, Academia Sinica)
(continued)

III. Geographical Distribution of *Pedicularis*

9. Grex POLYSCHISTOPHYLLUM ...............(61)
10. Grex DOLICHOMISCUS ..........(61)
11. Grex CYCLOCLADUS ......(62)
12. Grex NEOSCEPTRUM ....... (63)
13. Grex SCEPTRUM ..............(63)

Table showing important points in the distributions of the groups and subgroups of *Pedicularis* ...............(66)

B. The center of origin of *Pedicularis* ...............(67)

III. Geographical Distribution of *Pedicularis*.

In monographic works, the importance of geographic distribution can hardly be over-emphasized on a duofold reason. Of course, the study in this section of the work has its own duties to perform, i.e., the present areas of the plants concerned and possibly also their historical dispersal. In addition, there are the various other aspects in respect to plant distribution as the physiographic features of the areas occupied, the altitudinal dispersal, habitats, viz. ecological aspects etc. to be investigated. The accomplishment in all the above phases of distribution constitutes only one facet of the reason for its study, and there should be another quite different facet; it is that its study should provide a means by which a check can be made of the various phases of distribution to the taxonomic arrangement in the new system to see if there exists any correlation between them; the presence or absence of such correlations may well serve the purpose in attesting whether the system is nearly as phyletic as it is claimed to be.

As to why there should exist such correlations, we must refer to the Theory of Tolerance of Prof. R. Good.1) Here may be quoted three out of the six principles of his theory:

"Each and every plant species is able to exist and reproduce success-

fully only within a definite range of climatic and edaphic conditions.

The tolerance of a species is a specific character subject to the laws and processes of organic evolution in the same way as its morphological characters, but the two are not necessarily linked.

The tolerance of any large taxonomic unit is the sum of the tolerances of its constituent species.”

We must bear in mind the fact that the Theory of Tolerance is basically one that concerns more about the distribution of single species than collections of species, although the last principle here reproduced relates something about its tie with larger taxonomic units. Really it is not our aim to add something to its already well expounded relationships to specific distribution, but rather to reveal its other facet in relation to the higher taxa that we are referring to it now.

The nature of tolerance of any given species, as assumed, is in close concordance with the laws of evolution and genetics; in another word, it is its historical background which moulds the tolerance of any given species. This tolerance is supposed to remain temporarily static until some changes in external conditions chance to happen, or when the plant comes into contact with new environments on its tracks of dispersal. Apparently such change in external conditions which tends to stimulate a corresponding change in tolerance of a given species must itself be still within the bound of tolerance of that species, although the post-change condition must differ somehow from the original one under which the said species has subsisted, since it is obvious that a change too drastic as to be out of the tolerance variation of the species would certainly exterminate it before it has time to adapt itself to its new environments. Thus it may well be surmised that changes of tolerance through the impetus of new environments should not occur in too abrupt a manner, but would most likely happen in a slow and gradual way. By the above reasoning, we may conclude that the tolerances of closely allied species in any small taxa would theoretically be very much alike; also that the tolerances of any ancestral stocks and their offsprings belonging to two successive or not too far distant “generations of evolution”1) would, under normal conditions, retain similar amplitude in the range of tolerance. In case there is any change of tolerance, then it would surely be manifested in, and

1) In our study of the genus, there seems to be discernable, though somewhat difficult of discrimination, three different kinds of “generations” in the multiplication, differentiation and evolution of Pedicularis. The first is the word “generation” used in its conventional sense, and its function is pure and simple multiplication: the offsprings thus generated belong to the same species as their parent. The second is the “generation of segregation”, by which I mean figuratively the kind of generative processes by which species differentiates itself into close allies; the descendents emerged from such processes appertain usually to the same evolutionary rank as, though they may differ specifically from, their progenitor; e. g., P. flammea L. to P. Oederi Vahl, P. orthocoryne Li etc. The third is the “generation of evolution”, by which it is meant that its processes generate offsprings whose relationship with their forebear involves definite evolutionary differences as what is seen in the case of four species, from P. Oederi Vahl through P. pseudovertebrator H.-M. and P. kabadanensis Bonati to P. rhynchodonta Franch. etc. More discussions will be forwarded later in the subject of the area of a species and its relation to evolution.
made easily detectable from, the corresponding changes in altitudinal
distribution, in those of edaphic conditions and biotic environments from
the old to the new. And this is almost precisely what is found in our
study of genus *Pedicularis*. In the following lines, we are going to present
what a little result we have found in our investigation.

A. The present distribution of *Pedicularis* species in
systematic sequence

In the study of geographical distribution of any genus, the present
areas of the species must be reckoned with as of first importance, since all
other phases relating to this subject have to found their basis wholly or
partly on this one. In avoiding the cumbersome effect in writing, it is
wise to put forth the general trends of dispersal of the major taxa
separately from the distribution of species which is better to be submitted
in their respective proper positions in the systematic treatment, and this
is especially true when the genus is of considerable size. Although well
aware of this, and being confronted with the task in putting forth an
enormous number of species in the present genus, I have still taken to the
opposite method, because it is believed that in so doing, there will be the
definite advantage in bringing out certain details vitally connected with
plant distribution; also it will help to get a better insight into the inter-
relationship between evolution and migration.

Prain was the author who first made the effort to present an account
of the distribution of the genus. By basing on the statistics in endemic
percentage, aided by those in the distribution by structure and in the
distribution by colour, he divided the world into eight provinces of
endemism, namely, Circumpolar, European, Siberio-Turkestan, Japanese,
American, Caucasian, Tibeto-Chinese and Himalayo-Yunnanese. By the
same token, he further asserted that the routes of migration were by four
meridians, viz., the European, the Siberian, the American and the
Japanese. Following this, he also postulated several definite projections
for some of these meridians. These projections show in some instances
clear inconsistency with the facts observed in our study, and further
remarks will be made in due course. But the meridians of distribution
and the provinces of endemism can be advantageously used in our accounts
of the geographical distribution of the genus.

1. Gregex RHIZOPHYLLUM

This alternate-leaved group seems in all probability the oldest group
within the genus, and its Circumpolar origin is almost definitely traceable.
The group is subdivided into two subgroups as following:

1) Subgregex EURHIZOPHYLLUM—Presumably earliest of emer-
gence, this subgroup embraces now more than ten series within its scope.

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1) We have just received the twenty-second volume of Flora URSS which contains
a number of new *Pedicularis* species, which for want of adequate time, are not
included here in the geographical distribution, but will be considered later on
in the systematic treatment.
The initial ser. *Hirsutae-verae*¹ is represented by four anodontous species in the Arctic Circle. *P. flammaea* L., *P. hirsuta* L. and *P. lanata* Cham. et Schl. are three species less widely distributed. The first is found from Greenland down through Labrador to part of northern Rockies in the west, to Newfoundland and Iceland in the south in the Nearctic region; in Palearctic, it is found in Lapland and Scandinavia. The second and the third frequent besides Arctic Europe and Arctic America, are also seen in Arctic Siberia. The responsibility in the diffusion and evolution of the group was, however, largely shouldered by their most prolific ally, *P. Oederi* Vahl, a species which occupies the widest geographical area. It is distributed in the Arctic America,² Arctic and alpine Europe and Arctic and alpine Siberia. Due perhaps to less variable environmental conditions, the species kept and still keeps remarkably true to its original form in Europe and northern Asia. Only one related species, *P. Albertii* Regel, was cast off in Turkestan en route to the western Himalayas. On reaching North China and Japan, however, the species began to show its instability by giving rise to several forms as subsp. *yezoensis* Nakai, var. *heteroglossa* Prain, etc. But the really serious work of evolution was not earnestly begun until the species had reached southwestern China. Beside casting an off-shoot in the ser. *Corydaloides* with two species, *P. corydaloides* H.-M. of northwestern Yunnan and southern Sikiang² and *P. cryptantha* Marq. et Shaw of western Sikang and southeastern Tibet (subsp. *ectcta* Tsoong), and a few affinities as *P. angustiflora* Limpr. f. of Sikang, *P. orthocoryne* Li of northwestern Yunnan, the species, in pursuing its own main course, developed into the bidentate ser. *Pseudo-Oederianae*. The series just named contains two species, *P. pseudoversicolor* H.-M. and *P. habuchanensis* Benati, both of them inhabiting northwestern Yunnan. The next series with a characteristic multidentate corolla is *Rhyynchodontae* with the monotypic *P. rhynehondonta* Franch. of northwestern Yunnan, Sikang and southwestern Kansu. Immediately behind followed the slightly longer-

¹) Our presentation here is in concord with the arrangement in the phylogenetic schema in the first submission of this manuscript, wherein I have put *Hirsutae-verae* at the initiating end of *Eurhizophyllum*. This means that the scope of the series holds all the species with centrifugal inflorescence, i.e., *P. flammaea* L., *P. Oederi* Vahl, *P. angustiflora* Limpr. f., *P. orthocoryne* Li, *P. Albertii* Regel, *P. hirsuta* L. and *P. lanata* Cham. et Schl. as against ser. *Hirsutae-centripetae* whose sole constituent, *P. Lanstorffii* Fisch., has centripetal inflorescence. After long meditation on the fact that the last two species possess not only somewhat different general features, but have, at least one of them, two colpate pollen grains, I am now ready to accept Prain's view to distinguish these two species into *Hirsutae-verae*, to be separated from *Flammeeae* which holds *P. flammaea* L. and its four true allies. Under such view-point, the relationship between these three series and their respective lines of descendants would become the following: *Flammeeae* ancestral to *Eurhizophyllum*, *Hirsutae-verae* ancestral most likely to *Eu-apocladus* (Foliosae) and *Hirsutae-centripetae* ancestral to *Cladomania* (Palustrea). It follows that *Hirsutae-verae* at the beginning of the present subgroup should be changed into *Flammeeae*, and *Hirsutae-verae* should be, in turn, transferred to the beginning of *Eu-apocladus*, whose center of origin would also change from the European Province to the Circum-polar.


³) The southwestern Province Sikang has been amalgamated into Szechuan recently, but for the convenience of writing, the old name of Sikang has been retained in this paper.

The following series *Maenorhyncha* marks another side-development by having a corolla simulating those of ser. *Excelsae* with small lip and exceedingly long beak. It is monotypic; *P. maenorhyncha* Li being a native of northwestern Yunnan. Evolved from *Filiculae*, the bigger-flowered Ser. *Robustae* is exclusively of eastern and central Himalayas; *P. nepalensis* Prain is found in eastern Nepal and Sikkim, *P. Daltoni* Plain, *P. robusta* Hk. f. and *P. Garckeana* Prain only in Sikkim Himalaya. Next comes ser. *Macranthae*, embracing four species and a number of forms. Its range extends from southern Sikang and northwestern Yunnan where inhabits *P. insignis* Bonati, to Upper Burma in the south, the home of *P. nobilis* Bonati, through southern Tibet, Sikkim and Nepel, the native land of *P. Sculkyana* Prain, to Kumaon, the westernmost point reached at present by the series and the seat of *P. Klotzschii* Hurus. (*P. macrantha* Klötz.).*Pumilliones*, most probably arising from *Robustae*, is a small series of two species and a horde of forms. *P. Przewalskii* Maxim. in its typical form and various subspecies occupies an area from southern Kansu and northeastern Chinghai, through Sikang to northwestern Yunnan in the east and southern Tibet (Phari in the eastern Himalaya) in the west. *P. bella* Hk. f. is more westerly in range; it inhabits Sikang, the Sikkim Himalaya and western Tibet.

As its name implies, *Longiflorae* is a series whose constituents are highly specialized, long-tubed species. It is the most prosperous series of the subgroup, being furnished with no less than twenty-two species, and is also considerable extent in area. The center of origin seems to be in an area comprising northern Chinghai, central and southern Kansu and northern Szechuan where one mainly finds species possessing yellow flowers with uncontorted galea as *P. bidentata* Maxim., *P. armata* Maxim., *P. crano-lopha* Maxim., *P. decorissima* Diels, *P. chinensis* Maxim. and *P. longiflora* Rudolph. Among these species, *P. decorissima* and a form of *P. crano-lopha*, the var. *longicorns* Prain are also seen in Sikang while *P. chinensis* and *P. longiflora* are two wide-ranging species; the former extending eastward to Shansi and Hopei and the latter, besides being also found in the latter province, further ranging northward to Sayan, thence through the Kangai Mts. to the vicinities of Lake Kossogol, Baical and Transbaical. Southward, its area is further extended by its subsp. *tubiformis* Pennell through Sikang and Yunnan to enter and disperse westward all along the massive Chain and ultimately to find its present westernmost outpost at Baltistan in the western Himalayas.

The great number in the red-coloured and contort-galeate species in Sikang and northwestern Yunnan indicates that the series has its maximum development in this general area. Altogether thirteen species are accounted, of which, all but three are red-coloured. Six of these species, viz.
P. Croizetiana Li (yellow-flowered), P. Paxiana Limpr. f. (white-flowered), P. tenuituba Li, P. variegata Li, P. leptosiphon Li and P. latituba Bonati are found in Sikang with the last also discovered more lately in Bhutan; four more species, P. humilis Bonati, P. dolichantha Bonati, P. fastigiata Franch. and P. sigmoidea Franch. are the inhabitants of northwestern Yunnan, while still three more, P. Garnieri Bonati (yellow-flowered), P. Delavayi Franch. and P. dolichosiphon Li are species common to both these two provinces. More westerly, P. siphonantha Don replaces P. Delavayi Franch. of Yunnan in Sikkim and eastern Nepal. Two more species complete the list of the series, namely, P. Hookeriana Wall. in the central and western Himalayas from Nepal to Simla and P. punctata Decne. in the western Himalayas from Bashahr to eastern Afghanistan.

The last series, Megalanthae, is more westerly in range generally. P. pauciflora Pennell and P. megalantha Don are of the eastern Himalayas, the former being only found in Bhutan and Sikkim and the latter from Bhutan to eastern Nepal. The other species are western Himalayan, P. Hoffmeisteri Klotz. being from Kumaon to Chamba, P. elephantoides Benth. from Kashmir to Hazara and P. bicornuta Klotz. from Tehri to as far as eastern Afghanistan.

2) Subgrex RHIZOPHYLLIASTRUM—This subgroup had apparently evolved from the foregoing one, differing only in the few-flowered, usually centripetal inflorescence. Closely allied species are seen in two separate meridians, the European and the Siberian, both in most probability having descended from the wide-spread P. Oederi Vahl. The first unit, ser. Roseae, consists of three species: P. rosea L. and P. orthantha Griseb. are mainly seen in the alpine regions of the Balkan Peninsula, with the former also found in the West Alps; P. muscoides Li is of Sikang and southern Tibet. This anodontous series is followed by the bidentate ser. Merrillianae, with a single species, P. Merrilliana Li of southwestern Kansu, eastern Sikang and Bhutan, apparently having improved directly from P. muscoides Li. In Europe, such link between the “Anodontae” and “Rhyncholophae” is missing.

The succeeding series is the beaked Asplenifolias which is composed of seven species. Among these, P. geminata Portenschl. and P. asplenifolia Florke are of East Alps, while P. tsarungensis Li, P. Meyana H.-M., P. umbelliformis Li and P. Yui Li are of Sikang and northwestern Yunnan. One single species ranges more southwesterly is P. longipedicellata Tsoong of Bhutan. With dubious systematic position here is the monotypic ser. Odontophorae, whose P. odontophora Prain is found in Sikkim and adjacent Tibet. Paucifoliatas is a series constituted by six species, four out of which are confined to northwestern Yunnan, viz. P. tsangchanensis Franch., P. Forrestiana Bonati, P. yunnanensis Franch. and P. mierantha Li. The other two species are P. micromylic Hk. f. and P. pseudoheyei Tsoong, the former inhabiting southwestern Sikang, southeastern Tibet and Bhutan, and the latter being an endemic of Burma. The two series which follow Paucifoliatae are the monotypic Myochophilaæ of southwestern Sikang and Franchetiana in its typical and several forms found in southwestern
Szechuan, eastern Sikang, and northwestern Yunnan.

The big-flowered *Pseudomacranthae* is a series of three species, two of which, *P. aschistorhyncha* Marq. et Shaw and *P. Fletcheri* Tsoong are localized in southwestern Sikang, while the third, *P. Elwesii* Hk. f. with its several forms extends from northwestern Yunnan through southern Sikang and the eastern end of the Himalayan Chain to Sikkim and southern Tibet. Ser. *Albiflorae* is farther west in range. Beside *P. tapaensis* Tsoong of eastern Sikang, seven species are to be counted in the general area comprising Upper Burma, southern Sikang, Bhutan, Sikkim and neighbouring Tibet; they are: *P. rhizomatosa* Tsoong, *P. perpusilla* Tsoong, *P. Hicksii* Tsoong, *P. petrophila* Li, *P. Tayloriana* Tsoong, *P. Regeliana* Prain and *P. albiflora* Prain. Discounting the above-named, two more species are Nepalese; they are *P. Cooperi* Tsoong and *P. pseudo-regelianae* Tsoong. Finally, there is the twist-hooded, long-beaked and long-tubed *Neolatituba*, greatly advanced form from *Myochilae* and *Franchetiennes*; it holds a single species endemic in eastern Sikang.

2. **Grex DOLICHOPHYLLUM**

This opposite-leaved group is subdivided into four small subgroups as the following:

1) Subgrex EUDOLICHOPHYLLUM—This subgroup is nearer to *Eurhizophyllum* than all three other subgroups within *Dolichophyllum*. It is composed of two series, the bidentate *Cernuae* and the rostrate *Tatsienenses*, each containing two species; *P. cernua* Bonati and *P. myriantha* Li of the former and *P. tatsienensis* Maxim. of the latter are confined to southern Sikang and northwestern Yunnan, while the second species of the latter, *P. chenocephala* Diels, has its area more northward, being in southwestern Kansu and northwestern Chinghai.

2) Subgrex BRACHYSTACHYS—This subgroup seems to be more akin to *Rhizophylliastrium*, being also dwarf plants of very high altitude. The bidentate ser. *Collatae* holds two species, *P. Bietii* Franch. and *P. collata* Prain, the former inhabiting Sikang and the latter taking its abode in Bhutan and Sikkim. The second rostrate ser. *Pseudoasplenifolii* is composed of *P. schizorhyncha* Prain and *P. exigua* Li, two species limited to Sikkim Himalaya.

3) Subgrex DOLICHOPHYLLIASTRUM—This third subgroup consists of three series, *Atrovirides*, *Remotilaeae* and *Sikkimenses*. The first series with the bidentate *P. atroviridis* and *P. Sherriffii* Tsoong, is exclusively of southwestern Sikang. The second with its sole constituent, the short-beaked *P. remotiloba* H.-M. is only seen in western Yunnan. The three longer-rostrate species of the third series are slightly broader in area; *P. atuntsiensis* Bonati is of northwestern Yunnan, *P. Elliotii* Tsoong is of southwestern Sikang and *P. sikkimensis* Bonati, besides inhabiting the same area as the last species, is also found in Sikkim Himalaya.

4) Subgrex DOLICHOSTACHYS—Three series, *Piostachyae*, *Tantalorhynchae* and *Meteolorhynchae* combine to form this subgroup. The first with the toothless *P. piostachya* Maxim. and *P. ternata* Maxim. has
its area in Chinghai and Kansu (incl. Alaschan region of the old Ninghsia province). *P. tantolorhyncha* Franch. of the second series with moderate beak is found in northwestern Yunnan with its close ally *P. tantolorhynchoides* Tsoong in southwestern Sikang. The most specialized, long-beaked *P. meteolorhyncha* Li of the third series is confined to the Likiang Snow range.

3. **Genus BRACHYPHYLLUM**

The components of this opposite-leaved group fall into two natural subgroups as follows:

1) Subg. **EUBRACHYPHYLLUM**—This subgroup is formed by four series; they are the bi- and multi-dentate *Lyratae*, the moderately beaked *Brevifoliae* and *Debiles* and the long-beaked *Integrifoliae*. The seven species of *Lyratae* are *P. stenocorys* Franch. and *P. polyodontata* Li of southeastern and eastern Sikang, *P. laxispica* Li and *P. tomentosa* Li of northwestern Yunnan and *P. cymbalaria* Bonati, *P. deltoidea* Franch. and *P. lutescens* Franch. (in several forms) of both Sikang and Yunnan. Only one species is found slightly to the west; it is *P. lyrata* Prain of southern Tibet (eastern Himalayas). Ser. *Brevifoliae* contains six species, of which, *P. verbenaeefolia* Franch., *P. Smithiana* Bonati and *P. Tsaii* Li are of Sikang and northwestern Yunnan, *P. burmanica* Bonati is of Upper Burma and *P. porrecta* Wall. and *P. brevifolia* Don are of Himalayas from Sikkim in the east to Kashmir in the west. No less than fifteen species constitute the ser. *Debiles. P. debilis* Franch., *P. Maxonii* Bonati, *P. lamiooides* H.-M. and *P. villosula* Franch. are circumscribed to northwestern Yunnan; *P. rotundifolia* C.E.C. Fisch. is endemic in Upper Burma. *P. confertiflora* Prain, the Himalayan form of *P. villosula*, is seen in southwestern Sikang, southern Tibet and Sikkim. Other eastern Himalayan species are *P. sphaerantha* Tsoong of southwestern Sikang, *P. inconspicua* Tsoong of Bhutan, *P. tenuicaulis* and *P. chumbica* Prain of southern Tibet, and *P. instar Prain* of Sikkim. In the central Himalayas, two species, *P. domzeyensis* and *P. Poluninii* Tsoong, are found in Nepal. Finally the westernmost point are occupied by *P. Heydei* Prain and *P. canescens* Tsoong, two species inhabiting Penjub and Kashmir respectively. The climax series *Integrifoliae* with a single species in two geographical forms are seen in Sikang and northwestern Yunnan in the east, and Sikkim and southern Tibet in the west.

2) Subg. **BRACHYPHYLLIASTRAUM**—This subgroup holds three series, *Binariae*, *Pectinatiiformes* and *Urceolatae*. The monotypic, short-beaked *P. binaria* Maxim. of the first series is an endemic of northern Szechuan. The longer-rostrate *P. pectinatiiformis* Bonati of the second series is a native of eastern Sikang while its possible progenitor, the shorter-beaked *P. Komarovii* Bonati, being reported without precise locality, is presumed to come approximately from the same general area. Two species unite to form the long-tubed ser. *Urceolatae*; they are *P. urceolata* Tsoong of eastern Sikang and *P. xylopora* Tsoong of Bhutan.
4. *Grex APOCLADUS*

This is one of the most flourishing groups of the genus and is alternate-leaved. Its members fall into two subgroups as follows:

1) *Subgrex EU-APOCLADUS*—This subgroup begins with elate species of ser. *Foliosae*1) having anodontous corolla, being possible descendents of the European species of ser. *Roseae*. Seven species are counted in the Eurasian continents. In European meridian, *P. foliosa* L. occupies the West Alps, the Pyrenees and adjacent northern Spain, *P. sumana* Spreng. is dispersed in the East Alps and Apennines, while *P. Wilhelmsiana* Fisch., *P. condensata* M. Bib. and *P. atropurpurea* Nordm. inhabit the Caucasus, Transcaucasus and Pontus in Asia Minor. In the Siberian meridian, only one species, *P. sajanensis* Steph. was recorded from southern Siberia.

To the preceding, bidentate series, *Comosae*, more than thirty species are accredited. Its center of origin is apparently to be found in the same general area as that of ser. *Foliosae*, but by zonal distribution, its members had extended their area far and wide to the greater portion of the Eurasian Continent. A secondary center was formed later in the Altai-Tienshan Ranges where are to be found now a greater number of species than in its center of origin in Europe. The most broadly ranging species is the one that bears the serial name. Its area begins from the westernmost point in Sierra Navada on the Iberian Peninsula. Northeastward, it passes through the Pyrenees, the Auvergne and the French Alps to West and North Italian Alps, thence a secondary line of dispersion extends southeastward to the Apennines, but the main line still continues it eastward course through the Dinaric Alps in Yugoslavia, Taurus, Pontus to Armenia and Georgia. Northward through Middle U.S.S.R., it comes to the Urals; southward, it also extends to northern Iran. In East Siberia, its area begins from the territory along River Lena down to Baical, whence it extends eastward through Transbaical to Heilunkiang (River Amur) as its easternmost point of distribution. Southward from Baical, it extends to Lake Kossogol and again westward to Altai.

Of the remaining species, about eleven of them are represented in Europe, of which, only two are found some distance from the Mediterranean Basin; they are *P. campestris* Gris. et Schenk of eastern and southern Carpathians and the neighbouring Ukraine and northern Rumania and *P. daghestanica* Bonati of Caucasus. Besides these, two of the remainder keep a more westerly range, i.e., *P. schizocalyx* Lange of Castile and *P. asparagoides* Lapeyr. of Catalonia and Pyrenees. The other seven species are *P. graeca* Bunge, *P. Ferdinandii* Bornm., *P. heterodonta* Panč, *P. moesiaca* Stadl., *P. leucodon* Gris., *P. Fridrici-Augusti* Tommas and *P. petiolaris* Ten. The headquarters of these species is in the Balkan Peninsula, including an area from Greece in the south, Thrace in the east, through Bulgaria, Albania and Yugoslavia to Istrian Peninsula, although the first and the second are more restricted in range, being found only in

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1) Cf. footnote under subgroup *Eurhizophyllum* in page 44.
Greece and Macedonia respectively, and the last two species extend also to Latium and Apennines in Italy.

Eighteen more species are to be found in Asia, although among them some are shared by Europe. Circumscribed in or around the apparent second center of area of the series in Turkestan and Altai-Tien Shan Ranges, are a number of species comprising *P. altaica* Steph., *P. FETCHKOEI* Bonati and *P. KRYLOWII* Bonati of Altai and Kirghiz, *P. BREVIFOLIA* Regel of Songaria and Turkestan and *T. dubia* Fetchenko of Turkestan and Pamir. Beside these species just mentioned, all the others have their areas either much broader or else far distant from the secondary center. Among these, only two species find their ranges to the south; they are *P. dolichorrhiza* Schrenk from Songaria through Afghanistan to Gilgit in the western Himalayas and *P. brevirostris* Pennell of western Himalayas from Gilgit to Zaskar only. To the northeast of the secondary center, there are eight species, viz., *P. achilleifolia* Steph. from Pamir through Altai to North Mongolia; *P. uliginosa* Bunge of approximately the same area but being found further in Altai in the west and in Baical and Transbaical in the east; *P. flava* Pall. from Turkestan through Altai, Mongolia to Transbaical; *P. rubens* Steph. from Altai through Baical and Transbaical to the Lena River territory in Arctic Siberia; *P. venusta* Schangin from eastern Altai to Kamchatka with a white-flowered form in Hokkaido; *P. fissa* Turcz., a species confined to Baical and Transbaical; *P. nigrescens* Nakai, an endemic of Chosan Peninsula and *P. apodochila* Maxim. of Honshu and Saghalin. Finally, there still left three species which disperse both eastward and westward, namely, *P. physocalyx* Bunge whose area starts from Turkestan and Altai westward through the Kirghiz Steppe to Ural and also in Arctic Siberia, *P. lasiostachys* Bunge from Altai slightly eastward to Lake Ubsa and also to Mongolia, but mainly westward in Daghestan in Caucasus and around Kiev in Ukraine and *P. laeta* Stev. recorded in the east in Altai, Songaria, northern Mongolia and in the west through Siberian Steppe to Ural, and along southern Ural to the basins of Volga and Donets in Europe.

The third ser. *Rostratae* with moderate beak, comprising some thirteen advanced descendents of the preceding series, is almost exclusively European. Its center has apparently shifted from the Balkan Peninsula as occupied by the last series westward into the Alps from northern Yugoslavia (Croatia) through Austria, northern Italy and Switzerland to southeastern France. Here are *P. gyroflexa* Vill., *P. BARRELIERI* Reichenb., *P. elongato* A. Kerner, *P. rostrata* Linn., *P. cenisia* Gaud., *P. caespitosa* Sieber and *P. tuberosa* Linn., although the last two named occur also in northern Spain. Besides these species, *P. elegans* Tenore is only of central Apennines, *P. flavissima* Gandog., *P. pyrenaica* Gay. and *P. mixta* Gren et Godr. are restricted to northern Spain, *P. BEAUMGARTENII* Smk. is seen in southern Carpathians and Transilvania while *P. NORDMANNIANA* Bunge stays in the eastern skirt of the area in Asia Minor.

Having approximately the same status in evolution as *Rostratae*, the fourth ser. *Strobilaceae* shows a discontinuous area of the subgroup in
that the four species, *P. gracilicaulis* Li, *P. strobilacea* Franch., *P. pseudocephalantha* Bonati and *P. dichrocephala* H.-M. are all endemics of northwestern Yunnan without any related forms occurring in the intervening area between Yunnan and the southwest-northeast line of dispersal from Pamir to Baikal as occupied by the constituents of ser. Comosae. The fifth series *Oliganthae*, with somewhat longer beak is, too, mainly of northwestern Yunnan, wherein inhabit *P. tahainensis* Bonati, *P. dissectifolia* Li, *P. Fengii* Li, *P. oligantha* Franch., *P. tachnenensis* Bonati, *P. cephalanthea* and *P. longipetiolata* Franch., although the last two are also to be seen in adjacent Sikang. Only one species finds its home slightly to the west, and that is *P. cephalanthoides* Tsoong of Assam. The ten species that group into the next ser. *Oxycarpae* with usually contortedly beaked galea frequent an area much broader than that of the two foregoing series. Among these species, *P. subulatidens* Tsoong is of southern Tibet, *P. stenophylla* Li and *P. lanceifolia* Tsoong are of Upper Burma, *P. Stewardii* Li is of Kweichow, *P. tibetica* Franch. is of Sikang, *P. macilenta* Franch. is of northwestern Yunnan while *P. Monbeigeiana* Bonati and *P. oxycarpa* Franch. are both of northwestern Yunnan and southeastern Sikang. The last two species having a more northerly range are *P. torta* Maxim. and *P. Davidii* Franch. of southern Kansu and northern Szechuan, with the former also of western Hupeh and the latter also of southern Shensi. Three out of the four species of the seventh series *Dissectae* limit their areas in Sikang; they are *P. Souliei* Franch., *P. Petitmenginii* Bonati and *P. sparsiflora* Bonati. Slightly northeasterly is to be found the last species, *P. dissecta* Pennell et Li of southern Shensi and Honan.

The monotypic *Amplitubae*, a series with rather dubious affinity, is endemic in northwestern Yunnan. The last series, *Rhinanthoidae*, holds only two species, viz. *P. cyclorrhyncha* Li and *P. rhinanthoides* Schrenk; the former is of northwestern Yunnan, while the latter with its several subspecies is widely dispersed; the typical form occurring in S Gordon down through Pamir to the western Himalayas and its other subspecies from Afghanistan all through the Himalayas to Yunnan-Sikang, thence to Kansu, Shensi and Inner Mongolia.

2) Subgenre PSEUDAPACLADUS—Unlike the foregoing subgroup and also dissimilar to most of the other groups in the genus, this subgroup had scarcely evolved in the European meridian, not very much in the Siberian and Japanese meridians, but became greatly advanced and more prosperous in the American meridian, where it had further migrated southward over the equator into South America.

This subgroup, as defined, contains six series from the most primitive to the most advanced. The first series, *Limnogenae*, is a small one holding three toothless species, namely, *P. recutita* L. of the Alps from Austria to eastern France, *P. limnogena* Kern. of Balkan Peninsula from Carpathian to northern Greece and *P. olympica* Boiss. of Mt. Olymp in western Turkey.

The second series is the bidentate *Sudeticae*. The species representing the series is now found in the Polar regions of all three meridians of
distribution, but its original haunt seems to be in the Sudetic Mts. in central Europe. From here the range extends to Lapland, through Kanin Peninsula, the Islands Kolguev and Novaja Zemlya to the Polar Urals. In its Asiatic extension, it dispersed itself all through the Rivers Yenisei, Olenek, Lena, Kolyma, Anadyr to the Peninsula of Kamchatka; passing over St. Lawrence Island, it enters the American meridian into Alaska and arctic Canada; along River Lena, it also extends southward to Transbaical. With this species, no relatives are seen in the European meridian, but there are one $P. laresarensis$ Bornm. of southeastern Iran and five more found in the Siberio-Turkestan and the adjacent Japanese Provinces. These are $P. villosa$ Ledeb. found in the general region of Rivers Lena and Kolyma (also in Sakhalin?), $P. nasuta$ M. Bibb. of Okhotsk and Kamchatka, $P. Koidzumiana$ Tatwe. et Ohwi of Sakhalin and Hokkaido, $P. elata$ Wildl. from Tomsk to Transbaical and lastly $P. songarica$ Schrenk of Altai and Tienshan.

In the American meridian, $P. sudetica$ Wildl. dispersed itself in Alaska and arctic Canada. Southward, two close relatives emerged from this species in the Rocky Mountains; one, $P. cystopteridifolia$ Rydb. is confined to Yellowstone and the other, $P. scopulorum$ Gray has its area in Wyoming and Colorado.

The third series, the rostrate Compactae, is likewise shared by several meridians. In the European meridian, the series is only represented by a sole species, $P. incarnata$ Jacq. which frequents Galicia and Pyrenees in Spain, and also the Alps from eastern France to northern Austria. In the Siberio-Turkestan Province, $P. compacta$ Steph. has an extensive area, i. e., from Ural in the West, eastward to Narym, southeastward to Sajan, whence again eastward to Baical, and southward to southern Altai and Songaria. $P. uncinata$ Steph. has a much more restricted area of from southern Altai to Transbaical only. In the American Province, the two Rocky Mountain species of the previous series evolved into quite a number of species. Of these, there are $P. Hallii$ Rydb. of Montana and Wyoming, $P. lunata$ Rydb. and $P. anaticeps$ Pennell of Wyoming alone, $P. mogollonica$ Greene of Mogollon Mountains in New Mexico and $P. Parryi$ Gray which has distributed from Wyoming southward to Colorado, Utah, and Arizona; in the west, it is also seen in California. In the last two States occur two

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1) There is no doubt that $P. incarnata$ Jacq. is improved from $P. recutita$ L. But according to the law governing the development of the Flammaea-typed groups, there still lacks a toothed stage between these two species, and $P. sudetica$ Wildl. seems to fit well into this vacancy. Moreover, the far-reaching dispersal tracks of the subgroup into South America also lead one to surmise that the ancestral stock has originated in a point situated in a comparatively warmer country, and to this, the Mediterranean Basin is certainly a logic answer. It is to be noted further that in my discussions about hybridization (Vol. IV, pp. 141-142), I have referred $P. recutita$ L. as belonging to $Rhizophyllum$ and $P. incarnata$ Jacq. as belonging to $Apocladus$, it is because I have formerly kept ser. Linnogena, which holds the former species, in $Rhizophyllum$, and have put the latter species in ser. $Rostratae$ which has its position in $Eu-apocladus$. But I have since changed my opinion, and prefer to take ser. Linnogena from $Rhizophyllum$ to be put at the initiating end of $Pseudocladus$, also to bring $P. incarnata$ out of $Rostratae$ to be kept in ser. $Pseudocladus$, as what is seen in the phylogenetic schema.
more species, i. e., P. similis Heller and P. Howelli Gray respectively. The southernmost point is occupied by three species, each localized in a small area in Mexico; these are P. Ornizabae Cham. et Schl. of Hidalgo; P. Jonesii Brand of Jalisco and P. mexicana Zucc. of Mexico and Oaxaca.

Two more or less affiliated but somewhat different species, P. pedicellata Bunge and P. ornithorhyncha Benth. constitute the fourth series Ornithorhynchae; the former inhabits Sitka and the latter has its home in Mt. Rainier of Washington.

The highest development in floral structure of this subgroup is only attained by New World species as shown in ser. Incurvae and Surrsectae. The monotypic P. incurva Benth. of the former series is not only found in the Andes of Columbia, but coming actually over the Equator to Cuenca in Ecuador, thus surpassing P. zeylonica Bentham of group Cladomania in southward invasion. The latter ser. are constituted by three species, namely, P. contorta Benth., P. attollens A. Gray and P. groenlandica Retz. The area of the first species is in the Cascades of Washington and Oregon and the Rocky Mountains of Idaho, Wyoming and Montana; that of the second is located in Sierra Navada of California. The last species, being the most wideranging among the higher elements of the subgroup is found to grow with the second species in Sierra Navada where is most probably its center of origin. From here it finds its eastern extension in New Mexico; northwardly it ranges through the Rockies to British Columbia in the west and through Ruperts Land and Labrador in the east to become finally an immigrant of Greenland.1)

5. Greq ORTHOSIPHONIA

This opposite-leaved group is one of the largest groups within the genus. To judge by the facts on hand, there must be two different centers of origin for this group. On the one hand, the concentration of a number of primitive species with anodontous corolla in the Near East suggests the Caucasian Province to be one of its centers, wherein the species had perhaps sprung either from the existing members or from some extinguished forms of the ser. Limno genae. This center, though numerically superior in archeic species, is on the contrary less important in the evolutionary point of view, as the species had gained little headway in evolving into more specialized forms. On the other hand, the extreme similarity in morphology and the proximity in geographical area between P. pycnantha Boiss., seemingly the real progenitor of the group, and P. Albertii Regel, its most probable predecessor belonging to the ser. Hirsutae-verae, force one to take the Siberio-Turkestan Province to be the second center of origin for the group.

Systematically, this group is constituted by fifteen series. Of these, the initiating ser. Caucasicae contains about ten species. More than half of these species are concentrated in the Near East; these are P. cadmea Boiss. and P. Jankae Steining. of Taurus Chain in southern Turkey, P.

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1) Cf. discussions by Prain on Greenland species in pp. 43, 44; also see discussions in "Chronology of Pedicularis" in next issue.
caucasica M. Bieb. of northern Turkey, Transcaucasia and West Elburz of northern Iran, _P. pontica_ Boiss. of Pontus and _P. Beaugeausii_ Maxim. of Armenia.

In the second center of the series, there are two species, _P. Maximowiczii_ Krassn. of middle Tien Shan and _P. pycnantha_ Boiss. which occupies, with its several forms, a much broader area. From its center in western Turkestan, this species distributed westward through Iran, where two more near relatives, _P. Mobayensii_ Parsa and _P. Hausknechtii_ Boiss. were cast off, to stop presently in its westernmost point in Kurdistan of eastern Turkey. From the same center, it also extended southward through Afghanistan, then turning southeastward to the western Himalayas to stop at Bashahr (Kunawar) where marks its easternmost point of distribution at present.

Advanced directly from _Caucasicae_ is _Abrotanifoliae_, a series of more elate habit and contains about seven anodontous species. The possible stock of the series, _P. abrotanifolia_ M. Bieb. is represented by two forms, var. _altaica_ and var. _mongolica_ of Maximowicz; the former ranges from Alatau northward to Altai, again northwestward, it is to be seen in the southern Urals; the latter, however, inhabits only the Khangai Mts. and Lake Kossogol region in Mongolia. A near relative of the first species, _P. leptorhiza_ Rupr. is found in Altai, Tien Shan and Western Turkestan (Margelan). In the Koksu Valley of Tien Shan, there appears _P. tenuicalyx_ Tsoong. In southern Altai is another species, _P. moschata_ Maxim., also a near ally of _P. abrotanifolia_. After these species which are more northerly in range,¹ the area occupied by the remaining species are much to the south. _P. brevilabris_ Franch. is of northwestern Szechuan and eastern Sikang; _P. obscura_ Bonati, an endemic of northwestern Yunnan and _P. densispica_ Franch., the typical form of which is of northern Yunnan, southern Szechuan and southwestern Sikang, its subsp. _Schneideri_ (Bonati) Tsoong of southeastern Sikang and northwestern Yunnan. The discovery of the same subspecies in Lhasa and another form, subsp. _viridescens_ Tsoong in Kongbo shows that the species is not only still extending its range westward, but is also evolving actively. In the eastern Himalayas, three small series of uncertain derivation, _Gibberae_, _Denudatae_ and _Molles_ are found. The monotypic _P. gibbera_ Prain of the first and _P. donudata_ and _P. polygaloides_ Prain of the second are concentrated in the Sikkim Himalaya and immediate neighbouring Tibet. The monotypic _P. mollis_ Wall. has its alpine form, subsp. _alpina_ Tsoong, around Phari

¹) _P. pilostachya_ and _P. ternata_ of Maximowicz are two species formerly kept in ser. _Abrotanifoliae_, but on the similarity of the foliage leaves and general habit with the species of _Hirsutae-verae_ on the one hand, and that of _P. tenuicalyxa_ Franch. and _P. meteolarhyncha_ Li on the other, I have combined it with these two species to form a subgroup _Dolichostachya_ of the group _Dolichophyllum_. Seeing the disruption of geographical distribution of the ser. _Abrotanifoliae_ — the lack of species in the intervening area (North China) between Altai-Tien Shan and northern Szechuan — it is perhaps logical to keep these two species in ser. _Abrotanifoliae_ as did the other authors; in so doing, they would form with their areas (_P. ternata_ Maxim.: southern Mongolia, Chinghai and western Kansu; _P. pilostachya_ Maxim.: eastern Chinghai and western Kansu) a connecting link to fill up the gap in the area of the series.
in southern Tibet and its typical form extending eastward to southeastern Tibet, Bhutan and westward to Nepal.

Next comes the bidentate ser. *Sarawschanica* and *Platyrrhyncha*, comprising the advanced descendents of ser. *Caucasicae* and *Abrotanifoliae* respectively; they too, have their centers in Turkestan. Merely a step forward, *P. sarawschanica* Maxim. is almost simply a two-toothed *P. Maximowiczii* Krassn., and its location is plainly shown by its specific epithet. Out of six species of ser. *Platyrrhyncha*, only one species, *P. Strausei* Hauskn. comes from western Iran. In Turkestan, *P. pulchra* Pauls. is a species of Pamir, *P. platyrhyncha* Schrenk is of Kirghiz Steppe, *P. Waldheimii* Bonati is of Kokand, *P. interrumpa* Steph. is of Ferghana, but also extending northward to Altai and southern Altai and *P. chorgosica* Regel is of Khorgos.

The beaked forms begin from the monotypic series *Simaeh*, denoting a sideline development of *Abrotanifoliae*; *P. sima* Maxim. is circumscribed to western Kansu and northern Szechuan. In the west, ser. *Caucasicae* developed into a small series *Crassirostres*, containing two species, *P. Bungei* Tchibat. and *P. crassirostris* Bunge, with the latter represented by several subspecies. These are all localized in Caucasus and the Transcaucasia. In the east, the heirs of ser. *Platyrrhyncha* group into ser. *Myriophyllae*. They are seven in number, and occupy a very broad geographical area. The most widely diffused species is *P. myriophylla* Pall., *P. alaschanica* Maxim. and *P. Chamissonis* Stev. The first had probably first appeared in Songaria, from where it ranged northward to Siberian East Altai, Sayan, Lake Kossogol in northern Mongolia, Baical, Transbaical and central Mongolia; its forma *purpurea* is also found in Kossogol and Mt. Hsiaowutaishan in northern Hopei. The second ranges from western Mongolia, Kokonor region in Chinghai to Kansu (including former province of Ninghsia); from here southward, its place is taken over by its subsp. *tibetica* Maxim. which is seen in Chinghai, Assakol, and Lhasa, Gyantze, and Phari (eastern Himalayas) in southern Tibet. The third species, *P. Chamissonis* is also represented by two forms, subsp. *japonica* (Miq.) Tsoong and subsp. *genuina* Tsoong. The typical form begins its range from Kamchatka and Kuril Islands, eastward through the Aleutian Islands to arrive at Sitka in southern Alaska. The origin of the japanese form is somewhat ambiguous, its present range is located in middle Honshu and midwest of Kiushu; it may be a southward extension of the typical form from the Kurils, or else evolved from *P. myriophylla* of North China independently; in both these cases, there is disruption in distribution. Beside these broad ranging species, *P. scolopax* Maxim., a near relative of *P. alaschanica*, is an inhabitant of northeastern Chinghai and eastern Kansu; *P. cristatella* Pennell et Li frequents southwestern Kansu and northern Szechuan; *P. Tatarinowii* Maxim. and *P. Provotti* Franch. are two species of North China provinces, the first is an endemic of northern Hopei and the latter is also found in Inner Mongolia and northern Shansi.

In Bhutan, we find *P. Ludlowiana* Tsoong; the type of the monotypic ser. *Ludlowianae*, the origin and affinity of which is scarcely ascertainable.
The long-beaked ser. Gyrorhynchae is composed of three closely allied species, *P. Duclouxii* Bonati, *P. gyrorhyncha* Franch. and *P. Wangii* Li, the first of which is of Sikang and the second and the third are of northwestern Yunnan. Comprising about eight species, the still longer-beaked *Pectinatae* seems to have improved from *P. alaschanica* subsp. *tibetica*. Its range is extended much to the west in the Himalayas. The easternmost point occupied by this series is Kongbo province in southern Tibet, the home of *P. rhynchotricha* Tsoong. Beside this species, the other seven are exclusively the inhabitants of the western Himalayas. Among these, *P. pectinata* Wall. with its several subspecies is found from Kumaon to Gilgit and Hazara, *P. tenuirostris* Benth. from Tehri to Afghan border, *P. Stewartii* Pennell from Chamba to Hazara, *P. pyramidata* Royle from Lahul to Chitril, *P. kashmirica* Pennell with its subsp. *ornata* Pennell from Baltistan to Ladakh and its typical subspecies from westernmost Tibet to eastern Afghanistan, *P. multiflora* Pennell in Kashmir and finally, *P. cyrtorhyncha* Pennell is confined to Chitril.

The last series of the group, *Semitortae*, possessing contorted galeas has, on the contrary, an area much to the east and north than the preceding one. The five species of this ser. are *P. Oliveriana* Prain of southern Tibet (Phari and along the Tsango and its tributaries from Lhatze to Lhasa), *P. multenesis* H.-M. of Sikang, *P. Roborowskii* Maxim. of western Kansu and northern Szechuan, *P. semitorta* Maxim. of southwestern Kansu and eastern Chinghai and *P. Fetissovii* Regel of eastern Tienhsan.

6. *Grex SIGMANTHA*

Seemingly to have come from different sources, Orthosiphonia and *Cladomania*, the constituents of this opposite-leaved group are attributable to three subgroups as the following:

1) Subgrex NOTHOSIGMANTHA—This small subgroup consists only of three series, *Cheilanthifoliae*, *Curvutubae* and *Tienschanicae*. The first series contains three species of which *P. ophiocephala* Maxim. inhabits the portion of western Himalayas in Nepal and Kumaon, *P. globifera* Hk. f. frequents Sikkim Himalaya and adjacent Tibet, being common in wet meadows along Tsango and *P. cheilanthifolia* Schrenk with its several forms occupies a much larger area, the typical form being found in Alatau and Turkestan, while three subspecies replace its position in the western Himalayas. In the second series, there are only two moderately beaked species, *P. anas* Maxim. of southern Kansu and northern Szechuan with its subsp. *tibetica* in Sikang and *P. curvutuba* Maxim. of northern Kansu and Chinghai. Finally, the location of the monotypic, long-beaked *P. tienschanica* Rupr. of the last series is found in the western part of the mountain range which its name signifies.

2) Subgrex EUSIGMANTHA—Rather impropoportionately, the members of this subgroups are distributed to three series, viz. *Plicatae, Verticillatae* and *Microchilae*. The two species representing the first series
are *P. luteola* Li and *P. plicata* Maxim.; the former is endemic to northwestern Yunnan and the latter with its two subspecies occurs in southwestern Sikang, northern Szechuan, Kansu and southern Shensi.

As a minor taxon within the genus, the second series, *Verticillatae*, seems to be the most heterogeneous in nature, as its constituents are apparently not of a common line of descent. It holds within its scope no less than thirty species. Perhaps having arisen from the members of the previous series, *P. rupicola* Franch. seems to be the most primitive species of this series. Its area, comprising that occupied by its subsp. *zambalensis*, is in northwestern Yunnan and southern Sikang. In the former locality, there are to be found five more species, i.e., *P. likiangensis* Franch., *P. brachyceranii* Li, *P. glabrescens* Li, *P. lineola* Franch. and *P. Roylei* Maxim., with the one before the last occurring also in Upper Burma and Sikang and the last named one ranging all the way along the Himalayas to as far as Hazara. In-between these two extremities just referred, we have *P. nodosa* Pennell of Almora near Kumaon, *P. nana* C. E. C. Fischer and *P. rupicoides* Nakao of Nepal, *P. diffusa* Prain of Sikkim and neighbouring Tibet and *P. stenotheca* Tsoong of southwestern Sikang. To the north, Sikang, with the addition of Chinghai, northern Szechuan and Kansu forms an area wherein are to be found some fourteen species; these are *P. kansuensis* Maxim. and its subsp. *yargongensis* (Bonati) Tsoong, *P. tenera* Li, *P. Shawii* Tsoong, *P. pygmaea* Maxim., *P. Chingii* Bonati, *P. dolichostachya* Li, *P. multicaulis* Bonati, *P. daucifolia* Bonati, *P. involucrata* Tsoong, *P. flaccida* Prain, *P. szetscharanica* Maxim., *P. spicata* Pall. and *P. verticillata* L. Among these species, *P. kansuensis* and *szetscharanica* have now migrated farther west approaching Tibet in range and *P. spicata* has become a common species from northern Szechuan and Kansu all through North China, Mongolia, Baical and Transbaical to the Chinese Northeastern Provinces, while *P. verticillata* has dispersed itself far and wide into a great expanse of territory far surpassing those of its kin. Its area very nearly equals to a combination of two widespread species, namely, *P. comosa* L. and *P. Chamissonis* Steven. In Asia, it starts its range from its center of origin eastward to Shensi, Hopei, southeastward across the sea to be found in southern Japan; northward, it radiates to Altai, the Ordos, Mongolia, Baical and Transbaical, the northeastern Provinces, again northward to Yalta Peninsula and the regions along Rivers Yenisei, Olenek, Lena and Kolima in Arctic Siberia; again eastward, it comes to Okhotsk and Kamchatka, thence over St. Lawrence to Sitka in Alaska; In Europe, its range is continuous from Arctic Siberia westward to Lapland and the Scandinavia, wherefrom it comes down to the Carpathians, the Dinaric Alps of Balkan, the Apennines, the French Alps, and the Pyrenees to end finally at Sierra Navada overlooking the beach of Mediterranean. In Hupeh and eastern Szechuan, only one species, *P. holocalyx* H.-M., is found. In southern Shensi, there is *P. sparsissima* Tsoong, a close relative of *P. spicata* whose other ally, *P. Taquetii* Tsoong is an endemic of Chosan. In the northward path of *P. verticillata*, a number of affinities were evolved, these are *P. violaseces*
Schrenk of Alatau, *P. anthemisifolia* Fisch. of Alatau, Altai, northern Mongolia and southern Siberia, *P. eriophora* Turcz. of Kamchatka and Kurile Islands and lastly *P. amoena* Adams of the Polar Region. The mention of another species completes the list of the subgroup, i.e., *P. microchila* Franch., the monotypic form of series *Microchilae* with a strange corolla found in northwestern Yunnan and southeastern Sikang.

3) Subgenre RIGIOCAULUS—This small subgroup seems to find its closest kinship in the group *Cladomania*. It is formed by three series, *Salicifoliae*, *Rigidae* and *Ikomaniae*. The sole species of the anodontous first series is restricted to northwestern Yunnan. The second series possessing bidentate corolla contains six species, of which *P. rigida* Franch. is found in southern and northern Yunnan, *P. Mairei* Bonati in northwestern Yunnan only, *P. comptoniaeefolia* Franch. in southwestern Sikang, northern and northwestern Yunnan from where it further extends into Upper Burma; in the last named location occurs another species, *P. atra* Bonati. In the eastern outpost of the series is *P. rigidiformis* Bonati, being an endemic of Kweichow. The last series is again monotypic, the short-rostrate *P. Ikomai* Sasaki is an inhabitant of Taiwan Island.

7. Grex CLADOMANIA

The constituents of this prolific, alternate-leaved group are in a sense homogeneous, and no subgroups need to be introduced. The ten series which it embraces are *Hirsutae-centripetae*, *Palustres*, *Canadenses*, *Racemosae*, *Carnosae*, *Microphyllae*, *Polyphyllatae*, *Furfuraceae* and *Pseudo-erostres*. Many widely distributed species are among the constituents of this group, and they range the entire temperate complement of the Circumpolar Province.

*P. Lansdorffii* Fisch., the sole representative of the first series, occupies an area from Lena to Kamchatka in arctic Siberia. Then through St. Lawrence and Aleutians to arctic America, where it evolved into its bidentate var. *hians* (Eastw.) Tsoong. The second series *Canadenses* is bitypic; *P. canadensis* L. has its range from Saskatchewan and Minetoba to Nova Scotia, thence southwestward to the Rocky Mts. of Colorado, where the second species, *P. crenulata* Benth., was originated, but its area is further extended to New Mexico in the south and Florida in the east.

Appertaining to the third series *Palustres*, there are ten species with very close affinity between them. Descended from *P. Lansdorffii*, *P. palustris* L. and *P. labradorica* Wirsing are two forerunners of the series. Most likely came into being in the Arctic Circle, the former has invaded all North, Middle and East Europe; In Asia, it is dispersed all over arctic and subarctic Siberia, thence coming down to Mongolia, Altai and Songaria. The latter species occupies a somewhat smaller area in Europe, being only found in part of Scandinavia and North Ural; in Asia, its range equals almost to that of the former, but is limited in the south by a line from Baical region through Transbaical, Amur, northern Sakhalin and Kurils. Further east, it extends from Kamchatka to Alaska, Canada, Labrador and Greenland. In the European meridian, *P. palustris* gave
rise to four species, *P. sylvatica* L., *P. lusitanica* Cont., *P. gredensis* Gandog, and *P. numudica* Pomel. The first, being more diffuse, is found from northern Europe down to South Alps; the second and the third are found in the Iberian Peninsula while the fourth has come down to Algeria to be the sole species of *Pedicularis* found in Africa.

In eastern Siberia, one more species besides *P. labradorica* is found, namely, *P. adunca* M. Bieb., whose path of migration began from Kamchatka southward along the shores of Okhotsk Sea to invest finally the Island of Sachalin. In America, there are two species other than *P. labradorica*; they are *P. macrodontis* Richards. of Hudson Bay and *P. angustifolia* Bentham. of southwestern Chihuahua in Mexico.

The fourth series *Racemosae* holds but a few beaked species, yet geographically it occupies an enormous area. An interesting transitional form is *P. lapponica* L., connecting *Hirsutae-centripetae* and *Palustres* to the other members of *Racemosae*. Its Area is holarctic, beginning from Dovrefield in Norway in the west to Anadyr and Kamchatka in the east on the Eurasian Continents, with its southern limit in Mongolia at present; in America, it is found in Labrador and Greenland. Apparently having evolved from *P. lapponica*, there are three widely dispersed species. On the Eurasian Continent, it is *P. resupinata* L. and its various subspecies and allies that are now flourishing. The typical subspecies has its area starting from Yakutsk on River Lena; eastward it extends to Kamchatka, herefrom southward through the Kurils to Hokkaido and Honshu in the Japanese meridian where a close ally, *P. yezoensis* Maxim. was evolved; southwestward, it also disperses along the beach of Okhotsk and the Stenovoi to Amur Region, the northeastern provinces and the Peninsula of Chosan; southward from Yakutsk, it likewise passes along the Yablonovoi to Baical and Transbaical; from here westward, it ranges all through Sajan, Altai, Tomsk, crossing the Ural to reach at present the Kama River region in eastern Europe; from Baical region southward, it passes Mongolia, the Chinese Inner Mongolia, and the North China Provinces to stop, after crossing the Tsingling Range where its var. *galeobdolon* (Diels) was generated, at present in the Central provinces of Szechuan, Hupeh and Anhwei. The southernmost limit of this species is in Kweichow and Kwangsi where it presents itself in the form of subsp. *crassicaulis* (Vnt.) Tsoong.

In the American meridian, two other species held sway, i.e., *P. racemosae* Dougl., which is found from British Columbia southward to North California, and *P. lanceolata* Michx. which is distributed in eastern Canada and eastern United States.


1) As Rees Cyclopaedia is not available in our library, I am not able to know by recollection where is the location for *P. parviflora* Smith.
crenularis Li, P. crenata Franch. and P. veronicifolia Franch., with the last named one found also in southeastern Sikang. From this center, P. bifida Pennell takes to the west all through eastern and central Himalayas to Kangra in western Himalayas, beside being found in the Khasia Mts. in Assam; southwestward, two species, P. Collettii and P. corymbosa Prain were evolved in Upper Burma; in the southeast, P. Evrardii Bonati is the sole species of Indo-China. Lastly, at the southern end of Deccan and the Island of Ceylon, there is to be found P. zeylonica Benth., most likely a descendent of P. bifida.

From the turning point in ser. Microphyllae marked by P. tenuisetcta Franch., the group seems to have renewed its evolution once again by switching its leaf-shape back to that of Palustres. The center seems still in the Yunnan-Kweichow area, where are found three species, P. tenuisetcta Franch., P. Labordei Vant. and P. Henriy Maxim., although the two former species inhabit also adjacent southeastern Sikang and the last one has spread far and wide into Hupeh, Hunan, Kiangsi, Kiangsu, Kwangsi and Kwangtung provinces. From this center, two more species were sent out; they are P. flagellaris Bent. of Upper Assam and the Sikkim Himalaya, and P. Gammieana Prain of the latter location alone.

Closely following Microphyllae is the longer-beaked Polyphyllatae whose constituents, besides P. Limprichtiana H.-M. of southwestern Sikang, are all endemic to Yunnan; these are P. Stadlmanniana Bonati, P. kurienensis Bonati, P. pinetorum H.-M., P. gruina Franch. and P. polyphylloides Bonati. Furfuraceae is a series constituted by four species; they are P. taliensis Bonati of southwestern Yunnan, P. Hemsleyana Prain of eastern Sikang, P. Pantlingii Prain of Upper Burma, eastern Nepal, Sikkim Himalaya and neighbouring Tibet, and P. furfuracea Wall. of the latter two localities only. The monotypic Curvipes with P. curvipes Hk. f. and a subspecies frequents Assam and the Sikkim Himalaya. Last comes series Pseudo-erostres represented by the exceedingly long-tubed but beakless P. Perrottettii Bent. inhabiting Nilgiri Hills in lower Deccan.

8. Grex CYATHOPHORA

This interesting opposite-leaved group is composed of four small series, Reges, Cyathophyllumoides, Superbae and Cyathophyllae. The first of these series contains four bidentate species, all of them are centered in the general area of eastern Sikang and northwestern Yunnan. They are P. cupularis Li which belongs to the former location alone, P. Lipskyana Bonati and P. thammophila (H.-M.) Li which are shared by both of these localities and P. rex C. B. Clarke with its several forms has now spread from this center to Upper Burma and part of the eastern Himalayas in the west and Kweichow in the east, a fact denoting an active migration of the group still going on at present.

The second series is monotypic, P. cyathophylloides Limpricht f. with a swelled and slightly beaked galea, is a species confined to eastern Sikang. Superbae is the third series, and its monotypic, bigger-flowered and longer beaked P. superba Franch. inhabits northwestern Yunnan and neighbour-
ing southern Sikang. Finally, the two species of the highly evolved, long-beaked and long-tubed Cyathophyllae are P. cyathophylla Franch. of southeastern and eastern Sikang and P. connata Li of eastern Sikang only.

9. Grex POLYSCHISTOPHYLLUM

Being the smallest one within the genus, this opposite-leaved group is only supplied with two monotypic series at present, i.e., Pentagonae and Dichotomae. Geographically, both the bidentate P. pentagona Li and the moderately beaked P. dichotoma Bonati are restricted to the southern Sikang and northwestern Yunnan area.

10. Grex DOLICHOMICUS

This alternate-leaved group is formed by two subgroups as follows:

1) Subgrex PTERIDIOIDES—This subgroup is founded on two series, Pteridifoliae and Phaceliasfoliae. The former is monotypic, and P. pteridifolia Bonati is an endemic of Mt. Omei in Szechuan. The two species that group into the second series range wider; P. phaceliasfolia Franch. is found in western Szechuan and northwestern Yunnan while P. Fargesii Franch. occupies a station to the east, being seen in eastern Szechuan and western Hupeh.

2) Subgrex EUERDICUS—The geographical area of this subgroup presents at its initiation some points of interest. The presence of P. acaulis Wulf in Europe and its close ally P. Artseiaeri Maxim. in eastern Asia on the one hand and the absence of any related species in the intervening area on the other suggest a true case of vicarism, as its putative progenitor, P. Sceptrum-carolinum L. has spread itself from the North Polar region to both of these areas.

Systematically, this subgroup is subdivided into six series. The first one, Acaules, holds three toothless species. P. acaulis Wulf is found in southern East Alps and the Dinaric Alps and P. Artseiaeri Maxim. is in North China from Hopei to Shensi and western Hupeh. The latter species, unlike its European counterpart, shows its inclination to vary in its var. wutaiensis Hurus. and another kin, the P. ishidoyma Koidz. of Chosan. Following Acaules is the second ser. Vagantes whose monotypic P. vagans Hemsl. with beaked galea is an endemic of Mt. Omei. The third ser. Infirmea, with the single P. infirma Li denoting probably a sideline development from Acaules, is native to northwestern Yunnan. The fourth ser. Longipedes which represents the main line of descent enlists six species within its scope; they are P. filicifolia Hemsl. of western Hupeh, P. naturitifolia Franch. of eastern Szechuan, P. lazisflora Franch. of both these localities, P. longipes Maxim. of northern Szechuan, P. axillaris Franch. of Sikang and Yunnan and lastly, P. aquilina Bonati of the latter province only.

The name of the fifth series, Omiianae signifies by itself the location of a species and a subspecies it holds. The sixth ser. Muscicolaie has its center obviously in Sikang, where five out of six species, namely, P. gracili-
tuba Li, *P. sorbilifolia* Tsoong, *P. geosiphon* Smith et Tsoong, *P. pseudomuscicola* Bonati and *P. macrostiphon* Franch. are located although the first and the last are also found in northwestern Yunnan and the last is further seen in Szechuan. The sixth species, *P. muscicola* Maxim., has the widest area of them all; its homeland reaches far out into the provinces of Hupeh, Shensi, Shansi, Kansu (now including Ningsia) and Chinghai. The monotypic *P. batangensis* Bur. et Franch. of the seventh and the last series is confined to Sikang province.

11. *Grex CYCLOCLADUS*

This opposite-leaved group has now developed into the following three subgroups:

1) Subgrex ASTHENOCAULUS—Only two monotypic series constitute this small subgrex, i.e., the bidentate *Fragiles* and the moderately beaked and tubed *Flexuosae* (sensu stricto); the geographical areas of their monotypic species are in Assam and Sikkim Himalayas respectively with the latter also found more recently in Bhutan.

2) Subgrex BRACHYCHILUS—This subgroup is composed of three series, *Aloenses*, *Keiskeianae* and *Moupinenses* having somewhat discontinuous areas. Of the first, seven species are accounted; *P. Legendrei* Bonati is found in northeastern Szechuan, *P. Wardii* Bonati in southern Sikang, *P. aurata* (Bonati) Li, besides being found in the same locality as the last species, is also seen in northwestern Yunnan, where too, is to be found *P. aloensis* H.-M.; *P. brachychila* Li is confined to Sikkim Himalaya while *P. Petelottii* Tsoong is a species having been gathered somewhere in southern Yunnan bordering Indo-China.

With precisely the same habit as the preceding series but slightly improved corolla is the second ser. *Keiskeianae*; *P. Kusnetzowii* Komar. is an inhabitant of the region to the north of Amur in eastern Siberia, while *P. Keiskei* Fr. et Savat. lives on Honshu in central Japan.

3) Subgrex EUCYCOCLADUS—The distribution of this subgroup is more compact and is wholly zonal. The first series with the monotypic, anodontous *P. salviaeflora* Franch. which initiates the evolution of the subgroup is in its present range restricted to Yunnan and adjacent Szechuan. Advanced from this series are *Melampyrisflora*, *Longicaules*, *Graciles* and *Coniferae*. The bidentate *Melampyrisflora*, strictly speaking, contains only three species, including *P. melampyrisflora* Franch. of southern Sikang and northeastern Yunnan, *P. pseudomelampyrisflora* Bonati of eastern Sikang and northeastern Yunnan and *P. floribunda* Franch. of eastern Sikang only. The beaked *Longicaules* is formed by two species only, one is *P. longicaulis* Franch. of northern Yunnan and the other is *P. Dielsiana* Bonati, the area of which is somewhere in western China but without definite locality.

The longer-beaked *Graciles* is also formed by two species, although the area occupied surpassing by far those of all other series combined. The widely dispersed form of *P. gracilis* Wall. is its subsp. *stricta* (Wall.) Tsoong which began its migration from its original center in Yunnan and
southeastern Sikang westward all through the Himalayas to Shendtoi in far away Afghanistan. En route, it casted off a near kin, *P. khasiana* Pennell in Assam and another form reflexive of its ancestral stock, *P. salviaeflora* Franch., i.e. the subsp. *genuina* Tsoong of Nepal Himalaya. Representing singly the ser. *Coniferæ* is *P. conifera* Maxim., a rare species hitherto only found in western Hupeh.

12. **Greæ NEOSCEPTRUM**

This group is alternate-leaved, and consists of two subgroups as following:

1) **Subgreæ GEOPHYLLUM**—This subgroup is typified by a single series which in turn is also monotypic. *P. hirtella* Franch. with a bidentate corolla is an endemic species of Yunnan.

2) **Subgreæ EUNEOSEPTRUM**—Four series are embraced in this subgroup, namely, the two-toothed *Striatae*, the short- or moderately beaked *Proboscidea* and *Lachnoglossæ* and the long-beaked *Recurvae*. The first series presents, as in series *Acules* of *Dolichomiscus*, a discontinuity of areas occupied by vicarious species occurring in the American and Asiatic Continents. In the former continent, there are *P. Grayi* A. Nelson of Rocky Mts. in Wyoming, Colorado and New Mexico and *P. Furbishiae* S. Watson of Maine and neighbouring New Brunswick in Canada. In the latter continent, we have *P. striata* Pall., whose area begins from Transbaical down through Mongolia to North China provinces of Kansu in the west and Hopei in the east; and *P. mandshurica* Maxim. of eastern Manchuria and northern Chosan. These geographically distant but phylogenetically near species might have, in most probability, evolved independently and parellely in their respective area from related ancestors near to group *Sceptrum* but influenced by *Rhizophyllum*. The second series, the rostrate *Proboscidea*, however, belongs to Siberian Meridian only, and its two species, *P. proboscidea* Stev. and *P. brachystachys* Bunge, are mainly of Altai and Altai ranges. *Lachnoglossæ*, the third series with the single representative *P. lachnoglossa* Hk. f. is dispersed from Yunnan along the Himalayas to Sikkim. The last series is also monotypic, *P. recurva* Maxim. with its subsp. *polyantha* (Bonati) Tsoong has its range in southwestern Kansu, northeastern Sikang and northwestern Yunnan.

13. **Greæ SCEPTRUM**

Presumably, this is the second old group within the genus. It is separated into two subgroups as following:

1) **Subgreæ EUSCEPTRUM**—This subgroup is embodied by no less than fourteen series, having evolved apparently from the next subgroup *Brevilabium* which is even more primitive. In the first anodontous ser. *Gloriosæ*, we find one wide-ranging species; it is *P. Sceptrum-carolinum* L. whose area in Europe is from Scandinavian Peninsula and Lapland in the north to Rumania in the south; in Asia, it spreads all over arctic and subarctic Siberia to Okhotsk Sea in the east, and to North Mongolia and
the Chinese Northeastern provinces and Japan in the south, where it was
differentiated into a number of affinities. They are *P. gloriosa* Bisset et
Moore, *P. nipponica* Makino and *P. iwatensis* Ohwi of Island Honshu and
*P. Ochiana* Makino of Island Yakushima to the south of Kiushiu. On the
mainland, another one, *P. odontochila* Diels is found in the Tsingling Range.
The second series is *Grandiflorae* whose sole constituent, *P. grandiflora*
Fisch. finds its home in the area from Transbaical to northern Manchuria.
*P. seeckouensis* Bonati of the third series is found in Sikang and north-
western Yunnan. By far the most important series is the fourth one,
*Tristes*, whose principal species *P. tristis* L. appeared first in eastern
Siberia, from there it came down to Altai, Baical and Transbaical, whence
further down to northern Mongolia and the North China provinces of
Kansu and Shansi, where *P. shansiensis* Tsoong was segregated. In Central
China, its position is taken over by its subsp. *macrantha* Maxim. which
is distributed in Kansu, Hupeh, western Szechuan and Sikang. Further
down south, there occurs another affinity *P. galeata* Bonati of northwestern
Yunnan, standing for the monotypic fifth ser. *Galeatae*.

Improved directly from the last species is *P. dolichocymba* H.-M. with
boat-shaped, short-beaked flower belonging to the monotypic sixth series,
*Dolichocymbeae*, whose area is restricted to northwestern Yunnan and
southern Sikang. The seventh ser. *Rudes* is composed of six beaked
descendants of ser. *Tristes*, they are *P. rudis* Maxim. of Kansu (incl.
Ningshsia), and northern Szechuan, *P. decora* Franch. of northern Szechuan,
*P. princeps* of Sikang, *P. Dunniana* Bonati of Sikang and north-
western Yunnan, *P. Fischeri* Tsoong of Upper Burma and *P. Prainiana*
Maxim. of southern Tibet (eastern Himalaya). Emerging from *Galeatae*
is the eighth ser. *Ingentes* with shortly or moderately beaked galea. Its
eight species are mainly concentrated in Sikang province, these including
*P. Steiningeri* Bonati, *P. pseudosteiningeri* Bonati, *P. lophotricha* Li,
*P. tongolensis* Franch., *P. trichocymba* Li and *P. angustiloba* Tsoong.
The other two species are *P. ingens* Maxim. of eastern Chinghai and
northern Szechuan and *P. pseudingens* Bonati of northwestern Yunnan.

The ninth series *Imbricatae* contains longer-beaked species evolved
from *Rudes*, and there are four of them. Their center has shifted west-
ward, for *P. platychila* Tsoong is an endemic of Assam, *P. imbricata*
Tsoong, *P. mueronulata* Tsoong and *P. Clarkei* Hk. f. are all found in
Bhutan with the last also met with in the Sikkim Himalaya, in neighbour-
ing southern Tibet and Central Nepal. *Trichoglossae*, the tenth series, has
only two species advanced from *Dolichocymbeae*; they are *P. rhodotricha*
Maxim. of southwestern Szechuan, southeastern Sikang and northwestern
Yunnan, and *P. trichoglossa* Hk. f. which ranges from the last-named
locality westward all through Sikkim and Nepal to arrive now at Kumaon
in the western Himalayas. The eleventh series *Lasiophrydes* is formed
by three species; these are *P. lasiophrys* Maxim. in two subspecies dis-

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1) In naming the species in honor of C.E.C. Fischer, I have overlooked that
the epithet is preoccupied, so I would like to give it a new name, *P. neoisophryzi* Tsoong.
See full citation in systematic treatment (Part II).
tributed in eastern Chinghai, southern Kansu and northern Szechuan, *P. craspedotricha* Maxim. of northwestern Szechuan and *P. cinerescens* Franch. of Sikang; *Kongboenses*, the twelfth series that has come directly from *Ingentes*, contains two long-beaked species, *P. kongboensis* and *P. retingensis* Tsoong; the former is found in southeastern Tibet and the latter is slightly northward in range, being collected not far from Lhasa. The thirteenth series *Subsurrectae* is monotypic, and its single *P. Vialii* Franch. inhabits Sikang, Yunnan and Upper Burma. The fourteenth ser. *Excelsae* too, is monotypic, *P. excelsa* Hk. f. is a species of eastern Himalayas from Bhutan to Sikkim. The fifteenth and the last series *Kialenses* with contorted galea representing the highest advancement of the subgroup contains two species, i. e., *P. kialensis* Franch. and *P. streptorhyncha* Tsoong, both being confined to Sikang.

2) Subgenre BREVILABIUM—This subgroup must antedate the preceding one in existence, as *P. capitata* Adams seems to be the oldest species extant in group *Sceptrum* both in view of geographical distribution and morphological criteria. Its component species belong almost exclusively to Nearctic region where, curiously, it gained but little headway in evolution.

The four series that group into this subgroup are *Capitatae*, *Brevilabres*, *Trippinatae* and *Lunares*. Included in the first series are three species, *P. capitata* Adams, *P. semibarbata* Gray and *P. centranthera* Gray. Of these, the first is broadly dispersed in arctic Siberia and arctic America. In the former region, it reaches Taimyr River in the west and Anadyr in the east, where it also extends to Kamchatka; further east, it is seen on the islands in the Bering Strait and the Aleutians, therefrom it enters Alaska and Greenland. Both the second and the third species are found much to the south in range, the former is found in Sierra Nevada of California and in Nevada to the east and the latter is seen in the Rocky Mts. of southeastern California, southern Utah, southwestern Colorado and western New Mexico.

The second series is monotypic, *P. densiflora* Benth. is restricted to California. *P. tripinnata* Mart. et. Gal. of the third series is also monotypic; it belongs to the flora of Mexico. The fourth ser. *Lunares* is the largest one in the subgroup, and contains as many as twelve species, which are all shortly to moderately rostrate. The first of these is *P. lunaris* Nakai, the only Asiatic representative of this subgroup; it is found in Chosan Peninsula. All the remaining eleven species belong to the American meridian, and they all inhabit the Rocky Mountains in the west. Only two species, *P. bracteosa* Benth. and *P. latifolia* Pennell are found outside the United States. Both of them are found in British Columbia, with the former extending eastward into Saskatchewan and again southward into Utah and Colorado, and the latter extending southward directly into Washington and Idaho. The nine other species, including *P. paddeoensis* Pennell, *P. rainierensis* Pennell et Thomps., *P. atrosanguinea* Pennell et Thomps., *P. Thompsonii* Pennell, *P. Canbyi* Gray, *P. siifolia* Rydb., *P. pachyrhiza* Pennell, *P. flavida* Pennell and *P. Paysoniana* Pennell are
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* (?) signifies that the center of origin for Eu-apogladus might be in the Circumpolar Province, but might also be in the European Province. Cf. footnote to subgroup Eurhizophyllum in page 44.
distributed all along the Rockies in Washington, Montana, Idaho, Oregon and California.

After presenting the distribution of the various groups and subgroups, we would like to append hereby a table which will enable us to gain a more concise impression about the dispersal of major taxa in the genus in relation to each other. The signs used in this table needs some further explanation. Three signs are here used, of these, the sign of plus (+) signifies a province which is the center of origin of a group or subgroup, the sign of plus or minus (±) signifies a province where only one or a very few species of a given group or subgroup are represented, and finally, the sign of multiplication (×) signifies for a province which is the center of maximum variation for a group or subgroup.

B. The center of origin of Pedicularis

Having introduced the accounts of the distribution of the species under various groups and subgroups, we may now come to think of the all important problem as to where is really located the center of origin of the genus.

As alluded to before, Prain took to the view that the tracks of migration of Pedicularis species followed four meridians of distribution, and these meridians of course are built upon the assumption that the Circumpolar Province is the center of origin of the genus. This view was later accepted by Bonati in 1918. Limpricht in 1920, however, rejected the view of the first proponent; instead, the Altai-Tienshan Ranges were named by him as the cradle of the genus, an opinion which received the support from Dr. Li in his latest revision. To decide which of these two conflicting views is more appropriate, we must deduce our answer from factual distributions of the various groups and subgroups. For more direct impressions, we would like to condense the above lengthy presentation into the following paragraphs:

1. That Rhizophyllum has its two subgroups originated in different localities, i. e., Eurhizophyllum was originated in the Circumpolar Province, but its improvement into morphologically higher forms, or alternatively expressed, its “evolutionary generations”, were begun tardily in the Sikang-Yunnan area where the anodontous P. Oederi Vahl first evolved into the angulate-hooded P. pseudoversicolor H.-M., then into the bidentate P. habachcanensis Bonati and the multidentate and short-beaked P. rhyncho-donta Franch.; that Rhizophylliastrum was originated from the populations of P. Oederi Vahl separately in European and Tibeto-Chinese Provinces respectively, forming two spatially very distant centers of origin.

2. That Sceptrum was also generated in the Circumpolar Province; that Eusecretum began its evolution in central and southwestern China where first appeared forms with boat-shaped and short-rostrate galea like

1) See detailed discussions in “The area of a species and its relation to evolution” in next issue.
P. rudis Maxim. and P. dolichocymba H.-M.; that Brevilabium had its evolution started in the United States.

3. That Cladomania was originated in the Circumpolar Province by the first appearance of P. Lansdorffii Fisch., and the group had certainly begun its segregation and evolution rather timely, as we find in Europe and Siberia, and even in the North Polar region itself, not only a number of species of the bidentate ser. Palustres, but also quite a few rostrate forms as P. lapponica L. and P. resupinata L. of ser. Racemosae.

4. That Apocladus was probably originated in Europe1); that subgroup Eu-apoladus might have descended from ser. Roseae of Rhizophylliastrum, and both the toothless Fohiosae and the toothed Comosae distributed zonally through the Turano-Iranian region and Turkestan to Siberia and the latter to as far east as Japan; that Pseudapocladus might have been started in Europe by Limnogenae, and later became wide-spread through the diffusion of the great migrant P. sudetica L., whose offsprings thrived in Siberia and the Rocky-Andes Chain in America.

5. That Dolichomicrus was, like Rhizophylliastrum, developed in Europe and Asia independently, in the former locality by P. acaulis Wulff and in the latter locality by P. Artselaeri Maxim., both of them being presumably the descendants of P. Sceptrum-carolinum L.; that subgroup Pteridioides has its initiation in western China.

6. That the two subgroups of Neosceptrum were created separately; that Euoneosceptrum was evolved in both Asia and America, represented in Siberia and United States by closely allied species belonging to ser. Striatae, most probably of same descension; that Geophyllum came into being in southwestern China.

7. That Orthosiphonia was probably initiated in two different centers, i. e., Caucasus and Altai-Tienshan Ranges; It is to be noted that there was a similar zonal distribution as observed in Eu-apocladus.

8. That the three subgroups of Sigmantha were not generated in the same locality, but were developed separately, although their corollal characters are similar; that subgroup Nothosigmantha was originated in the Siberio-Turkestan Province, partly in agreement with the range of Eu-apocladus and Orthosiphonia; that subgroup Rigiocalus was originated in Himalayo-Yunnanese Province, corresponding in area with certain members of Cladomania; that Eusigmantha was originated in Tibeto-Chinese Province, likely also in Himalayo-Yunnanese Province.

9. That besides the six alternate- and the two opposite-leaved groups just mentioned which include in them ten subgroups, the remaining five groups with nine-subgroups are all opposite-leaved, and their centers of origin are excusively in southwestern China.

From the foregoing paragraphs and the hints from the accompanying table, we learn that that part of Siberio-Turkestan Province where elevate the Altai-Tienshan Ranges is an area showing a preponderance of Apocladus (Eu-apocladus) and Orthosiphonia, two groups which for

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1) Cf. footnote to subgroup Euryphyllum in page 44.
apparent enough reasons, can not be deemed as the most primitive within
the genus. Besides the constituents of these two groups, the only presence
of others are Sigmantha and Eurhizophyllum. For similar reason, we
are indifferent to the few species of Sigmantha here found. For
Eurhizophyllum to which we must attach prime importance for its being
one of the progenitor-groups, we find here only two species, i.e., the wide-
spread P. Oederi Vahl and its ally P. Albertii Regel. As to the other
progenitor-group Sceptrum, not a single species is represented in this
area.

Now let us see how the fact stands in the Circumpolar Province. For
Eurhizophyllum, there are to be counted two species, P. Oederi Vahl and
P. flammea L., with three more forms supposed as of hybrid origin but
nevertheless still closely allied, viz., P. hirsuta L., P. lanata Cham. et Schl.
and P. Lansdorffii Fisch. For Sceptrum, we have P. capitata Adams and
P. Sceptrum-carolinum L. The complete absence of one ancestral group
and the poor representation of the other in Altai, in vivid contrast to
perfect representation of both these groups in the North Polar region
tells us with precision where to find the center of origin of Pedicularis.

Furthermore, it is germane to remind our readers here that the
evolution in floral sizes for Rhizophyllum is definitely progressive, i.e.,
the more modern the form, the bigger the flower it bears. What is true
of this principle to evolutionarily different species is almost equally true
to close affinities and even true to various forms under a single species.
In the present case, we find in the Tibeto-Chinese and Himalayo-Yunnanese
Provinces not only a profusion of large-flowered, highly specialized forms
of Rhizophyllum, but also some bigger-corollal forms of P. Oederi Vahl (e.g.,
var. heteroglossa Prain, etc.). On the contrary, what we see in the North
Polar region and the Alps are just ordinary individuals of P. Oederi Vahl
identical with those found in the Altai-Tienshan Ranges; and we must not
forget that P. flammea L. in the Arctic bears much smaller flowers than
P. Oederi Vahl. Of course it is but logical to find larger-sized corollas in
the two southern provinces, as the trends of migration and evolution
are directed towards them. But if we take Altai-Tienshan to be the
center of origin, then the Circumpolar and European Provinces would
become, just as the southern provinces, secondary centers in the distribu-
tion of Rhizophyllum. Now the presence in the Circumpolar Province
of the small-flowered P. flammea L. would become thereby a stumbling-
block in the path of such a hypothesis, since it is very difficult of
explanation as to why, both being equally secondary centers, the primitive
Rhizophylli should develop bigger flowers southward but smaller flowers
in the opposite direction. It is more than apparent that Altai-Tienshan
served only as a favourite lodge for P. Oederi Vahl on its way from its
initial center in the North Pole to its optimum location of development
in the Tibeto-Chinese and Himalayo-Yunnanese Provinces, but nothing
more.

Besides the reasoning presented above, we may try to find some
further evidence in bio-statistics. Prain in his diagram 3 (distribution
by structure, page 45) compares beaked forms with beakless ones; and in such a procedure, the latter would of necessity include those derivatives possessing bidentate galea. Here is the reason why there is an inadvertent increase in the percentage of "archaic" forms in the Siberio-Turkestan Province.

To elucidate this point, an abridged table has been prepared out of the eight tables of Bonati. No effort is further made to include the species described since his time, as their exclusion will not in the least affect the accuracy of the results derived from these statistics.\(^1\)

Bonati compiled his tables by dividing the genus according to the "evolutionary corolla-types" and phylloxy into eight sections as following:

- AA = Anodontae-Alternifoliae
- BA = Bidentatae-Alternifoliae
- RA = Ryncholophae-Alternifoliae
- LA = Longirostres-Alternifoliae
- AV = Anodontae-Verticillatae
- BV = Bidentatae-Verticillatae
- RV = Ryncholophae-Verticillatae
- LV = Longirostres-Verticillatae

Although we have already discarded these "evolutionary types" as a basis for our system, the above symbols which represent Bonati's sections may nevertheless serve the purpose of presenting the eight types of combinations which show by themselves the clear stages of advancement within the genus. Besides these eight signs representing the eight combinations, some other signs which are indispensable to our compilation are introduced, and they need some further explanations as following:

- \(N\) = The total number of species in each province
- \(E\) = The total number of endemics in each province
- \(P\) = The percentage of the total number of endemics in relation to the total number of species in each province, i.e., \(\left(\frac{100E}{N}\right)\)

- \(N\) = The number of species pertaining to each of the eight combinations in each province
- \(E\) = The number of endemics pertaining to each of the eight combinations in each province
- \(P\) = The percentage of endemics of each combination in relation to the total number belonging to the same combination in each province, i.e., \(\left(\frac{100(\frac{E}{N})}{N}\right)\)

- \(PN\) = The percentage of \(N\) in relation to \(N\), i.e., \(\left(\frac{100(N)}{N}\right)\)
- \(PE\) = The percentage of \(E\) in relation to \(E\), i.e., \(\left(\frac{100(E)}{E}\right)\)

\(^1\) It is because all species added to the Circumpolar Province since Bonati's time appertain to primitive types while those described from other provinces belong mostly to more advanced types.
<table>
<thead>
<tr>
<th>Province</th>
<th>N</th>
<th>E</th>
<th>P</th>
<th>(N)</th>
<th></th>
<th></th>
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<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>R</td>
<td>A</td>
<td>L</td>
<td>A</td>
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<td>15</td>
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<td>66.7</td>
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<td>23</td>
<td>14</td>
<td>7</td>
<td>4</td>
<td>24</td>
</tr>
</tbody>
</table>

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(Continued)
In the table, it will be seen that under N, the Circumpolar Province occupies the sixth place with a total of twenty-two species while the Siberio-Turkestan is the third with sixty three species in all. The percentage of endemism in relation to the total number of species for the former is 50%, while that for the latter is 66.7%. This apparently constitutes one of the reasons why Dr. Li regards the former as ill-defined and refuses to accept it as the birthplace of the genus (Rev. I, page 239). In examining the figures of AA under (N), we find the two provinces being equally endorsed, the numbers being 7 in both. In endemism of AA (E), the figures of the two provinces are again the same, being 5 each. The two equivalent numbers result in the third balance in (P), being both 71.4. Now if we turn to the figures under (PN) and (PE), we will at once become aware of the all high percentage shown in AA of the former province, being 31.8 and 45.4 respectively, while those of the latter province drop sharply out of all proportion, being 11.1 and 11.9 respectively. These figures show unmistakly the high endemism of the most archaic, anodontous types in the Circumpolar Province.\(^{1}\)

Moreover, if we pay some attention to the figures of the eight combinations under (PN) which signify the percentage of the number of species on a certain level of evolution (N) out of the grand total of each province N, we will not fail to notice that the farther is a province distant from the Circumpolar, the smaller is the number of conservative forms, and simultaneously, the greater the number of advanced forms, and vice versa. Such concentric nature in the distribution of archaic types and the excentric nature in that of specialized ones certainly can not be mere fortuitous phenomena, but must denote a fact that there is maintained some natural harmony between the evolution and the distribution of the genus.

But what the above statistics offer us is mere phenomena in the distribution of Pedicularis, and the decision of the center of origin will largely depend upon how we interpret them. There seems to be in the field of plant-geography two current views in contradistinction to each other. The first is held by Komarov\(^{2}\) whose method of investigation was

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1) In this connection, we must not lose sight of the fact that in the former works of Pedicularis, after the decision of a hypothetical archaic type of corolla, be it a toothless or a toothed one, all species possessing such a corolla would be regarded inclusively as primitive, irrespective of what their other morphological criteria have to offer. Such is apparently not a sound way to judge the antiquity of any species. For illustration, P. salviaceflora Franch. can be suitably named. Though theoretically primitive by possessing an anodontous corolla, it has nevertheless infused into its very being certain sense of modernity by its annual habit, its opposite phyllotaxy, its highly ramificate stems etc. If further examples are needed, then all derivative groups and subgroups will be found replete with similar cases at their respective stage of nascentcy. All this mean that the value as denoted by the shape of the hood is only relative but not absolute. Even in the selfsame “Anodontae”, different association with other characters may bear very different value. Now if we examine the “Anodontae-Alternifoliate” in the Circumpolar Province, it will be clearly perceptible that species primitive both in floral structures and in other respects are concentrated here.

summarized by Wulff\textsuperscript{1}) as “disclosing the phylogenetically most primitive types, the direction of their evolution, the centers of concentration of these primitive types, the direction of their further distribution”; in brief, it is merely the orthodox school of thinking that where there is a concentration of archaic types, there is to be located the center of origin. The second is advanced by Matthew,\textsuperscript{2}) for whose principle we can do no better than to quote from Babcock,\textsuperscript{3}) “... radial distribution of older types from a common center accompanied by the development of more advanced types nearer the center” and “that at any one time in a large group of organisms showing close phylogenetic relations the most conservative will be found farthest from the center of origin and the most advanced, nearest the center of origin”.

It is evident that all the authors with the inclusion of the present one who had tried, or is trying, to locate the center of origin for *Pedicularis* bear in their minds the essence of the first, or the Komarovian school of thought, and the result arrived at comes naturally to rest on the Arctic Circle or the Altai-Tienshan Ranges, and nobody has ever entertained even the faintest idea in regarding the Tibeto-Chinese or the Himalayo-Yunnanese Provinces to be the center of origin for the genus. I think, at least here in *Pedicularis*, Matthew’s point of view is hardly applicable to any extent.

*(to be continued)*

\textsuperscript{1) Wulff, E. V.: An introduction to historical plant geography (English translation, 1950), 36.}
