中國古生物誌

總號第139冊　　新甲種第5號

中國科學院 古生物研究所 / 古脊椎動物研究室 編輯

陝北中生代延長層植物羣

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目　　錄

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一. 緒　言

蘇聯科學界耆宿奧勃魯契夫院士 (Обручев) 當係最先在陝北的延長層中採集植物化石的地質學家，他曾於 1893—1894 年在中國及中亞細亞的地質旅行當中，在陝西北部、新疆、甘肅、山西等地採集植物化石。這一批材料曾經奧國古植物學家克拉梭 (F. Krasser)[82] 研究，其論文發表於維也納出版的當時奧國皇家科學院數學及自然科學的院刊第 LXX 卷 (1900，第 1—15 頁，圖版 I—IV)。奧勃魯契夫院士在陝西北部採集的植物化石，克拉梭當時認爲是屬於恭華那系的(Gondwana-System)。克拉梭在論文結論中 (1900，第 14 頁) 簡述如下：

恭華那系 (Gondwana-System)

地點：三十里舖村莊附近的溝中 (陝西省)

下恭華那系面相 (二叠紀)：Cordaitaceenblätter (*?Noeggerathiopsis hislopi* Bunb.)

中恭華那系 (三叠紀)：*Danaeopsis hughesii* Feistm.

奧勃魯契夫標本採集號碼 *489C*

上述的兩種化石克拉梭在論文中第 7 頁曾加以敍述。其地點則敍述在第 6 頁中：

"中國陝西，三十里舖村莊附近的一個溝中，這一個地點是在陝西的北部，由吳堡縣(黃河邊)至綏德州的路上，差不多離綏德州城東北約 12—15 公里之處。沿着一個小河所成的河溝是一條路，在這條溝邊露出的地層很厚，地層的岩性是一種綠色砂岩及灰綠色頁岩，這些岩層是屬於上面已經提及的所謂'高煤層'的。化石標本是在這個河溝的底部所散佈的幾堆大石塊內所採得的，但根據岩石的性質是和河溝的斜坡上的岩性是完全相同的，並且根據此類散佈着的大石塊的體積的寬度，我們知道這些大石塊的發源之處是不會很遠的。陝西北部的所謂'高煤層' (Ueberkohlenschichten)，它的順序微有凌亂 (schwach dislociert) 但沒有問題是屬於比較石炭紀爲年青的時代的，可能是屬於中生代的。從這些地區，更往西走所看到的好像都是更新的地層。而更往東走經黃河東岸而至山西，較老的地層出現了，而到了柳林鎮，石炭紀的煤層出現了。"

最有意義的奧勃魯契夫院士當年的地層視察和今日的比較詳細的調查結果大致是符合的，所謂綠色砂岩及灰綠色頁岩，現在我們已經知道屬於所謂延長層的。他的所謂"高煤層"現在已經知道屬於所謂瓦窰堡煤系及衣食村煤系的，其時代確如奧勃魯契夫院士的推論，是屬於中生代的侏羅紀的。他的所謂這些地層的順序在陝北微有凌亂，那是因爲在當年延長層和覆在其上的瓦窰堡煤系及衣食村煤系的關係還沒有搞淸楚之故。更有興趣的是奧勃魯契夫院士的所謂"更往西走好像都是更新的地層，而更往東走經黃河東岸而至山西較老的地層出現了，而到了柳林鎮石炭紀地層出現了。"這一段敍述，根據潘鍾祥 1936 年[127] 的著作所發表的一張陝北油田地質圖，我們知道奧勃魯契夫院士當年的敍述是完全正確的。因爲直覆在他的"高煤層" (卽現在的瓦窰堡煤系及衣食村煤系) 之地層，往西走都一一出露卽現在所謂"安定層" (上侏羅紀) 及"保安系" (白堊紀)，更往西走爲更新的地層如上新統及更新統的紅土層及黃土層。而往延長層出露之處往東走，較老的地層出現卽現在我們所知道的石千峯系。所謂"到了柳林鎮石炭紀煤層出現"，卽現在我們所知道的石盒子系 (二叠紀) 及月門溝系 (上石炭紀)。

應該指出的是：當克拉梭研究標本的最初的時候，他曾相信上面提及的兩種化石 (卽 Nr. *489C*, Coll.

Obr.)，是發現於同一個地層的，並且屬於同一個地質時代的。後來他又相信這是一件很可能的事，卽他所鑑定爲 *Cordaites*（亦卽他的 *?Noeggerathiopsis hislopi*）是發現於一個較老的地層中的。他這樣說（1900，第6頁）[82]："我覺得更可能的是奥勃魯契夫的標本號碼 *489C* 的幾塊化石是屬於同一地層及同一地質時代的；但也不是完全不可能的，是定爲 *Cordaites* 的化石發現於較老一點的地層中的，而這一塊化石和其他的化石（卽他定爲 *Danaeopsis* 的化石）的一同發現於那一個溝內，可能是因爲本地人民因爲建築方面的目的，從較遠的地方將這些石頭偶然地堆在一起的。"

更有趣的是克拉梭當研究的最初時，是曾經將他定爲 *Danaeopsis hughesi* 的化石，先定爲 *?Danaeopsis marantacea*（Presl）Heer 的；因此當最初時，Krasser 曾經相信這些化石的地質時代是屬於上三叠紀的。他這樣說（1900，第6頁，脚注）："當奥勃魯契夫告訴我關於當地的地質情況之後，及當我認識 *Danaeopsis hughesi* 這一個種之後，我僅能將含 *Cordaites* 葉部化石的地層當作古生代來看。可是這一個種卽 *Danaeopsis hughesi* 最初我是定爲 *Danaeopsis marantacea* 的，因此它的地層時代我是曾經定爲'上三叠紀'（卽 Keuper 期）的。"最近的野外的地層工作完全證明了奥勃魯契夫院士當年所採集的標本的的確確是屬於同一地層中的，而這一個地層卽本文所研究的延長層是的確屬於上三叠紀的，和克拉梭最初的想法是相同的。

自克拉梭在這一帶所鑑定的植物化石公佈以後，古植物學家對於這些化石頗有討論（如 Gothan[38]，1915，第270頁；Halle[50]，1927，第138頁；斯行健[169]，1931，第7頁，斯行健[167]，1933C，第77頁；潘鍾祥[127]，1936，第23頁，第38頁）。根據本書作者最近研究的結果，克拉梭所指的第一種化石應該就是本書所敍述的 *Glossophyllum? shensiense* 新種（本書第48頁），其第二種化石應該就是本書所討論的 *?Protoblechnum hughesi*（Feistm.）Halle（?新種）（本書第41頁）。這兩種化石都是屬於延長層的。克拉梭謂其地層屬於二叠紀（下部 *Glossopteris* 面相）及三叠紀（中部恭華那系）顯然是沒有多大意義的。關於延長層植物羣是否有恭華那植物羣的親緣關係作者當在下面及本書結論中詳細討論及之。

在中國古書中陝北的延長層植物化石的發現亦早已有記載。宋代沈括（1029—1093）的夢溪筆談第21卷有下列一段敍述：

"近歲延州永寧關大河岸崩，入地數十尺，土下得竹筍一林凡百莖，根幹相連悉化爲石。適有人過，亦取數莖去，云欲進呈。延羣素無竹，此入在數十尺土下，不知其何代物。無乃曠古以前地卑氣濕而宜竹耶。"

尹贊勳教授在"中國古生物學之根苗"[197]一文（1947 地質論評第12卷1—2合期，第66頁）曾說："這裏所說的竹可能是陝北中生代地層的 *Neocalamites* 或 *Schizoneura* 此類化石頗有與竹相似之處，易於被認爲竹。'曠古以前地卑氣濕而宜竹'，寥寥幾個字已把用植物化石推論古地理古氣候的原理活生生的表現出來之。"尹教授所猜想的意見卽沈括當年的所謂竹筍，應爲現在我們延長層植物羣中所描述的屬於木賊科中的"新蘆木"（*Neocalamites*）當是沒有疑問的。據筆者的意見，沈括的所謂竹筍當係"新蘆木"卽 *Neocalamites* 的髓模（Pith-casts）化石（參看本書圖版II，圖2圖版IV，圖1，2；圖版VI圖b—8；圖版VII，圖1，2），此種髓模化石在延長層中是發現很多的，尤其是在宜君縣四郎廟灰河溝一帶。所謂延州卽現在的延安，是延長層發現的標準地點之一。有意義的是所謂木賊科植物在今天也適宜於生長在地卑氣濕的地方的。沈括在第十世紀時已經知道他所發現的是植物的化石，並且他以植物化石而推論當時的氣候也是很有理由的。現在地質學家都知道植物化石是推論各地質時代的氣候的最重要的證據，是各地質時代的"氣候指示者"（climate-indicator）中國的宋代學者* 就知道用植物化石來推斷植物生存時的氣候是不能不令人驚異的。關於沈括的重要發現也曾敍述於陳楨教授的"關於中國生物學史"一文中（1955年生物學通報第1期第6頁）。陳教授說明沈括是在延安做官時，發現所謂"竹"的化石的。

自從1936年潘鍾祥同志的重要論著"陝北古期中生代植物化石"（中國古生物誌甲種第4號第2册）發表以後，中國北方，尤其是延長層植物羣的重要性，頗引起了地質學家、古生物學家，尤其是古植物學家的注意。因爲這一個植物羣無論根據地質次序及植物化石的種屬來講，都較東亞中生代侏羅紀的造煤時期爲

* 在歐洲方面，最先知道化石不是"自然的遊戲"，而是生物的遺跡的是意大利的哲學家達•芬奇（Leonardo da Vinci 1452—1519）遲於沈括四百多年。

老。它的時代顯然是屬於上三叠紀的，而尤其可能的是屬於上三叠紀中部至上部的。即潘鍾祥同志所指的屬於考依波-瑞底克期 Keuper-Rhaetic 的。根據本書作者最近的意見延長層植物羣似和歐洲"中部上三叠紀"(middle Keuper) 的 Lunzer Keuper 和 Basler Keuper 以及北美的 Virginia-Keuper 各植物羣大致可以比較。而尤其和 Lunzer Keuper 植物羣更爲接近。關於這一個意見和延長層的地質時代，當在本書結論中再詳細討論及之，潘的 1936 年所發表的延長植物羣共爲 15 種列表於下：

?Schizoneura gondwanensis Feistm.
Cladophlebis cf. *roesserti* Zeiller
Cladophlebis cf. *gigantea* Ôishi
Cladophlebis shensiensis P'an
Cladophlebis grabauiana P'an
Cladophlebis szeiana P'an
Bernoullia zeilleri P'an
Danaeopsis hallei P'an
"Danaeopsis" hughesi Feistm.
Thinnfeldia nordenskioldi Nath.
Thinnfeldia rhomboidalis Ettingh.
Ginkgo magnifolia (Fontaine)
?Noeggerathiopsis hislopi (Bunburg)
Podozamites lanceolatus (L. & H.)
Problematicum

上述的化石表內之 *?Schizoneura gondwanensis* Feistm. 是一塊保存不完全的碎片，似爲 *Neocalamites carcinoides* Harris 的一種保存狀況。*Cl.* cf. *roesserti* 可能卽等於 *Cl. shensiensis*。此外如 *"Danaeopsis" hughesi* Feistmantel 卽本書第 41 頁所描述的 *?Protoblechnum hughesi* (Feistm.) Halle，此種化石是否眞正屬於恭華那植物羣的種屬實大有問題。又潘同志表內的 *?Noeggerathiopsis hislopi* (Bunburg) 卽本書第 48 頁所描述的 *Glossophyllum*? *shensiense* 新種。根據上述，我們知道延長植物羣的和恭華那植物羣的親緣關係實不甚明顯，關於這一點本書作者亦當於結論中再討論及之。又潘同志表內的 *Danaeopsis hallei* P'an 實係本書第 28 頁的 *Danaeopsis fecunda* Halle 關於這一點斯行健和李星學 1951 年的論文亦曾有詳細的討論，下面亦將再有提及。潘同志所描述的 Problematicum 卽本書的 *Conites* sp.（本書第 59 頁）。

自從 1936 年潘同志的論文出版以後，延長植物羣除陝西北部外在甘肅東部及西部亦有所發現。其化石經斯行健和李星學公佈爲下列各種：

Danaeopsis fecunda Halle
Cladophlebis shensiensis P'an
Cladophlebis grabauiana P'an
Cladophlebis cf. *roesserti* Zeiller 此種可能是屬於 (*Cl. shensiensis* 的)
Cladophlebis szeiana P'an
Bernoullia zeilleri P'an
Neocalamites carrerei (Zeiller)
Equisetites sp.
Taeniopteris sp.
Desmiophyllum sp.

最令人注意的是地層次序方面，甘肅與陝北亦完全可以對比。在陝北方面直覆於延長層的地層名瓦窰堡煤系，其時代當屬於下侏羅紀卽里阿斯期。而在甘肅方面直覆於延長層之上的煤系地層名安口窰煤系其植物化石亦完全和陝北的瓦窰堡系的種屬相同。地層時代當亦屬於里阿斯期。在甘肅的材料中最有科學意義的化石是一塊 *Danaeopsis* 的實羽片 (fertile pinna) 其全部形態和孢子囊的排列狀況，孢子囊的形態及體積，俱和瑞典 Scania 瑞底克期 (Rhaetic) 的 *Danaeopsis fecunda* Halle 完全相同。因此本書作者認爲潘同志 1936 年所描述的 *Danaeopsis hallei* P'an 實亦有屬於 *Danaeopsis fecunda* Halle 的裸羽片 (sterile pinna) 的可能。兩者羽片的形態及體積和葉脈的型式亦幾乎完全相似，故潘同志的新種卽 *D. hallei* 當在取消之列。潘同志[128] 在最近的論文中也表示完全同意 (1954，地質學報 34 卷 2 期，第 211 頁)。除陝西北部及甘肅東部及西部以外，延長層的地層及其植物羣在東亞其他地方迄至今日尙未有發現*。斯行健及李星學[178] (1951，第 89 頁) 曾特別指出延長層的地質時代當屬於瑞底克期 (卽上三叠紀的上部)。現在研究當前的豐富材料的結果，本書作者相信潘鍾祥同志 1936 年的意見是完全正確的，卽延長層的時代當屬於上三叠紀卽考依波-瑞底克期 (Keuper-Rhaetic)，此地層不能老於考依波紀 (Keuper) 亦不能新於瑞底克期。延長層的總厚據現今在宜君區的估計當在 1175 米左右，而 *Danaeopsis* 及 *Neocalamites* 等化石卽在其最底部的地層

* 參看本書第 4 頁的附錄。

亦有所發現。因此作者相信延長層的底部地層可能是屬上三叠紀(即考依波紀)的初期的,而其頂部的地層(本文所研究的材料極大部分是屬於頂部的)是屬於瑞底克期(Rhaetic)亦即是上三叠紀的晚期的。據此則潘氏1936年定延長層的地質時代爲考依波–瑞底克的意見應該完全可以支持的。

本書所研究的材料,極大部分是作者1951年之冬的陝北旅行和關佐蜀及湯任先二同志所採集的。另一大部分化石是石油總局送來鑑定的。若干標本是黃劭顯同志等所採集的。少數延長層底部的標本是王水同志所採集的。更有三、四塊標本延長層底部的標本是賈福海、高存禮兩同志所採集而送來研究的。本書作者對於石油總局負責人及上述諸同志表示深切感謝之忱。本書所敍述的種屬較潘鍾祥同志1936年所發表的爲豐富,可以看到這一個植物羣的大概面貌;但這不是說這一批材料,是可以代表延長層植物羣的全部的。本書作者深深相信在未來的不斷的地質調查及化石採集工作中,將有更多的具有植物學上、地層學上、古地理學上特別意義的植物化石的出現的。作者並且相信除陝北及甘肅外,中國其他地區尤其是在中國北部,延長層的繼續揭露也不是不可能的。最可惜的是幾乎延長植物羣的所有化石,都未曾保存着炭質薄膜,因此不能利用"浸解方法"研究其表皮及小氣孔的構造。作者希望在未來的不斷採集工作中能找到保存有炭質薄膜的標本。

本書全部圖版的化石是劉雪筠同志攝影的,插圖是張務聰同志代畫的,稿件抄寫及外文打字是鄒志學,張嗣秀,楊農伯,徐寶瑞等同志操勞的,參攷文獻的編排及植物羣對比表是張善楨,周志炎同志代作的,全稿的編排,黃宗甄同志費了很多的精力,本書作者對於上述諸同志謹表深切感謝之忱。

附　錄

當此書完稿寄出付印後,前寧夏省阿拉善旗又發現厚約1,000米以上的不含煤層的陸相地層,岩石性質和延長層大致相同,並含少數化石(周志炎、張善楨,1956,第53–66頁)。最近新疆準葛爾盆地黑油山亦發現延長層及若干很標準的化石如 *Cl. shensiensis* ……等化石。直覆在延長層之上的地層爲下侏羅紀的煤系地層,亦含化石。本書作者當於最近的將來,當另著文報道之。

二. 種屬的敍述

苔蘚植物門

屬 名 *Thallites* Walton

1925. *Thallites* Walton, Carboniferous Bryophyta I. p. 564.

Thallites sp.

(圖版 LVI, 圖 1, 1a, 2.)

1933b. Problematicum Sze, p. 51, pl. 12, fig. 8.

延長層頂部發現的化石,顯然是和福建長汀的瑞底克期至里阿斯期所發現的化石是相同的。根據"葉狀體"的保存形態,我們很有理由相信,這一類的化石是屬於苔蘚植物的苔類的一部分的,雖然假根 (rhizoids) 和"氣孔" (air-pores) 在標本上尚未能看出。

葉狀體 (thallus) 爲二义分枝式 (dichotomy) "中肋" (median band) 較黑,並且比較地爲寬厚。葉緣 (margins) 較薄,其顏色和母岩的顏色幾乎完全相同。葉狀體究竟幾次分义尚未明白,根據圖版 LVI 圖 1, 1a 所表示的標本,可能是作三次分义的狀態的。最後的兩個义枝互成的角度,約爲 45°。假根和"氣孔"在標本上未能看出。

福建長汀所發現的標本,保存更不完好,本文作者 1933 年曾用比較保留的態度定其名爲疑問化石 (Problematicum),但在正文中明顯地指出:"人們可將此種化石想到藻類植物的任何一種身上去,但我相信不是藻類化石。""我們最先應該想到"作者又再加伸說:"這類化石是屬於和藻,葉體或葉狀體的苔類像地錢等植物的。一個可以和我們的化石相比較的種是發現於英國 Yorkshire 中侏羅紀下部 (Lower Oolite) 的 *Marchantites erectus* (Leck.) Seward (Leckenby[94] 1864, 第 81 頁, 圖版 11, 圖 3; Seward[152], 1898, 第 233 頁, 圖 49); 這一個種和當前的化石不同之處是在分义的次數較多。關於"種"的討論,因爲標本的保存不完善以及很多相同的化石的鑑定方面的困難性,我們不能說很多話。"

關於 *Marchantites* 的一個屬名,根據 Walton[188] 1925 年的意見,僅限於一個種即 *M. sezannensis* Sap. 這一個種是發現於巴黎盆地 (Paris basin) 的始新統的;它的生殖器官的構造以及葉狀體的形態都和現代苔類的一屬所謂的地錢 (*Marchantia*) 是很接近的。Walton 的意見是:古生代及中生代的被前人定爲 *Marchantites* 的其他各"種"的化石都和地錢 (*Marchantia*) 無關,因此都不能定其屬名爲 *Marchantites*. Walton 復活了 Kidston 的屬名 *Thallites* 應用於這些化石,他說道 (1925, 第 564 頁) "這一個形態名詞 (Formname 即 *Thallites*) 可以應用於一切直到現在被定爲 *Marchantites* 的化石;除出那些化石比方說 *M. sezannensis* Sap. 它是含有沒有疑問的地錢科 (Marchantiaceae) 的親緣關係的。" Walton 於是定 *Thallites* 的定義如下:

"所有化石其植物體是作藻葉體的形態的 (Thalloid form),這些形態可以在藻類,苔蘚類,有時在比較高等的門類中找到的。同時這些化石並不含有那些足以證明其確屬於藻類,苔蘚類以及其他門類的形態的。"

Walton 的所謂"其他較高等的門類"是指蕨類植物的有性世代時的"原葉體" (Fern prothallia) 的。Walton 顯然是指蕨類植物的"原葉體"化石,也可以定其屬名爲 *Thallites* 的。因此我們可以明白,所謂 *Thallites* 是一個"形態屬名" (Form genus) 也是一個"籠統屬名" (Sammelgattung),這一個屬名可以應用於一切其親緣關係尚未明白的化石的,其植物體的形態是作藻葉體即葉狀體的形態的,這些葉狀體可以在藻類,苔蘚類而有時可在較高等的門類 (如蕨類植物的原葉體即 Fern prothallia) 中找到的。Walton[188] 在

1925年，所發表的論文第386頁，同時創造了另一個新的屬名 *Hepaticites* 應用於那些和現代的苔類(Hepaticae)確實的證明有親緣關係的化石。保存最完美的是 Walton 在英國上石炭紀所發現的 *H. kidstoni, H. willsii*………等化石。 Walton 關於他的"形態屬名" *Hepaticites* 所給的定義如下：

"植物化石具有和現代的苔類（Hepaticae）親緣關係的證據，並且具有和藻類（Algae)。蕨類植物門(Pteridophyta）以及其他各門類的植物相區別的特徵，都可以定爲形態屬名 *Hepaticites*, 假使這些化石的構造方面的知識太不够保證定爲另外一個特殊的屬名。"

根據上述的意義，我們可以明白：凡是定爲 *Hepaticites* 的化石，必須確實具有和苔類的親緣關係的標本。換一句話說，這些化石必須具有和現代苔類相同的生殖器官的證據。因此我們也可以明白，凡是定爲 *Hepaticites* 的化石，方可確實無疑地放在苔蘚植物門（Bryophyta）之下，另外一方面凡是定爲 *Thallites* 的和苔類大致可以比較的化石，是應該保留地用一個問號放在苔蘚植物門之下的；因爲這些化石僅僅根據葉狀體（Thallus）的形態的，而不是具有生殖器官方面的證據的。同時 *Thallites* 不過是一個形態屬名如譯成中文應該是"擬藻"或可譯爲"葉狀體化石"，定爲 *Thallites* 的若干種化石，也可以屬於藻類植物的，甚至可能是屬於蕨類植物的"原葉體"化石的。

根據 Lundblad[103]（1954，第408頁），*Thallites* 是一個適當的屬名可以應用於中生代的不甚可靠的地錢（liverworts）化石的（參看 Harris[57]，1942）。她認爲特別值得提出的有下列各種（1955[104]，第31頁）：

Hepaticites wonnacotti Harris 1942. 中侏羅紀，英國。

Thallites rostafinskii (Raciborski) Harris. Raciborski 1888, 1894. 里阿斯期底部，波蘭。

Thallites zeilleri (Seward) Harris. Seward 1894, Harris 1942; 韋爾登期，(Wealden) 英國。

Thallites sewardii (Berry) Lundblad. Berry 1920. 下白堊紀，美國。

Thallites blairmorensis (Berry) Lundblad. Berry 1929. 下白堊紀，加拿大。

Thallites yabei (Kryshtofovich) Harris. Kryshtofovich 1929, 1933, Ôishi 1940, Harris 1942. 上侏羅紀至下白堊紀，西伯利亞，朝鮮，日本。

Thallites uralensis Kryshtofovich & Prynada 1933. 瑞底克期至里阿斯期，蘇聯（烏拉爾東部）

Thallites jimboi (Kryshtofovich). Kryshtofovich 1918, 1929; 中白堊紀，蘇聯（庫頁島）

Lundblad 沒有提到英國 Yorkshire 的"中侏羅紀下部"的 *Marchantites erectus* (Leckenby)，這一個種現在應該定爲 *Thallites erectus* (Leck.)。根據 Seward[152]（1898，第234頁），這一個種是和 *Thallites zeilleri* (Seward）是很相接近的。上面已經提及本文作者1933年曾經指出：長汀的化石是和英國 Yorkshire 的種是很相以的。同時本文作者當時又曾說明，因爲標本的保存不完善及因爲很多同樣化石的鑑定方面的困難性，關於討論相同的"種"的問題最好不要指出肯定的意見。同樣的話當然可以應用於當前的延長層化石。我們既然不能清理前人所造成的糾紛，我們至少也應該避免在糾紛之上再加上糾紛。因此本文作者相信延長層的化石和福建長汀的化石都應該暫定爲 *Thallites* sp. 如果我們要將這些化石創立一個新的種名，那末也應該說明創造新種的理由及詳細討論這一個新種和其他相近的各舊種的區別。否則最好不要胡亂地創立新的種名。

地點：陝西宜君縣四郎廟炭河溝

地層：延長層上部

蕨類植物門

(一) 木賊綱

木賊目

木賊科

屬名 *Equisetites* v. Sternberg

1833. *Equisetites* v. Sternberg, 11, p. 43.

(圖版 II, 圖 5; 圖版 IV, 圖 4, 5, 5a; 圖版 VI, 圖 3—5, 5a.)

***Equisetites sarrani* Zeiller**

1903. *Equisetites sarrani* Zeiller, p. 144, pl. 39, figs. 1-13.

1926. *Equisetites* sp. E. cf. *sarrani,* Harris, p. 54; pl. 2, figs. 2, 3.

1931. *Equisetites doratodon* Harris, p. 16, pl.3, figs. 1, 2, 4-6, 9, 11, 13, 14, 16, 18, textfig. 3f.

1933. *Equisetites sarrani* Sze, p. 20; pl. 3, fig. 10.

1936. *Equisetites* cf. *sarrani* P'an, p. 12, pl. III, fig. 10; pl. IV, figs. 1-6.

1937. *Equisetites sarrani* Harris, p. 9.

1949. *Equisetites* cf. *sarrani* Sze, p. 3, pl. 15, figs. 1-3.

詳細異名單 (Synonym) 從略

這一個種在材料中異常豐富，俱保存於黑色頁岩中，地點爲延長縣七里村河南岸陡崖，根據岩石性質這一個地層是否確屬於延長層中實有問題。這一種潘鍾祥亦已曾描述，據其説明，實發現於延長層之上的瓦窰舖煤系的最底部地層中。本文作者所研究的延長縣的標本係石油管理局同志所採集和延長層化石一同寄來，其確實地層的層位未加説明，玆暫附述於本書中，等待將來確實的證明。但因延長層植物羣中含有越南東京的植物羣份子很多，而這一種 *Equisetites* 又是東京煤田最普通的化石，則此種在陝北一帶既生存較新的瓦窰舖煤系時代，亦生存於較老的延長層時代亦有可能。

根據"節間"，"關節"尤其是連成有齒形的"葉鞘"的全部形態當前的標本幾乎和東京所發現者完全相同，因此作者認爲鑑定當無問題。在當前的材料中，單獨保存的"關節盤"(Nodal diaphragms) 亦甚多，保存俱甚佳，大小不一，其四周的無數的放射的細長的凸肋構造亦至爲顯明。此種單獨保存的"關節盤"亦和東京所發現者完全一致。在同一塊標本上，更找到一個"子囊穗"(cone) 的化石碎片亦和東京所發現者，毫無異致，此"子囊穗"爲無數鱗片狀六角形的盾形孢子葉所組成 (圖版 VII, 圖 7, 7a)。

地點：陝西延長縣七里村河南岸
　　　陝西綏德縣義合鎮
地層：延長層上部

***Equisetites brevidentatus* Sze 新種.**

(圖版 V, 圖 1, 1a.)

僅有一塊令人異常注目的標本係賈福海及高存禮同志在山西省臨縣第八堡的延長層中所採集的。據採集者書面通知，化石所在的地層位置爲下距紅色的石千峯系之頂約 100 米 (此 100 米中亦含有植物化石)

化石層以上所見到的地層確屬於延長層約500米（未見到頂部）全部岩性以灰綠色砂質頁岩及頁岩爲主亦偶然夾有淡紅色砂岩及紫色頁岩。延長層在此地亦以不連續地覆於石千峯系之上，如此則此化石當係產於延長層的底部，在同一層位中亦發現 *Danaeopsis* 化石。樹幹部似甚大，保存而爲化石的碎片尚寬至11厘米，其原來直徑之大可想而知。幹部外表異常平滑，僅隱約地可以見到極細的縱紋。關節上部的葉鞘印痕尚保存着，葉鞘的每一枚齒俱很短很大，頂部爲鈍圓形。齒的寬度和其長度大致相等（寬度約爲6—7毫米，長度約爲5—6毫米）其基部互相連合着之處因標本破碎未曾保存，齒亦似甚爲平滑。葉鞘全部究有葉（卽齒）若干，未能確定，就保存於當前的碎片而論，葉鞘上還保存着14枚，則原來幹部每一葉鞘齒的數目之多可想而知。

當前的植物顯然係一新種和下面描述一種卽 *E. sthenodon* 相比，葉鞘的齒較短，較圓，並且葉鞘基部連合着之處亦較少換言之卽每一枚齒（卽葉）露出之處較多。*E. sthenodon* 的關節上的頗具特徵的一行橫列的枝痕，在 *E. brevidentatus* 的標本上亦未曾見到。我們定此新種名爲 *brevidentatus*，（*brevis* 是短的意思）。或多或少相似的標本也發現於格林蘭的瑞提克層中經 Harris 定爲 *Neocalamites carcinoides* 的樹幹部的"外模化石"（external cast）. Harris[52] 相信他的標本上的圓印痕是枝部遺落後的印痕（1931, pl. 4, fig）。在他的標本上枝痕和葉痕相間，他的意思，可能是對的。但在當前的標本上，此種印痕似代表着葉鞘的齒部因爲並不完全是圓的。並且在標本的左邊上的幾個齒其頂端凸出微作尖銳形，並且在我們的標本上，也沒有看出葉痕。我們暫定此化石爲 *Equisetites* 的新種等待着將來更多的材料發現時再加決定和討論。

地點：山西省臨縣第八堡。

地層：延長層下部。

Equisetites sthenodon Sze 新種.

（? 圖版 II，圖 4；圖版 VI，圖 1，1a，2）

這一個新種，僅保存兩塊葉鞘化石（係一個植物體的正負兩面 part & counterpart）及一塊幹部化石。葉鞘的保存係一碎片，在標本上尙保存6－7個巨大的齒，齒的最寬處在其基部約爲8毫米，同樣寬度保持着至向前三分之二之處，然後突然收縮，頂端作鈍尖形。齒自基部至向前三分之二之處亦互相連合着。齒的表面甚平滑。無一切皺紋。齒和齒之間互相接合的溝所謂"縫合溝"（kommissural-furchen）在葉鞘的下半部大致可以看出。

Equisetites 的葉鞘化石的每一枚齒的體積巨大如當前的化石在已發表的文獻中是很少見的。葉鞘的保存係一碎片，原來樹幹部直徑的寬度之大亦可想而知。葉鞘的保存既僅係碎片，則整個葉鞘，齒的數目亦無法推斷。根據齒的體積及形態在舊文獻中所已描述的各種比較可以和我們的種相接近的是 *Equisetites platyodon* Brongniart. 這也是一個比較稀少的種，但係一個重要的標準化石，它是德國南部瑞士北部的上三叠紀中部的所謂 Schifsandstein 層的標準化石。這一個上三叠紀中部的 *Equisetites*，根據描述它的幹部達到10厘米，每一葉鞘僅有葉（卽齒）20—40枚。它的每一枚葉（卽齒）的寬度和我們的種相差不多，但較爲狹長，並且其互相連合之處，達到向前五分之四之處，因此露出而爲齒尖的部分亦較我們的種爲短，並且其齒尖亦較爲尖銳，雖然我們的種如標本保存較佳時其齒尖亦可能是尖銳的。茲暫定當前化石的新種名爲 *sthenodon* 希臘文 *Sthenos* 是堅強有力之意。

幹部化石的外表，甚爲平滑，無其他一切皺紋。在關節上，有一行橫列的枝痕，枝痕保存作圓形，直徑約爲3毫米，正中部有一點微微凸起。經仔細視察，關節的上部（卽上面）的葉鞘印痕還影約地可以見到。葉鞘的每一枚齒的體積和形態和上述的兩塊標本完全一致。關節上每一個枝痕的位置適位在兩枚齒的中間之處（亦卽兩枚齒的互相連合着之處）。這一塊保存枝痕的幹部化石顯然和上述的葉鞘化石同屬一種，最後應該指出的是：*Equisetites platyodon* 的幹部外表，亦非常平滑，但關節上尙未見有一行橫列的枝痕。

地點：陝西耀縣房兒上。

地層：層位未明。

Equisetites acanthodon Sze 新種.

(圖版 V 圖 2, 2a.)

另外一塊令人異常注目的葉鞘化石係本文作者和關佐蜀同志1951年在宜君縣四郎廟所採集者。根據葉鞘的齒部形態知此新種的體積較上述兩種爲小葉鞘本身連接合程度甚強。葉鞘碎片還保存着"葉齒"9個。葉齒本身露出部分很短，前端作鈍圓形。最令注意的是鈍圓形的葉齒之前還接連地着生肌理（Texture）甚薄的葉膜（Lamina），此種葉膜當然代表着葉齒的頂部。葉膜的最寬處在其基部，緩緩地向頂端狹細，頂端尖而銳。在放大鏡下視察葉膜的表面有極細的縱紋線。葉膜的基部寬近於3毫米（不到3毫米）自基部至頂端葉膜長約7—8毫米。葉鞘本身接合之處高至少爲5—6毫米。

此新種因其葉齒前的葉膜的尖銳的形態而令人注意，玆定其種名爲 *Acanthodon* 希臘文 *Acanthos* 是細而尖銳之意。

根據葉鞘的體積及形態此新種頗接近於 *Equisetites planus* Sze（1933 b, p. 50, pl. 8, fig. 10; pl. 11, fig. 8）[168] 這一個種發現於福建長汀縣的下侏羅紀地層中。這一個種的葉鞘本身的接合程度亦甚強。其葉鞘本身接合之處高至12毫米其每一葉齒互相接合的渚所謂縫合溝（Kommissuralfurchen）亦不明顯。葉齒出露之處亦甚短惟葉齒的前端微顯三角形，頂端鈍。是否將來找到保存更佳的標本時其葉齒之前亦接連着肌理甚薄的長而尖銳的葉膜，則不得而知。惟此種的葉齒的前端，既爲鈍的三角形和當前的標本至少不是同屬於一種的。

地點：陝西宜君縣四郎廟炭河溝。

地層：延長層上部。

Equisetites deltodon Sze 新種.

(圖版 IV 圖 3, 3a.)

這一塊僅有的標本，顯然也是 *Equisetites* 的葉鞘化石。葉鞘亦甚爲堅強而巨大，齒作伸長的三角形，齒長約5毫米，其基部的寬度約爲4毫米，頂端鈍尖。

齒和齒彼此距離頗遠，其互相距離之處約爲4—6毫米。葉鞘及齒的表面，俱甚爲平滑。有時齒的中部大致可以見到一淺溝，自齒的頂部直通至葉鞘，這可能是受標本保存境況的影響。

這一種 *Equisetites* 其葉鞘及齒既如此巨大，可以想見其原來樹幹的體積也必定是很寬闊的。這一類巨大的 *Equisetites* 在中生代的文獻中是非常少見的。

地點：陝西宜君縣焦家坪。

地層：延長層上部。

Equisetites? sp. (cf. *E. rogersi* Schimper)

(圖版 VII 圖 3, 4, 4a.)

這一個化石也很可能是 *Equisetites* 的葉鞘化石。根據狹細，瘦長而尖的鋸齒頗似北美維基尼亞州的上三叠紀中部的 *Equisetites rogersi* Schimper（Fontaine[30]，1883，第10頁；圖版 II，圖 1, 2）但標本太破碎不全，我們暫定爲 *Equisetites?* sp. （cf. *E. rogersi* Schimper）等待着保存較佳的標本。

地點：陝西宜君縣高崖底。

地層：延長層底部。

Equisetites sp. (Strobili of *Equisetites*)

（圖版 V 圖 4；圖版 VII，圖 5—7,7a.）

在若干灰綠色矽質頁岩中保存着無數單獨的 *Equisetites* 的子囊穗的印痕化石（Impression）子囊穗的寬度大致爲 10 毫米長度大致爲 15 毫米作橢圓形。表面爲無數小的六角形的盾狀孢子葉所組成和其他古生代及中生代的 *Equisetites* 的子囊穗形態完全相同。譬如古生代石炭紀中部的 *Equisetites hemingwayi* Kidston 的子囊穗的形態和體積，和當前的標本亦大致相同，僅其所組成的盾狀的六角形的孢子葉的數目較少（參看 Seward[152]，1898，p.262，Textfig. 57A）。

是否當前的標本和本文圖版 VII 圖7，7a 所表示的子囊穗同屬於一種，並且同屬於 *E. sarrani* Zeiller 亦不能完全決定。當前的標本保存於灰綠色矽質頁岩和 *Neocalamites carcinoides* Harris 常常保存在一起，屬於眞正的延長層的。

地點：陝西延長縣七里村。

地層：延長層上部。

地點：山西興縣李家凹。

地層：延長層下部。

屬 名 *Neocalamites* Halle

1908. *Neocalamites* Halle, Mesoz. *Equist.* Schwed. p. 6.

Neocalamites carrerei (Zeiller) Halle

（圖版 IV，圖 2，2a；圖版 VI，圖 6）

下列異名表（Synonym）是挑選比較重要者

1903. *Schizoneura carrerei,* Zeiller, Pl. 36, figs. 1-6; pl. 37, fig. 1; Pl. 38, figs. 1-8.
1908. *Neocalamites carrerei,* Halle, p. 6.
1908. *Neocalamites carrerei,* Seward, p. 85, pl. III, fig. 1.
1920. *Neocalamites carrerei* Yabe, pl. 1, figs. 2-3.
1923. *Neocalamites carrerei* Kryshtofovich, p. 8, pl. 1, figs. 1-3.
1925. *Neocalamites carrerei* Kawasaki, p. 37, pl. II, pl. III, figs. 10-12, pl. XLIII etc.
1927. *Neocalamites carrerei* Du Toit, p. 315, pl. 16, figs. 2-3.
1931. *Neocalamites hoerensis* Sze, p. 51, pl. 9, fig. 4.
1932. *Neocalamites carrerei* Kryshtofovich & Prynada, p. 365.
1932a. *Neocalamites carrerei* Ôishi, p. 56.
1932b. *Neocalamites carrerei* Ôishi, p. 269, pl. III, figs. 1-4; pl. IV, figs. 1-2.
1933a. *Neocalamites carrerei* Sze, p. 24, pl. 5, figs. 3-4.
1936. *Neocalamites carrerei* Ôishi & Takahasi, p. 117, pl. 1, fig. 1.
1936. *Neocalamites carrerei* P'an, p. 9, pl. 3, figs. 1-3.
1949. *Neocalamites carrerei* Sze, p. 3, pl. 14, figs. 7-8.
1952. *Neocalamites carrerei* Sze & Lee, p.2, p. 26, pl. 1, fig. 6.

在 1952 年斯行健和李星學的著作第 2 頁及第 20 頁中已經提及這一個越南“東京”（現在應改稱爲“北部”爲了在古植物學文獻上便於查考起見，這裏仍使用舊名，請讀者予以注意）煤田的重要種，是和多數被定爲 *N. hoerensis* (Schimper) Halle 及 *N. ferganensis* Kryshtofovich 的標本是很不易區別的。普通在 *N. hoe-*

rensis 每一節是比較狹瘦的，但這不是區別種的理由。現在一般古植物學者的意見，區別這兩個種最要緊的根據每兩個"葉痕"(或可名爲葉跡)之間的縱肋的數目。不過就是根據這一點 *N. koerensis* 和 *N. carrerei* 的區別還是很少的。因此多數學者對於區別這兩種都感到相當的困難。本文作者最近的意見以謂最妥當的辦法，還是將這兩個種合成一種。不過在本文中還未曾如此處理。Harris 也曾經說過。"許多莖幹很寬，節很短的標本，以可定爲 *N. carrerei* 但莖幹的寬度和節的長度在多數標本中差異甚大，使多數標本不易鑑定。"當前的材料，其每兩個葉跡之間的縱肋數目爲 2—3 條和東京的標本完全相同因此定爲 *N. carrerei* 是很可靠的。

地點：陝西宜君四郎廟炭河溝。

地層：延長層上部。

Neocalamites carcinoides Harris

(圖版 I，圖 1, 1a；圖版 II，圖 1, 1a, 2；圖版 III，圖 1—3；圖版 IV，圖 1；圖版 VI，圖 7, 8；圖版 IX，圖 1, 2, 2a.)

1908. *Equisetites scanicus* (?non Sternberg) Halle pars; p. 22; pl. VIII, figs. 1-5; pl. IX, figs. 16, 17.

1926. *Neocalamites* cf. *inopinata* (Non Zeiller) Harris, p. 51; pl. 4, fig. 7; pl. 9, figs. 1, 4.

1931. *Neocalamites carcinoides* Harris, p. 25, pl.4, figs. 2, 3, 5-7; pl. 5, figs. 1-4; pl. 6, figs. 1-4, 6, Textfig. 5A-D.

1934. *Neocalamites carcinoides* Harris, Kawasaki, p. 65-71.

1936. *Neocalamites* cf. *carcinoides* Harris, Pân, p. 11, pl. III, figs. 4-9.

1936. ?*Schizoneura gondwanensis* Feistm, Pân, p. 13, pl. IV, figs. 7, 7a.

1937. *Lobotannularia carcinoides* Harris, p. 11.

這一個格陵蘭的種，在陝北的延長植物羣中顯然也是許多特出的重要代表之一。若干標本也被潘鍾祥描述，但此次所發現者，保存更爲佳美幾乎在格林蘭所發現的經 Harris 定爲這一種類型 (types) 的標本都發現於當前的材料中。圖版 IV，圖 1 的一塊標本是代表着樹幹的外表的化石。每一節的寬度至少爲 8—8.5 厘米，其長度不明。有一塊化石 (本文圖版 II，圖 2) 節的寬度爲 5.5 厘米，其長度爲 14 厘米。縱肋很細，縱溝很淺。縱肋及縱溝在關節上成叉互排列。圓而小的葉痕在標本上非常明顯。各葉痕彼此互相距離之處寬度爲 4—6 毫米。葉痕的直徑不到 1 毫米，但其正中部的一點極細的代表維管束痕，還影約地可以看出。各葉痕之間有 4—6 條縱肋，偶然似亦有 7 條者。圖版 I，圖 1，1a 所表示的標本是枝部化石。枝部的節頗狹而細，其寬度不到 5 毫米，長度爲 4—5 厘米，節上的細的縱肋頗顯明。關節微微外凸。葉輪着生於每一關節上，每一葉輪在我們的標本上還保存葉 10 枚 (可能在植物生存的時候每一葉輪的葉的數目不止此數)，在枝部的每一關節的兩側，葉成爲兩"羣" (groups) 每一"羣"有葉 5 枚，葉都向外伸張，多數向枝部的前部伸出，也有微向後伸者，但從無直指向枝部的後部(卽基部)的葉。可能在植物生存時，所有的葉在葉柄處都微微扭轉 (twisting) 都平舖着成爲一"面" (plane)。所有的葉似乎在其基部都不互相連合着 (free)。葉的長度至少爲 12 厘米，(單獨保存的卽脫離葉輪的葉其長度有超於此者) 葉的最寬處在其中部，寬度約爲 3—5 毫米，也有更寬於此者。葉的形狀爲劍形 (卽披針形)。每一枚葉的長度應該是大致相等的，可能有一部分微向枝的基部下彎的葉較狹及較短。葉的中脈顯明，中脈的粗度大致等於葉的寬度的五分之一。在關節附近每一葉的葉邊幾乎互相接觸，葉邊普通是直的，極偶然地也有微現波浪形者。間於中脈及邊緣的部分，似乎是較嬌弱的，這部分有很細的及很密的橫紋，在標本上卽可看出。這一類的標本和 Harris[52] 論文中的 pl. 5, figs. 3, 4 及 pl. 6, fig. 6, 及插圖 5 A-D (1931) 是完全一致的。

另外一部分標本，葉的全部都互相接合着似乎都是互相"鎔合着"(fused)。這些標本的葉是較長 (有時葉亦有較寬者) 本文圖版 III，圖 1 所表示的一塊標本每一枚葉長至 20 厘米還未曾保存完全。這些標本葉的中脈似乎也比較粗。這些標本完全和 Harris (1931, pl. 4, fig. 5) 及潘鍾祥 (P'an, 1936, pl.3, figs. 6—9) 的報告是完全相同的。在我們的材料中，也有些標本葉彼此互相平行地排列着，似乎並不是互相鎔合着的 (本

文圖版 III，圖 2，3)。

本文作者並且相信 Harris[52] 在其 pl. V, fig. 5 及 pl. VI, fig. 5 (1931)的兩塊標本不是屬於 *N. carrinoides* 的而是屬於 *N. carrerei* 的。這些標本和 Harris[51] 自己在 1926 年的論文中、pl. IX, fig. 5，所定爲 *N. hoerensis* 的一塊標本是大致相同的。因爲根據圖影，這些標本每兩個葉痕之間的縱肋數目，普通僅爲 2—3 條，僅僅極偶然地有 4 條而已。

最有意思的是：這一個種 Harris[51]，1926 年定爲 *Neocalamites* cf. *inopinata* Zeiller, 1931 年[52] 改爲一新種 *Neocalamites carcinoides* Harris 1937 年又改爲 *Lobatannularia carcinoides* (Harris) n. Comb. 本文作者對於他的 1926 年[51] 的最初的意見及 1937 年[56] 的最晚的意見都未能完全同意。關於第一個意見 Harris[52] 自己在 1931 的論文第 29 頁有所改正，他說"*N. carcinoides* 顯然和 *Annulariopsis inopinata* Zeiller 不同，Harris[51]自己曾將 (1926) 此兩種相比較的。在前者的葉已證明比較狹瘦，並且其頂端是尖銳的，在後者的葉其頂端是鈍的。" 1931 年 Harris[52]改定此種爲 *Neocalamites*，他的意見顯然是很對的。他這樣說 (1931, p. 22)：*N. carcinoides* 種是令人注意的，因爲它的最普通樹幹化石類型和 *N. hoerensis* 是很相同的；有些標本其葉分成兩"羣"，每一"羣"的葉，"鎔合" (fused) 在一起，很像典型的 *Schizoneura*；另外有些標本，每一葉輪的幾枚葉比其餘的葉較短，這個形態又像 *Lobatannularia*. 這一個種的許多型式幾乎包括了這三個屬的形態。我將這一個種安置在 *Neocalamites*，因爲標本中的最普通的類型和這一個屬最相一致" 本文作者完全同意上述的意見。因爲如果我們將枝部及葉部化石定爲 *Annulariopsis*，*Lobatannularia* 那末樹幹化石將如何處置呢？因爲樹幹化石的一切形態，完完全全和 *N. hoerensis*，*N. carrerei* 及其他 *Neocalamites* 的各種是相同的。而况且葉部化石也和 *Lobatannularia* 及 *Schizoneura* 倘有相當的距離的。1937 年 Harris 似乎和其他若干學者一樣 (比方說 Gothan, Yabe, Koiwai, Ôishi 等)傾向於將這一類植物，當作在中生代地層中的一種古生代植物羣中遺留下來的孑遺 (Relics) 植物來看待，雖然除出 Gothan 外，他們都沒有指出"孑遺"的這一個名詞，也沒有正式指出這些東西是"孑遺植物"。Harris[56] 在 1937 年將他的 *N. carcinoides* Harris 一種又正式地改爲 *Lobatannularia carcinoides* (Harris) n. Comb. 並且原書第 11 頁中說道"*Lobatannularia* 是東亞的古生代晚期及中生代古期* 的標準植物，在那裏這一個屬有好多種，但我們的種和所有東亞各種都很容易區別，因爲葉很多，葉的形態亦不同。這一個屬在格陵蘭並且可能在瑞典的下侏羅紀底部的發現，明顯地具有相當大的興趣。" 最後一句話，和 Ôishi 在 1940, p. 186 頁中關於 *Lobatannularia nampoensis* Kawasaki 所說的完全相同，他這樣說"這一塊標本在朝鮮的下部大同層 (Lower Daidó Formation 屬於下侏羅紀) 的發現是有特殊的興趣，因爲它是這一個屬的最年青的代表。" 根據本文作者之意格陵蘭的種 (卽 *N. carcinoides*) 顯然是 *Neocalamites*，根本和東亞的古生代植物無關，Harris 自己也曾講過：所謂 *Lobatannularia* 的葉是比較短得多而且葉的形態也和格陵蘭的標本不相同的。作者應該利用此一機會，特別指出所謂 *Lobatannularia* 的葉論不但在關節的兩旁，有成圓裂片 (lobes) 的形勢而且葉輪之間有"葉鑲嵌"(leafmosaic) 的形態，在格陵蘭的標本是完全沒有葉鑲嵌的形態的。並且格陵蘭的葉部及枝部化石是毫無疑問地是着生在 *Neocalamites* 式的樹幹化石上面的此種化石和 *H. carrerei* *N. hoerensis* 及其他各種 *Neocalamites* 是完全相同的。古生代的 *Lobatannularia* 也和 *Annularia*, *Asterophyllites* 等一樣是着生在 *Calamites* 式的樹幹化石上面的。因此本文作者在本文中仍定當前的標本爲 *Neocalamites carcinoides* Harris. 應該指出的是：朝鮮下侏羅紀的僅有的一塊標本原先經川崎 (Kawasaki)[73] 定爲 *Schizoneura nampoensis* (1925, p. 39, pl. 41, fig. 115) 後來改爲 *Lobatannularia nampoensis* (Kawasaki 1927, pl. 7, fig. 29; Ôishi 1940, p.186)。這一塊僅有的朝鮮中生代標本，旣不是 *Schizoneura* 也不是 *Lobatannularia* 最適當的名稱還是 *Neocalamites* 因爲其着生的樹幹化石也顯然不會是 Calamites 式的而是 *Neocalamites* 式的。標本是一塊枝部化石而具其上面僅保存着一個葉輪，"葉鑲嵌"的形態也不能確實證明的。可能朝鮮的一塊標本也是屬於 *N. carcinoides* Harris 的因其葉的寬度是和當前的延長標本完全相同的；但葉的長度不够，並且地層時代也不相同。(其地

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* 應該指出的是：東亞的中生代古期 (Older Mesozoic)實無此種化石，朝鮮下侏羅紀的僅有一塊 *Lobatannularia nampoensis* Kawasaki 鑑定也頗有問題，實亦係 *Neocalamites* 的一種，下面將再提及。

層時代可能較延長層略高）。朝鮮的標本,最好暫時加以保留的態度暫定爲 *Neocalamites nampoensis* (Kawasaki) Sze n. Comb. 最後應該更特別指出的是根據本文作者之意,越南東京的標本也應該暫定爲 *Neocalamites inopinnata* (Zeiller) n. Comb. 因爲東京的標本也顯然是着生於 *Neocalamites* 式的樹幹化石不而是着生於 *Calamites* 式的（全世界的中生代地層至今未曾發現和古生代 *Calamites* 相同的化石）。 Harris 自己曾將格陵蘭的標本定爲 *Neocalamites* cf. *innoptnata* (Zeiller) 並且在 1931 年將他的標定改定爲 N. carcinoides 的。他在 1931 年 p. 29 並且指明東京的種其葉比較短並且比較鈍和格陵蘭的種是不相同的,上面已經提及。

矢部 (Yabe) 及小岩井 (Koiwai) 在 1928 年的一篇討論 *Annulariopsis*, *Lobatannularia* 及 *Annularites** 的論文,主張中國和朝鮮古生代的 *Lobatannularia* (卽 *Annularites*) 和越南東京的上三叠紀底部（卽瑞底克期）是同屬的,因優先例的關係,此種化石其屬名應爲 *Annulariopsis*. 因爲這一個屬名是 Zeiller 在 1903 年所創的。 德國 Gothan 教授從前似亦曾傾向於這一種意見因爲他似乎相信越南東京的 *Annulariopsis* 是東亞古生代所遺留的一種孑遺植物。 本文作文在 1942 年的中文著作“福建植物化石之研究”一文第 13 頁中曾有下列一段說明“作者對於 *Annulariopsis* 一類植物係古生代留下的”孑遺”的意見不表示及對, 但以 *Annulariopsis* 一名代替 *Lobatannularia* 則不甚贊同,因東京所發現者保存不全……將來如能在東京瑞底克期或下侏羅紀地層中發現多量且保存較好標本,確與古生代的 *Lobatannularia* 相同時,始可將 *Lobatannularia* 取消,目下實嫌過早” 本文作者研究延長植物羣之後覺得作者 1942 年的意見尙須略加補充。 上面提及卽東京的所謂 *Annulariopsis* 葉部化石其着生的樹幹化石顯然是 *Neocalamites* 的型式和 *N. carrerei*, *N. hoerensis* 及 *N. carcinoides* 以及其他各種是相同而决不是着生於古生代的 *Calamites* 的樹幹型式的。因此所謂“孑遺” 的意見亦須加以相當的保留因爲如果此種植物是孑遺的話,那末,中生代的所有 *Neocalamites* 樹幹化石都將是古生代的所遺留的“孑遺”了。這一點意見 Gothan 似根本未曾想到過的。最有意思的是 Harris 在 1937 年發表的論文 P. 11 將所有 *Neocalamites* 式的樹幹化石都改定爲 *Lobatannularia* 了（比方說他將 1931 年的論文的 pl. V, figs. 1, 2, 5 及 pl. VI, fig. 5), Harris 自己似乎根本沒有想到這些樹幹化石完全和 *N. carrerei*, *N. hoerensis* 及其他 *Neocalamites* 各種是完全同屬於一個屬名的。如果將這些化石定爲 *Lobatannularia* 那末, *N. carrerei*, *N. hoerensis* 及其他各種 *Neocalamites* 將如何辦法。 是否將一列改定爲 *Lobatannularia* 呢? 如果將 *N. carrerei* 等各種改定爲 *Lobatannularia* 是如何的不切合實際的呢! 本文作者更深深相信如果將當前的延長植物羣的所有樹幹化石如本文的圖版 IV. 圖 1 等化石和 Harris 一樣定爲 *Lobatannularia* 也一定會碰到批評的。

地點: 延長縣七里村 18 井
　　　宜君縣四郎廟炭河溝。
地層: 延長層上部。
地點: 延長縣懷林坪。
地層: 延長層中部。

Neocalamites brevifolius Sze 新種.

（圖版 V, 圖 3）

這一個新種, 雖僅有一塊標本,但頗具特徵,樹幹寬度約爲 3 厘米,長度不明（在標本上其長度的保存爲 10 厘米）表面甚平,在關節上,葉痕凸出度很強。節很短, 長僅 8—11 毫米。 每一關節所保存的葉痕在標本的一面上尙可看到有 7 個,其全部當可能在 14 個左右,卽樹幹的每一葉輪可能有葉 14 左右。葉痕比較地甚爲粗強每一葉痕其直徑大約爲 1.5 –2 毫米。葉比較地甚粗甚短, 葉長不到 2 厘米,寬約 2 毫米,向前彎伸,其頂端似頗鈍尖,中脈不明顯。所有的葉在其基部都不和其他的葉相合而成爲鞘狀的。 因此當前的植物顯然是 *Neocalamites* 而不是 *Equisetites*.

* 這一個屬名係 Halle 在 1927 所創,其標本和川崎 (Kawasaki) 1927 爲朝鮮同時代所創的 *Lobatannularia* 完全相同。但川崎的論文早數月出版,因優先例的關係, Halle 同意取消這一個屬名。

雖然材料太少,當前的植物,顯然代表着一個新種, 因爲在已發表的舊文獻中是沒有一個種可以和此相比較的。

地點: 延長縣七里村煉廠。

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Neocalamites rugosus Sze 新種.

(圖版 VIII, 圖 1—3, 1a, 3a, 圖版 XL. 圖 4—6.)

當 1951 年 9 月本文作者和關佐蜀同志及其他石油管理局同志們在宜君四郎廟找到本文圖版 XL, 圖 4—6 的化石時曾不能決定此種化石是屬於何種植物的。當然因其化石表面上的彎曲度甚強的無數橫列的深溝而感到興趣。後石油管理局送來延長縣材料中有一塊標本 (本文圖版 VIII, 圖 1) 其表面有同樣的令人異常注目的無數彎曲度甚強的橫列的深溝。在這一塊標本上見到一個顯明的關節, 關節上有一行橫列的頗寬而圓的葉痕, 因此知道這一類標本是屬於木賊目 (Equisetales) 的。最有意思的是: 在這一塊標本的右邊尤其是在關節的下部還可以看見一部分樹幹表面的細而密的縱肋和縱溝 (本文圖版 VIII, 圖 1, 2) 頗似 *Neocalamites* 的形態。如將這部分用小刀輕輕地括去,便顯出了彎曲度甚強的橫列的紋綫因此本文作者相信此種彎曲如鋸齒形的紋線乃係樹幹的皮層 (Cortex) 的表面形態。是否所有中生代的 *Neocalamites* 的各種其皮層表面或表皮下的構造都作如此形態呢? 作者不敢完全肯定,因爲同樣標本前人似尚未描述過,作者暫定當前的標本爲一新種 *Neocalamites rugosus* Sze sp. nov.

最有興趣的是當此稿完成後,作者接到 Jongmans 教授寄來大批論文的單行本, 發現北非古生代的中石炭紀地層中,也有大致相似的化石。Jongmans 定爲 *Calamites rugosus* Jongm*. (1951, Sud-Oranais Pl. I, fig. 1)。古生代的 *Calamites* 樹幹化石也有完全同樣的彎曲的構造和中生代的 *Neocalamites* 相同,實令人異常注意。筆者曾寫信給 Jongmans 教授, 詢問對於此種構造的意見。Jongmans 教授接到此信後, 卽寄來 1915—1917 年 Kidston 和 Jongmans[77] 合著的兩大本厚書,這兩本厚書是討論歐洲西部的蘆木化石的 (A monograph of the *Calamites* of Western Europe)。在這一篇重要的論文中,筆者發現一種定名爲 *Calamites carinatus* Sternberg var. *rugosus* K. et. J. 的化石,也有和當前的延長層的標本的相同的構造。Kidston 和 Jongmans 在論文中 (1917,第 149 頁,圖版 41, 圖 1—3; 圖版 155, 圖 1)。對於這一類化石, 有下列一段說明: "這一個"變種" (Variety) 的髓部石核和枝部印痕和 *C. carinatus* 是完全一致的; 而這一個變種和 *C. carinatus* 不同之處是它的'皮層的表面' (Outer surface of the cortex) 有特殊的形態。" 由此看來, Kidston 和 Jongmans 在當年顯然相信這一種彎彎曲曲的線條是蘆木的'皮層的表面'的一種構造,而 Jongmans 在最近四十年來並沒有改變這一種想法。因此作者認爲當前的中生代延長層的化石, 是 *Neocalamites* 的皮層 (亦卽所謂 Cortex) 的表面的一種特殊的構造,大約也不至於錯誤的。

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地層: 延長層上部。

地點: 陝西,延長縣馮家溝村。

地層: 延長層上部。

Neocalamites sp.

(圖版 II, 圖 3.)

在材料中有一塊標本, 保存異常破碎, 視其形態似係代表 *Neocalamites*. 樹幹的細而密的縱肋及縱溝至

* Jongmans 教授 1955 年 6 月 12 日的來信說: *Calamites rugosus* 的最好的圖影是發表於他的 1913 年的論文 Die Calamariaceen des Rheinish-Westphälischen Kohlenbeckens, Mededeelingcu van's Kigks Herbarium, 20 1913, Pl. 13, f. 1, 2, 3. 這本書他無法寄給我, 因爲他已經送完了。

爲顯明。此外還可見到一行橫列的枝部遺痕。枝痕在碎片者還保存着5個，枝痕爲圓形，頗大，其直徑幾乎達到1厘米，其內部還可見到很多短的成放射狀的構造。很可能的這一塊樹幹的"印痕化石"也是屬於 *N. carcinoides* 的。

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地層：延長層上部。

Neocalamites? sp.

(圖版 VII 圖 1—2, 1a, 2a.)

圖版 VII，圖 1，2 所表示的標本是一木賊目（Equisetales）的髓模即髓部石核（Marksteinkerne）。此種髓模化石似屬於 *Neocalamites* 的成分爲最多。很可能的此種髓模是屬本文所描述的 *Neocalamites carcinoides* Harris 的，因爲幾乎完全相似的化石也曾發現於格陵蘭的下侏羅紀地層中，和 *N. carcinoides* 相伴生（參看 Harris[52]，1931，pl. V, fig. 1）。標本的直徑爲7.5厘米，節甚短，長僅16毫米，凸肋及凹溝甚爲顯著。凸肋在關節處或作交叉形態或作直通形態。在延長層中此種髓模化石至爲豐富。

地點：宜君縣四郎廟炭河溝。
地層：延長層上部。

(二) 蕨　綱

1. 眞蕨目

紫萁科（即薇科）

屬名 *Cladophlebis* Brongniart

1849. *Cladophlebis* Brongn. Tableau p. 25.

Cladophlebis (*Todites*) *shensiensis* P'an

(圖版 X, 圖 1—3; 圖版 XI, 圖 1—3; 圖版 XII, 圖 1—5; 圖版 XIII, 圖 1—4; 圖版 XIV, 圖 1—5; 圖版 XV, 圖 1—17; 圖版 XVI, 圖 5; 圖版 XVIII, 圖 1—5; 圖版 XIX, 圖 3—4; 圖版 XXI, 圖 5; 圖版 XXVII, 圖 6)

1936. *Cladophlebis shensiensis* P'an, p. 15, pl. IV, fig. 16; pl. V, figs. 4-6; pl. VI, figs. 4-8.
1936. *Cladophlebis* (*Todites*) cf. *roesserti* P'an, p. 14; pl. IV, figs. 11-15; pl. V, figs. 1-3.
1951. *Cladophlebis shensiensis* Sze & Lee, p. 89.
1951. *Cladophlebis* cf. *roesserti* Sze & Lee, p. 89.

關於這一個最易於認識的種，在當前的材料中有數十塊標本，遠超過原著者當時所研究的材料。所有的標本，保存俱十分佳美。若干保存很佳的標本，其小羽片的體積及形態，頗和潘同志原來的標本不同，但葉脈是完全相同的（如本文圖版 XI、圖 1—3 等）。作者當初頗有意爲這些標本另創新的種名，經過相當的考慮以後，決定仍將其歸於此種。因此此種的原來特徵，根據當前的豐富材料，須加以修改及補充。

葉體很大，至少兩次至三次羽狀分裂。最後倒數第二的羽片也很巨大，其長度與寬度俱不明，其寬度至少約爲30－40厘米，中軸甚平、縱紋不顯，寬至少爲13毫米，很遲緩地向頂部狹瘦。最後一次的羽片頗緊擠，線形至披針形（即劍形），緩緩地向前端狹小。其寬度約爲4.5厘米，其長度不明，但至少長約爲15－20厘米。半對生至互生於中軸上，在"葉體"的底部約和中軸成60－80°，在葉體的頂部，約和軸成45°。小羽

片多半是幾乎垂直地着生於羽片軸上,在"葉體"及羽片的頂部,比較斜伸於軸上。在葉體底部,小羽片有時緊擠地排列着,有時亦不甚緊擠,很寬鬆地排着,在"葉體"頂部的小羽片頗互相緊擠,有時甚至互相蓋覆。在羽片頂端的小羽片,其基部互相連接。小羽片俱作全緣形無鋸齒,其前面的側邊很強地向內凹,其後面的側邊很強地凸作弓形,小羽片形態頗有變異,最典型的小羽片幾乎近於正方形至三角形,基部最寬,頂端微向前彎爲鐮刀形,最大的小羽片其長度約爲2.3厘米,寬度爲10毫米,幾乎近於長方形,其基部寬,同樣寬度,直至小羽片頂端三分之二之處始突然收縮,頂端鈍圓,若干小羽片彎作鐮刀形的程度甚強。葉脈顯明,中脈僅微粗於側脈,中脈以極銳的角度,自羽片軸伸出後,即以垂直的形勢,彎向小羽片的前部,中脈到達自小羽片基部向前二分之一或三分之二之處,即因分乂而消散,側脈微彎成波浪形,頗爲特緻,分乂二次至三次,普通多爲三次,最後很少地亦有分乂至四次者,在小羽片基部後邊的第一條側脈,彎曲度頗強,分乂三次,在其基部即初伸出時即分乂一次,然後繼續再分叉二次,很少地最末的另一叉枝叉分叉一次,此第一條側脈看過去,頗似自羽片軸直接伸出,但經仔細視察後,實自中脈的向下延的部分伸出的。實羽片化石,似爲 *Todites* 型式。

最典型的標本,在當前的豐富材料中,僅有一塊,表示在圖版X圖1,1a上。這一塊標本,其小羽片的形態,幾乎近於四方形至三角形,其長度僅微大於寬度,到達頂部時,其後面的邊突然彎向前面,作鈍圓形,其前面的邊微凹而直,這一塊標本的小羽片全部形態和葉脈型式,和潘鍾祥的最典型的標本完全一致(譬如他的圖版VI,圖4,4a.及5,5a.1936)。本文圖版XXI,圖1的標本,也和潘的圖版V,圖4—5及圖版VI,fig.6相同。本文圖版X,圖2;圖4 XI,圖1—3;圖版XII,圖1—4;圖版XIII,圖1—3,其小羽片的形態其長度幾乎大於寬度一倍,幾乎近於長方形,其前端彎作鐮刀形的程度亦甚強,形態甚爲特緻,作者在野外採集時,幾疑此類標本,是一新種。經仔細視察,知其葉脈的型式和 *Cl. shensiensis* 完全相同。作者覺得爲此類標本,創一新的"變種"(Variety)名亦毫無意義,因此類標本,顯然代表着 *Cl. shensiensis* 的葉體(Frond)的底部,故中軸及羽片及小羽片,俱較爲巨大。在材料中還有另外不少標本(如本文圖版XIV,圖3—5;圖版XVI,圖5;圖版XXVII,圖6),頗近似潘鍾祥原先鑑定爲 *Cl.*(*Todites*) cf. *roesserti* Zeiller (non Presl) 的標本(1936, p. 14; pl. IV, figs. 11—15; pl. V. figs. 1—3)但此種標本,顯然仍屬於 *Cl. shensiensis* 的。根據潘鍾祥(1936 p. 16)的討論(1)*Cl. shensiensis* 的小羽片較 *Cl. roesserti* Zeiller 爲寬;(2)*Cl. shensiensis* 的葉脈較後者爲鬆;(3)*Cl. shensiensis* 的側脈彎曲度較後者爲強。作者覺得這三個理由,都不堅強。(1)根據當前的材料 *Cl. shensiensis* 的標本,其長度大於寬度的很多;(2)在東京的材料中經 Zeiller 定爲 *Cl. roesserti* 的標本,其葉脈比較鬆的也很多(譬如 Zeiller 的 pl. II. figs. 3, 3a. 1903);(3)在東京的材料中其側脈彎曲度甚強的也很多(譬如 Zeiller 的 pl. II. figs. 5, 5a, 6, 6a.)根據上述三種理由,本文作者認爲潘同志在延長層中所描述的 *Cl.* cf. *roesserti* 是不存在的,這些標本,應該全屬於 *Cl. shensiensis* 的。

根據 Harris[51](1926, p. 59)的意見認爲越南 Zeiller 在東京煤田所描述的 *Cl. roesserti* 和英國 Yorkshire 中侏羅紀的 *Cl. whitbyensis*(=*Cl. williamsoni*)是沒有區別的,尤其是因爲兩者的實羽片化石是完全相同的。筆者[166]在1931年發表的論文第50頁中亦曾表示將 *Cl. roesserti* Presl 和 *Cl. whitbyensis* Brongn. 合成一種,是頗有可能的,但作者同時亦曾指出,這個問題須徹底檢視一番 Franken 的所有標本,方可決定之。若干其他學者似亦有相同的意見,我們可以在他們的討論中看出來,而在日本學者橫山(Yokoyama)[198]的論文中,我們找到幾塊標本,曾被鑑定爲 *Asplenium roesserti* var. *whitbyensis*(1891, p. 242, pl. 32, figs. 3,3a,4)。根據潘鍾祥的意見(1936 p. 15),認爲 Zeiller 所描述的東京標本和普通所謂 *Cladophlebis roesserti* Presl 是不相同的。他指出:東京的標本,其側脈較緊擠,較彎曲,分叉次數較多,而中脈自中軸伸出後,不久即消失不顯。如果潘氏所指出的意見是可以成立的,那末東京的標本,實在和當前的 *Cl. shensiensis* 頗相接近。是否東京的一部分被定爲 *Cl. roesserti* 的標本,有屬於 *Cl. shensiensis* 的可能呢?比方說,Zeiller 論文的 pl. II, figs. 3,3a. 及 figs. 6,6a. 是的確和我們的材料是相差無幾的。

總之 *Cl. roesserti* 一種,已有不少糾紛,若干學者所定爲 *Cl. roesserti* 的標本,幾乎完全和 Zeiller 的東京標本不相同的,比方說,Harris 所鑑定的格棱蘭東部的標本(1926, p. 57, 插圖 3A—D)。這一個種似須徹底加以整理。

最有意義的是:在當前的材料中,也找到了很多標本,似爲實羽片化石,小羽片幾乎作圓形,葉脈不顯明,

小羽片的全部似爲孢子囊所蓋覆。這些標本（本文圖版 XV，圖 1—16）實在頗和 Zeiller 所研究的東京的被定 *Cl. roesserti* 的實羽片化石，是相近似的，而且實羽片的體積也完全一樣。因爲 *Cl. shensiensis* 的實羽片化石和東京的所謂 *Cl. roesserti* 的實羽片是完全相同的。東京的種，實在也有屬於 *Cl. shensiensis* 的可能的。我們希望在同一地點將來找出更多的同樣的，並且保存較佳的實羽片化石。或多或少地相似的實羽片化石，也發現於日本的成羽區植物經大石[121]（1940, p. 194, pl. III. figs. 1, 1a）定爲 *Todites goeppertianus* (Muenster) krasser。和 Harris（1931, p. 31）一樣，大石也相信 Zeiller 的東京標本所謂 *Cl. roesserti* 是屬於 *Todites goeppertianus* Muenster sp. 的。大石也曾指出（1932, p. 275; 1940, p. 195）越南東京煤田及日本成羽區的 *Cl. roesserti* 是和瑞典、德國以及其他地方的所謂 *Cl. roesserti* 是完全不相同的。而最初（1838）Presl 的"種型"標本所謂 *Alethopteris roesserti* Presl 是一塊不能鑑定的碎片，而若干後來學者所鑑定爲屬於 Presl 的種的標本是代表着另一種蕨類，此種蕨類和 *Todites goeppertianus* 也完全不同的。和 Harris（1926, p. 59）及 Seward（1910, p. 341）一樣，大石也相信 *Todites goeppertianus* 是和侏羅紀的 *Cl. whitbyensis*（=*Cl. williamsoni*）是很相近似的，兩者很難區別，不過大石指出，雖然兩者的實羽片化石大致相同的，但裸羽片是不相同的，在 *Cl. whitbyensis* 側脈較爲簡單（即分叉次數較少）較鬆，彎曲程度較弱，並且中脈直達小羽片的頂端。本文作者也覺得大石所指出的區別是很對的。惟無論如何，陝北延長層所發現的新種 *Cl. shensiensis* 其實羽片也是屬於 *Todites* 的，並且也大致和 *T. goeppertianus* 及 *T. whitbyensis* 是相同的，是很有趣的。應該指出的是：根據實羽片的體積或多或少作圓形的形態，當前的延長層標本，也實在和北美上三叠紀的 *Acrostichides linnaeaefolius*（Fontaine[30], 1883, pl. IX. figs. 1, 1a）的實羽片化石是很相近似的。

潘鍾祥亦曾將他所指的 *Cl. roesserti* 和 Leuthardt[100]（1904, p. 34, pl. XIV; pl. XV, figs. 1, 2）所指的 *Cl. rütimeyeri* Heer 相比較，這一個瑞士 Basel 的上三叠紀種，實在和我們所說的 *Cl. shensiensis* 頗相近似的，尤其是 Leuthardt 論文的 pl. XIV. 所表示的一塊很大而保存很完善的標本，根據幾乎近於四方形至三角形，後面的邊鈍圓而向前彎的小羽片的形態及葉脈的型式和我們的最典型的標本(譬如本文圖版 X，圖 1, 1a 的標本)，更不易區別。是否瑞士的上三叠紀種和我們所說的 *Cl. shensiensis* 可以合成一種呢？我們也暫不作決定，因爲若干瑞士標本，如 Leuthardt 論文的 pl. XV. figs. 1, 2。其小羽片的基部是作收縮的形態，因此這些標本頗接近於 *Cl. lobifolia* Phillips。根據 Leuthardt 論文中的 pl. XV. fig. 1 的標本，其每一羽片的基部的下邊的第一個小羽片的形態，更不甚正常，這一性質也頗和 *Cl. lobifolia* 是相同的。當然將 *Cl. rütimeyeri* 和 *Cl. lobifolia* 合成一種，似乎也不可能，兩者顯然代表着兩種不同的蕨類，而況且 *Cl. lobifolia* 的實羽片化石也已經證實是屬於 *Eobracia* 型式的。

1953 年蘇聯古植物學家 Брик[9,10]（1952, p. 22, pl. VI, figs. 16, 3—7 etc; 1953, p. 15, pl. 21, figs. 1—3）也描述若干哈薩克西部的標本及若干東 ФЕРГАНСКОГО 盆地的標本，定名爲 *Todites roessertii* Zeiller 他的標本似和東京所發現的是相同的。潘鍾祥更將延長的 *Cl. shensiensis* 和格稜蘭東部的 *Cl.* (*Todites*) *goeppertianus* 相比較，根據當前的豐富材料，這兩種的裸羽片差異太甚，是完全沒有相同之處的。

地點：陝西宜君縣四郎廟炭河溝
　　　陝西延長縣七里村及烟霧溝
　　　陝西宜君縣杏樹坪七母橋
　　　陝西綏德縣葉家坪
　　　陝西延長縣烟霧溝
　　　甘肅華亭縣劍溝河
地層：延長層上部
地點：陝西延長縣石家溝
　　　陝西綏德縣沙灘坪
地層：延長層中部

地點：陝西綏德縣高家庵
陝西綏德縣橋上
地層：延長層下部

馬通蕨科

屬名 *Phlebopteris* Brongniart

1928-37. *Phlebopteris* Brongniart Hist. d. Végét foss. P.

1936. Phlebopteris (Bgt.) Hirmer et Hoerhammer emend, Palaeont. 81, B, P. 3.

Phlebopteris? linearifolia Sze 新種.

(圖版 XXVII，圖 7, 7a.)

這一塊標本形態也異常特殊。中軸比較地甚為瘦細寬似僅為1毫米。小羽片（比較妥當的似應稱為羽片）非常緊擠幾乎彼此互相接觸，並且似完全對生於軸上。小羽片為瘦而細長的線形，寬僅3.5毫米，長達5厘米以上，其兩側邊幾乎互相平行，其頂端似為鈍圓形，兩側邊為全緣形無鋸齒。小羽片的基部似向下延於軸上並且各小羽片在其基部似互相連接着。中脈瘦細，僅微強於側脈但甚為明顯最初以一銳角自中軸伸出，伸出後即立刻彎出，直達小羽片的頂端，側脈頗細，亦甚為顯明，排列非常寬鬆彼此互相距離之處幾乎到了2毫米，除小羽片的頂部以外，所有的側脈幾乎完全是規則地分叉兩次，初伸出時即分叉一次到達中途時又再分叉一次，側脈和中脈所成的角度為35—45°。在小羽片頂部的側脈幾乎都是分叉一次後，其前面的叉枝又分叉一次。實羽片化石未曾發現。

在研究材料中僅有一塊標本，是本文作者和關佐蜀同志親自採到的。這一塊標本，很可能的是代表着一個新屬，但材料不足，保存又不完善，保存孢子囊的實羽片化石，又未曾找到，作者等待更佳材料到來時再加詳細的鑑定和描述。根據小羽片的狹細而瘦長的形態此種，似接近於 *Phlebopteris*（即前人所謂 *Laccopteris*），根據側脈的分叉型式，此種植物，接近於 *Phlebopteris münsteri* (Schenk) Hirmer et Hoerhammer，但在後者其側脈並不是規則地作二次分义型式，其側脈分叉一次其後面的叉枝又分叉一次。因此側脈的分义型式和我們的種亦微有不同。

關於 *Phlebopteris* 的各種，前人都誤定屬於 *Laccopteris*。Hirmer 和 Hoerhammer 1936 年徹底地研究和整理舊文獻以後始加以改正。他們找出了 Presl (1820—38) 所創的屬名所謂 *Laccpteris* 是根據一塊完全不能鑑定的碎片的，並且是確實地不屬於 Matoniaceae 科的。而最初完全沒有疑問地屬於 Matoniaceae 科的標本却是 Brongniart[12] (1828—1837) 所創的屬名 *Phlebopteris* 的。自從 Hirmer 和 Hoerhammer[65] 1936 年的重要論文發表以後，所有從前的古植物學教科書及古植物學手册（Handbuch）都須徹底地加以修改，這一種論文，無疑地是古植物文獻中重要的著作。所謂 *Phlebopteris*（即1936年以前所有古植物學家所誤定的 *Laccopteris*）的各種，其蕨葉（frond）都和現代的 *Matonia* 相似，其各羽片是作掌狀地集合於一個公共的主軸（稱之為葉柄更為適宜）上的。並且其囊羣（Sori）是很規則地排列於小羽片的兩側的側脈上的。當前的標本過於破碎不全無法證實其整個"葉體"的形態並且保存囊羣的標本也尚未發現，是否屬於 *Phlebopteris* 當然是不能決定的。關於 Hirmer 和 Hoerhammer 1936 的重要的長篇論文，本文不擬再作詳細介紹，因為這是不在本文範圍以內的。不過應該指出的是已描述的 *Phlebopteris*（即 *Laccopteris*）可分為兩類，一類是有簡單的網脈的如 *Ph. brauni* (Goppert) H. et H. 及其他各種。一類是為羽狀脈的如 *Ph. muensteri* 及其他各種。當前的種以接近羽狀脈的 *Phlebopteris* 各種成份為較多。根據羽片的形態及脈的型式我們的種似最接近於 *Phlebopteris angustiloba* (Presl) Hirmer et Hörhammer，但側脈的分义型式亦微有不同，在 *Ph. angustiloba* 其側脈分义一次後僅其前面的义枝又再分一次的（Lundblad,[102] 1950, pl. 13, fig. 2)。藤岡(Huzioka)[68] 記載一種 *Ph. takahasii* 於日本的上部里阿斯期(1938, p. 143—146 Textfigs. A–C)，這一個

日本種其羽片基部的側脈分乂次數較多而且分乂不甚規則，並且若干支脈也稍有互相結合的傾向。上面已經提及，我們的新種如發現葉體較全及保存囊羣的標本時，可能是一個新屬而不是屬於 *Phlebopteris* 的。Carpentier[15]（1927，p. 27，pl. IV, figs. 1—4）描述一種 *Feronia sewardi* 於 Foron 的下白堊紀初的韋爾登期（Wealden），其羽片極爲狹瘦細長，兩側邊幾乎完全平行和我們的種甚相近似但葉脈型式較爲特緻，有成束的形勢。在同一篇論文中 Carpentier 又描述一種 *Cladophlebis*（cf. *Pteris frigida* Heer）sp.（1927，p. 14，pl. 10，figs. 6—7）這一種也是以狹瘦細長的小羽片爲其特徵的，但葉脈多數是一次分乂的。我們的植物，很可能是不屬於 *Cladophlebis* 的。

地點：宜君縣四郎廟炭河溝。

地層：延長層上部。

2. 眞蕨目，屬於何科未定

Cladophlebis cf. ***gigantea*** Ôishi

（圖版 IX，圖 3,4；圖版 XXIII，圖 3,3a.）

1932. *Cladophlebis bitchuensis,* Ôishi, 1932b, p. 283, pl. VII, fig. 2.
1932. *Cladophlebis bitchuensis* Ôishi, 1932b, p. 284, pl. VII, fig. 1.
1936. *Cladophlebis gigantea,* P'an, p. 17, pl. VII, figs. 1, 1a etc.
1940. *Cladophlebis gigantea,* Ôishi, p. 264.

本文作者在野外採集時，以及進行描述所採的標本時，覺得非常奇怪的，是在當前的材料，並沒有一塊標本代表着 *Cl. gigantea* 一種，而這一種在潘鍾祥所研究的材料，是非常豐富的。最後古生物研究所年青同志周志炎在宜君縣的材料中找出了一塊（本文圖版 IX，圖 4），標本雖非常破碎，但根據小羽片的形態和三次分乂的側脈型式和潘同志的一部分標本是很相近似的（譬如他的 pl. VII fig. 3），後來我們又在延長縣的材料中，又找出了一塊（本文圖版 IX 圖 3），這塊標本更接近於大石的成羽（Nariwa）植物羣的標本，我們在此先描述延長縣的標本。延長縣的僅有一塊標本，係代表"最後一次的羽片"的碎片，中軸寬約 2 毫米，小羽片肌理似甚薄，半對生，在基部最寬，然後漸向頂部狹細，頂端未曾保存，似鈍而圓。小羽片的寬度約爲 1 厘米，長度不明，至少當爲 3 厘米以上，小羽片的邊緣，彎成波浪形並且有成圓裂片（lobes）的傾向。中脈以 45° 自中脈伸出，比較地甚粗而強，頗直，似直達小羽片的頂端。側脈在基部（近於中脈處）分乂一次到達中途時又分乂一次，到達近於邊緣時又分乂一次，共分乂三次，因此每一條側脈形成一束側脈、這一塊標本，根據小羽片的體積及形態，尤其是其彎成波浪形的邊緣，是和日本的標本是完全相同的，作者相信鑑定當可確實無疑，雖然如此，我們也暫加一 cf. 的符號在種名之前，因爲我們僅有一塊標本，而且是一塊碎片。宜君縣的標本，比較不甚標準，因爲和日本的標本相比，小羽片的形態及體積，俱有差異，但上面已經提及和潘同志所研究的材料有一部分是相同的。這也不過是一塊碎片，中軸不到 2 毫米，小羽片的體積較小，寬僅 5—6 毫米，長約 17 毫米，大致爲長橢圓形，頂端鈍而圓微彎成鐮刀形，基部微作收縮狀，邊緣近於全邊形，僅有時極微弱地彎成波浪形，小羽片半對生於軸上，幾乎垂直地着生於軸上。中脈初伸出時，雖以一銳角向下延於軸上，但立刻以一直角的形勢彎向小羽片的頂部，中脈亦比較地粗強。側脈頗細，初伸出時卽分乂一次，然後繼續分乂二次，共作三次分乂狀態。這一塊標本，雖側脈的三次分乂的型式，和日本的標本完全相同，但小羽片的體積和形態，究和日本的不甚相同，這塊標本，種名之前是應該加上一 cf. 的符號的。

潘鍾祥將各種形態及體積不相同的標本，都定爲 *Cl. gigantea*，有些標本，其小羽片寬僅 3 毫米，長不到 5 毫米（譬如他的論文中的 pl. VII，figs. 6—8）有些標本，側脈都作二次分乂型式（譬如他的 pl. VII，figs. 3—5），潘同志相信這些標本，有一部分是代表這一種的"蕨葉"的頂部的，一部分是代表着葉體的中部的。這一個意見，雖然是很可能的，但小羽片的形態及體積以及葉脈旣和日本的標本相差如此之甚（比方說，潘同志

的pl. VII, fig. 4 的標本,甚至其小羽片的頂端尖而銳,深彎作鐮刀形,小羽片的全部形態竟作三角形,至少在鑑定上,應該加以相當的保留。筆者同意大石[121]在 1940 年發表的論文第 265—266 頁所提出的意見,他說:"……更進一步,作者以爲這是很有問題的,是否 *Cl. gigantea* 一種的小羽片的變異的程度,可以達到其體積小到和中國的標本一樣。因此筆者希望將中國的標本,暫時定爲 cfr. *Cladophlebis gigantea* Ôishi, 等待着將來在日本的成羽 (Nariwa) 植物羣及中國的延長植物羣的各地點的更多的保存更佳的標本,能在這些標本中找出滿意的證據,證明這些標本,是同屬一種的。"

潘鍾祥又將大石的在同一地點所描述的 *Cladophelbis bitchuensis* Ôishi 和 *Cl. gigantea* 合成一種,關於這一點大石本人似亦不甚同意,因爲他在 1940 年的"日本中生代植物"[121]的原書中,將此兩種還是分成兩種敍述的 (1940, p. 253 及 p. 264)。他在該書 254 頁中更說道:"潘先生相信 *Cl. bitchuensis* 和 *Cl. gigantea* 是同種的,但這兩種可能是可以區別的,因爲在前者其小羽片是全邊的並且其頂端,比較少作圓形。" 對於這一點筆者和潘同志的意見完全相同,因爲僅僅根據小羽片的形態是一向不能完全作爲分種的根據的。何況日本的 *Cl. gigantea* 小羽片邊緣也僅微彎成波浪形而已,而且此種波形也很寬、很圓,和全緣的,是相差無幾的。我們區別蕨類化石的各種,一向是着重在葉脈的型式的,我們區別古生代的種子蕨化石及蕨類,更是如此。日本的 *Cl. bitchuensis* 及 *Cl. gigantea* 葉脈,俱作三次分叉狀態,型式完全相同,體積也完全相同,因此本文作者認爲將此兩種合成一種,是完全合理的。Ôishi (1940, p. 254) 將 *Cl. bitchuensis* 和 *Cl. haiburensis* 相比,又將 (1940, p. 265) *Cl. gigantea* 和 *Cl. halleiana* Sze (Sze[166] 1931, p. 32, pl. VIII, figs. 1—2) 相比,筆者亦認爲非常勉強,因爲 *Cl. haiburensis* 根本是一個不清楚的種,原著者訂定此種時,其葉脈畫得非常含糊,而且現在原來的種型標本 (type-specimens) 已經遺失,無法再用現代攝影術將其重新攝影公佈於世,筆者在前著中曾再三討論及之。這一個英國侏羅紀種,將永遠成爲含糊的種。而且就是根據原來非常含糊中的圖畫 (Lindley & Hutton,[101] 1837, pl. 187) 這一種似乎其側脈也不是作三次分叉的狀態的。*Cl. haiburensis* L. et H. 的原來種型標本的一小部分,曾被 Brock 畫出,登載於 Seward et Thomas 1911 年的論文第 15 頁上,根據這些圖,這一個種的側脈也以兩次分叉爲主,僅僅是極偶然地有所三次分叉者。 *Cl. halleiana* Sze 的標本,其側脈是作四次分叉的狀態的,小羽片作伸長形比日本的標本要長得多。潘鍾祥將 *Cl. gigantea* 和 *Cl. fukiensis* Sze (Sze[168], 1933b, p. 48, pl. 8, figs. 1—3) 相比,並且認爲此兩種是有很近的親緣關係的。本文作者完全同意此說。

地點: 陝西延長縣七里村。
陝西宜君縣四郎廟炭河溝 (P, I. #)。
地層: 延長層上部。
地點: 陝西綏德縣沙灘坪。
地層: 延長層中部。

Cladophlebis raciborskii Zeiller

(圖版 XXI, 圖 7; 圖版 XXII, 圖 3,3a; 圖版 XXVI, 圖 1—7; 圖版 XXVII, 圖 1—5; 圖版 LIII, 圖 3)

1903. *Cladophlebis raciborskii,* Zeiller, p. 49; pl. V, fig. 1.
1906. *Todites williamsoni* Yokoyama, p. 18, pl. III; p. 20, Pl. V, fig. 1a.
?1911. *Cladophlebis kamenkensis* Thomas, p. 66, pl. III, figs. 1-3.
1922. *Cladophlebis raciborskii* Yabe pl. V, fig. 3.
1931. *Cladophlebis* cf. *raciborskii* Ôishi, p. 234; pl. XVI, figs. 6-6a; pl. XVII, fig. 1.
1932a. *Cladophlebis* cf. *raciborskii* Ôishi, p. 7; pl. II, fig. 1.
1932b. *Cladophlebis raciborskii* Ôishi, p. 286; pl. 28, fig. 1.
1932c. *Cladophlebis* cf. *raciborskii* Ôishi, p. 287; pl. VIII, fig. 3; pl. X, figs. 3-4.
1933a. *Cladophlebis* sp. Sze, p. 13; pl. VI, fig. 8.
1936. *Cladophlebis raciborskii* Zeiller forma *integra* Ôishi & Takahasi, p. 119.

1938. *Cladophlebis raciborskii* Zeiller forma *integra* Ôishi & Huzioka, p. 73.
1952. *Cladophlebis raciborskii* Sze & Lee, p. 23; pl. i, figs. 7, 8.
1953. *Cladophlebis suluktensis* Brick, p. 43; pl. 18, 19, fig. 2.
1955. *Cladophlebis* cf. *raciborskii* Lee, p. 35; pl. 1, figs. 2-8.

在當前的材料中,有十餘塊保存不全,但形態異常標準,葉脈異常顯明的碎片是和 Zeiller 所描述的越南東京煤田的 *Cladophlebis raciborskii* 完全相同的。所有的標本俱代表着最後一次的羽片,其長度不明,其寬度可達7厘米,中軸甚平,達適當寬度,小羽片互生至半對生基部最寬,同樣寬度直至向前端三分之二之處,然後漸漸向頂端狹瘦,頂端鈍尖,頂端多微彎成鐮刀形。小羽片自基部至前端三分之二之處是全緣的,然後微現鈍齒形直至頂端。小羽片的基部的前邊微微地擴張,基的後邊微微地收縮。中脈比較地粗強,頗直和羽片軸成一寬角(±70°)伸出,直達小羽片的頂尖。側脈頗鬆,和中脈大致成45°,所有的側脈,除在小羽片的極頂端部分外,都很規則地分叉二次,小羽片前端的每一鈍齒接受着每一側脈所分出的一束支脈。這一個異常特徵不易認錯的種,其保存最佳的標本,至今仍爲 Zeiller 所研究的越南東京的一塊標本 (1903, pl. V. fig. 1), 因此, Zeiller[201] 所給的種的特徵,特譯述於下:

"葉體顯然是兩次羽狀分裂的,體積可能是很大的,主軸頗平或顯微弱的縱紋。羽片頗直,對生至半對生,羽片的每一半邊寬度約爲25—40厘米,或超過於此。羽片彼此互相緊擠,甚至互相蓋覆。羽片的兩側邊自其基部直到其長度的極大部分,都是互相平行的,然後收縮向前狹瘦,直到頂端。羽片的寬度爲25—60毫米,長度至少爲20厘米,小羽片頗直,互相接觸,頗直或稜稜地向前狹細,小羽片的兩側邊自基部向前到達其整個長度約二分之一之處,是互相平行的,然後收縮向前狹細直至頂尖。小羽片自基部到達其整個二分之一或三分之一之處是全緣的,然後顯出鋸齒形。小羽片的基部的前邊微微地擴張,基部的後邊微微地收縮,各小羽片在其基部很微微地互相連接,其寬度爲5—8毫米,長度爲15—35毫米。每一羽片基部的前邊(即上邊 Anadrome)的第一個小羽片,其長度和其餘的小羽片大致相等,緊緊地貼着或幾乎緊緊地靠近着主軸。中脈顯著直達小羽片的頂尖,在基部初伸出時,微微地向下延於軸上。側脈或多或少地相密生,近於基部時分叉一次,分叉後不遠地每一叉枝又分叉一次,分叉後的叉枝彼此互相接近。"

根據上述的東京標本的"種的特徵",我們知道當前的陝西延長層的無數標本,雖然都是碎片,是和 Zeiller 的種是完全相同,絲毫沒有差異的。羽片的寬度;小羽片的長度及寬度;小羽片的形態;小羽片的前端顯現鈍齒;中脈的比較粗強,並且初伸出時的向下延於軸上,然後突然彎出直達頂尖,側脈的兩次分叉型式,陝西的標本和東京的種,彼此完全一致。更重要的並且更有興趣的是:我們的標本,其小羽片的基部的上邊微微地擴張,其下邊微微地收縮的形態(本文圖版 XXVI, 圖 1, 2)也和東京的種一般無異,此種形態即 Zeiller 所謂"à base légèrement dilatée en avant et contractee en arrière, faiblement soudées entre elles"。所謂 faiblement soudées entre elles 即各小羽片在基部彼此微微地互相連接着,這在我們的標本中,也可以看出來的。

在東亞 *Cl. raciborskii* 一種,除越南東京及陝西延長層外,也被大石[118]描述於日本的成羽 (Nariwa) 植物羣 (1932b, p. 288, pl. 28, fig. 2, 1940, p. 282) 並且被川崎[73]記載於朝鮮 (1925, p. 15, pl. 7, figs. 25—29; pl. 34, fig. 94, 1926, pl. 4, fig. 11)。Kawasaki 的朝鮮標本,多半是不甚標準的,並且其側脈也不是完全兩次分叉的,有些朝鮮標本,其小羽片幾乎完全是全緣形。一部分朝鮮標本如川崎[74], 1926, pl. 4, fig. 11. 可能是屬於 *Cl. raciborskii* forma *integra* 的。成羽 (Nariwa) 植物羣中,除發現標準的標本外,還發現若干化石,其小羽片全部作全緣形,前端並無鋸齒,大石在1932年定此等標本爲 *Cl.* cfr. *raciborskii* Zeiller (Ôishi[118], 1932, pl. XXVI, fig. 3; pl. XXVIII, figs. 3—4), 1938年及1940年改定此等標本爲一變種爲 *Cladophlebis raciborskii* Zeiller forma *integra* Ôishi et Takahasi (Ôishi[120], 1938, p. 119; Ôishi et Huzioka[122], 1938, p. 73; Ôishi[121], 1940, p. 283), 大石認爲 *Cl. kamenkensis* Thomas (Thomas[161], 1911, p. 66, pl. III, figs. 1—3) 及筆者在1933年所描述的四川廣元標本曾定爲 *Cladophlebis* sp. (Sze, 1933a, p. 13, pl. VI, fig. 8) 都屬於此變種。對於這一點,筆者應該利用此一機會表示完全同意,因筆者當時也曾將廣元的標本和 Thomas 的 *Cl. kamenkensis* 及 Zeiller 的 *Cl. raciborskii* 相比較的,並且也曾指出 Thomas 的新種,是否能成立頗有疑問,因爲 Kamenka 的標本也和廣元的標本相同,都是根據保存不佳

的碎片的 (Sze, 1933a, p. 13)。筆者當時又曾經指出:日本學者的所謂 *Cl. haiburensis* L. et H. 至少一部分可能大部分也是屬於這一類型的。譬如大石在 1932 年發表的 pl. 26, fig. 1; 川崎在 1925 年發表的 pl. 5, figs. 16,17,19; 1926 年的 pl. 2, figs. 4—6 的許多標本。關於這一點大石在 1940 年論文中,却並沒有表示意見。 1952 年蘇聯古植物學者 **Брик** 在東 ФЕРГАНСКОГО 煤田所描述的 *Cladophlebis suluktensis* Brick (1953, p. 43, pl. 18, pl. 19, fig. 2) 根據羽片及小羽片形態及體積以及葉脈的型式,似乎也是屬於大石所敍述的 *Cl. raciborskii* forma *integra* 同一類型的,因爲其小羽片的前端亦無鋸齒。Brick 自己也曾經將他的標本和 *Cl. kamenkensis* Thomas 及 *Cl. raciborskii* 相比較的。**Брик** 也許尙未看到大石的論文。

和 *Cl. denticulata* 一樣,小羽片的邊緣是否有鋸齒,並不是作爲分成變種的根據的。因此作者認爲 *Cl. raciborskii* f. *integra* 的學名,是沒有成立的必要的。

Cl. raciborskii 最近被李星學[95]敍述於晉北大同煤田的雲崗統 (李星學, 1955, 第 35 頁)。其層位高於普通的大同煤系。雲崗統的時代,李星學定爲中侏羅紀 (參看本書第 91 頁表 3)。

根據小羽片的形態及葉脈的型式,大石在 1940 年的論文 p. 288, pl. 21, figs. 4, 4a 在日本下白堊紀 Ryoseki Series 的 *Cladophlebis takezakii* Ôishi 也大致可以和當前的標本相比較的,這一個日本下白堊紀種,根據 Ôishi 的描述,其小羽片的前端也顯出鈍齒,並且每一鈍齒,也接受着一個側脈所分出的一束支脈,並且每一側脈也分叉兩次,其中脈也甚明顯,並且直達小羽片的頂尖。 僅有的區別是在其小羽片長得多,並且側脈密得多。其地層時代旣相差甚遠,本文作者也同意爲日本的下白堊紀標本創一新的種名,大石本人未將此種標本和 Zeiller 所敍述的種相比較,而兩者形態的相同之處,實在令人注意。

地點: 宜君縣,四郎廟的炭河溝。

地層: 延長層上部。

Cladophlebis kaoiana Sze 新種

(圖版 XIX, 圖 1, 1a, 2 圖版 XX, 圖 1—3; 圖版 XXII, 圖 1, 1a)

關於這一個新種,當前的材料相當豐富,保存都異常佳美,葉體至少兩次羽狀分裂。 最後倒數第二的羽片,寬度至少爲 20 厘米,長度不明; 中軸比較地狹瘦,寬不到 3 毫米,其上有極細但極顯明的縱紋; 最後一次的羽片對生至半對生,和中軸成 45°,長度爲 8—10 厘米,寬度爲 20—24 毫米,線形至披針形 (卽劍形),其兩側邊大致互相平行,到達頂部便突然收縮,其頂端可能是很尖的,羽片軸亦頗瘦細,頗平,亦有極細的縱紋,自基部很緩緩地向頂尖狹細;小羽片互生非常緊擠,普通其寬度爲 5—6 毫米,長度爲 15 毫米,兩側邊幾乎相平行,頂端鈍而尖,微彎成鐮刀形,小羽片和軸大致成 45°。 中脈亦比較狹細,但非常顯明,以 45° 的角度自羽片軸伸出,緩緩地向前狹細,幾乎直達小羽片的頂端;側脈亦狹瘦,亦非常明顯,不甚緊密,亦以大致 45° 的角度自中脈伸出,側脈普通都分叉兩次,近於小羽片最頂端的側脈普通分叉一次,在小羽片基部及中部的側脈初伸出時卽分叉一次,到達中途時又分叉一次,在小羽片前部的側脈,普通自伸出後到達中途時,始分叉一次,到達小羽片的邊緣時又再分一次。所有小羽片都是全緣的,其肌理 (texture) 似非常薄弱的。各小羽片在其基部又似互相連合着的,在羽片頂部的各小羽片,其連合的程度更強,看過去好像變成羽片的裂片 (lobes) 一樣。 位在羽片基部的前邊卽上邊 (anadrome) 的第一個小羽片比較成長方形或長橢圓形, 大致和主軸相平行; 位在羽片基部的後邊卽下邊 (catadrome) 的第一個小羽片比較微短, 微寬較作鈍圓形和主軸大致成 35° 或 45°。

這一個新種,以其小羽片肌理的薄弱,中軸的狹瘦而苗條,中脈及側脈的狹細而顯明,給人以一種非常雅致的印象。雖然大致同樣型式的 *Cladophlebis* 前人已不知描述了多少種,本文作者仍相信當前的標本是代表着一個新種。 *Cladophlebis* 各種的糾紛情況,前人已指出很多。因此與其將當前的標本,隨便地定一個舊種名,不如另創一個新的種名,因爲這樣做,至少可以不在已經存在着的無數糾紛中,再加上新的糾紛。

很可能的無數前人所鑑定 *Cl. nebbensis*, *Cl. haiburensis* 的一部分標本,有屬於此種的可能的。甚至一

部分前人所定的 *Cl. whitbyensis* (=*Cl. williamsoni*) 的標本,也有屬於此種的可能的。

這一個新種,作者贈榮譽於高振西同志: *Cladophlebis kaoiana* Sze sp. nov. 高同志的自我刻苦的精神,一向為同人所敬佩。

地點: 陝西宜君縣四郎廟的炭河溝。

地層: 延長層上部,

Cladophlebis graciles Sze 新種

(圖版 XXIV, 圖 1, 1a, 2, a; 圖版 XXV, 圖 1—4)

這一個形態異常雅致的新種,在我們的材料中,我找到了好多塊。葉體至少兩次羽狀分裂,最後倒數第一的羽片寬至少為12厘米,長度不明,主軸雖不甚寬,但甚為堅強,表面似頗為平滑,有時也現出一條凸肋。主軸寬約3厘米,向頂部緩緩地狹細。最後一次的羽片,對生於主軸上,亦有半對生者,線形至披針形,其長度至少為7厘米。基部最寬,緩緩地向頂部狹細,頂端甚為尖銳,中軸亦甚為緊強,自主軸以45°的角度伸出直到羽片的頂端。羽片軸彼此互相距離之處,大致甚為固定,普通彼此互相距離之處,約為15毫米,各羽片的佈置因此比較地甚為緊擠。羽片的寬度在其基部約為15毫米。小羽片甚小,俱為全緣形,寬度約為4毫米,長度約為5毫米,形態大致為斜方形或半四方形 (subquadrate) 頂端普通鈍而圓,微向前彎,因此小羽片的前邊較直,後邊較彎。小羽片互生至半對生於軸上,甚為緊擠,各小羽片的基部似互相連合着,在羽片頂端的各小羽片其基部連合的程度更強。中脈甚細,但極明顯,和軸成45°,基部較粗,直達小羽片的頂端。側脈較中脈更細,但亦甚為顯明,不甚緊密,在小羽片基部及中部的側脈,俱分义兩次,在小羽片頂部的側脈,普通僅分叉一次,很偶然地分义一次後,其另一支脈又再分一次。側脈多半亦以45°自中脈伸出。在羽片基部的後邊(即下邊)的第一個小羽片似較寬,較圓,並且較近於三角形,此小羽片的形態,較其餘的小羽片微有差異。此小羽片和主軸大致成45°。實羽片化石,未曾發現。

多數標本,俱甚為破碎,保存最為完善的兩塊標本(代表着正負兩面 Part and Counterpart) 表示在圖版 XXIV 圖 1, 2 上,當前的新種,形態異常雅致,雖保存於粗的砂岩上,但葉脈甚為清晰。在文獻中所已經描述的各種,很少有可和當前的新種相比較者。僅有的一種,大致可和我們的種相比較的,是 Fontaine 所描述的北美 Virginia 州上三叠紀中部的 *Cladophlebis microphylla* Fontaine (1883, p. 51, pl. XXVII, fig. 2)。這一個北美種,正如種名 *microphylla* 所含意,也以較小的小羽片,令人注意,羽片的長度及寬度亦大致和我們的種相等,亦甚緊擠,亦以45°自主軸伸出,亦為線形至劍形,基部為最寬漸向頂部狹細。小羽片的長度和寬度及其大致為斜方形或半四方形的形態,並且其基部互相連合的形態,亦和我們的種完全一致。最重要的區別,似在其葉脈,根據 Fontaine 的描述及其圖版 27 圖 2a 的放大圖所表示,北美的種,其中脈以其基部為最粗,伸出小羽片的中部時,即因分叉而消散。所有的側脈,都完全為一次分叉,絕無兩次分叉者。另外一個北美上三叠紀種,大致可以和我們的種相比的是 Fontaine[30] 所說的 *Cladophlebis ovata* (1883, p. 50, pl. 26, fig. 5; pl. 27, fig. 3)。這一個種根據原來的描述,其小羽片的肌理似甚厚 ("thick in consistency"),小羽片似微大於我們的種,並且各小羽片的基,是不相連合的 ("separate at the base"),葉脈不甚明顯,根據原來的描述是埋入於小羽片厚的肌理之中 ("immersed in the thick leaf substance of the pinnules")。但根據描述及 Fontaine 的圖版 26, 圖 5a, 中脈到小羽片的前部,即因分叉而消失,側脈僅在小羽片最基部的一條側脈為兩次分叉,其餘的都為一次分叉,很偶然地有一條側脈,分叉一次後,其另外的一枚叉枝又分叉一次。因此這一個北美種似乎和我們的新種比較不甚相接近的。

地點: 宜君縣杏樹坪黃草灣的七母橋(採集者斯行健,關佐蜀,另一碎片化石,採集者黃劭先)。

地層: 延長層上部。

Cladophlebis ichünensis Sze 新種

(圖版 XVIII, 圖 10—11. 圖版 XXVIII, 圖 1—2. 圖版 LIII, 圖 4)

蕨葉 (frond) 的體積和形態尚未明白,葉體至少爲兩次羽狀分裂。 中軸比較地粗強, 寬至少爲 3 毫米。羽片爲線形,其兩側邊幾乎互相平行,寬度約爲 18 毫米,長度不明, 羽片軸亦頗粗,幾乎垂直地着生於主軸上。 小羽片頗緊擠,幾乎互相接觸着, 和羽片軸成 60—70° 基部微向下延,小羽片作長四方形或長橢圓形,頂端鈍而圓,微作鐮刀形,其最大的長度約爲 11 毫米,最大的寬度約爲 4 毫米。葉脈頗鬆,非常顯明,中脈比較地粗強以一銳角向下延於軸上,然後向外彎出,頗直,幾乎以同樣的粗度直達小羽片的頂部,側脈頗鬆,較細,但極爲顯明,最先以 40° 的角度自中脈伸出,即向外彎伸,到達邊緣時和邊成 50°。 幾乎所有的側脈都明顯地作一次分义狀態,所有的側脈在其基部分义一次後幾乎不再分义,僅在小羽片的基部的第一條側脈分义一次後很偶然其前面的一條义枝再分义一次;很偶然地此第一條側脈分义一次後其後面的义枝又分义一次。小羽片的下半部(卽後半部),基部第一條側脈似直接從中軸伸出,但此側脈顯然是着生於中脈的向下延的部分的。這一條側脈自伸出後其彎曲度頗強。實羽片化石未曾發現。

標本雖不多,更甚破碎,但形態頗且特徵。此種標本如發現於古生代地層古植物學者將毫不猶豫地定爲 *Pecopteris*.

可能前人所定的 *Cl. nebbensis* 的標本的一部分是屬於此種的。

地點: 宜君縣杏樹坪黃草灣七母橋。(採集者: 湯任先同志)
地層: 延長層上部。

Cladophlebis stenophylla Sze 新種

(圖版 XXI, 圖 1—4)

蕨葉體至少兩次羽狀分裂;最後倒數第二的羽片大致爲線形其寬度約爲 7—8 厘米,主軸甚堅強,上有縱紋。 最後一次的羽片,和主軸成 45°, 頗堅擠,彼此互相緊觸或微微地相離,線形,或線形至披針形 (卽劍形) 緩緩地向頂端狹細,頂端似爲鈍圓形。小羽片亦互相緊擠,邊和邊相接觸,和羽片軸約成 70°, 小羽片互生至半對生,甚小,作長四方形,頂端爲寬圓形,其長度約爲 6 毫米,寬度約爲 2.5 毫米。中脈狹細,側脈和中脈約成 60—70°, 微彎,普通分义一次,不甚緊擠。

此一新種以小羽片的狹瘦及緊擠爲其特徵,中生代的各種 *Cladophlebis* 很少有和此可比較者。 根據羽片及小羽片的體積,本文作者描述的內蒙(綏遠)下侏羅紀的 *Cladophlebis arguta* (L. et H.) Halle (Sze[168], 1933b, p. 24, pl. 4, figs. 1—4) 似和此種或多或少可互相比較,但在 *Cl. arguta* 小羽片形態微有不同,若干小羽片其基部作收縮狀態(或多或少成 neuropteridisch 形態),其兩側邊有時微彎成波浪形,其頂端作鈍圓形,但亦有作尖銳形者。 側脈以一直角自中脈伸出, 多數雖僅分义一次,但在小羽片基部的側脈多爲二次分义。

地點: 宜君縣杏樹坪黃草灣七母橋。(採集者: 湯任先)
地層: 延長層上部。

Cladophlebis paralobifolia Sze 新種

(圖版 XXII, 圖 2,2a. 圖版 XXIII, 圖 1.)

這一個新種發現於陝西延安縣的延長層中,詳細地點未明,係石油管理局地質調查隊 1953 年 6 月 13 日所採集。標本的反面,還保存着甚佳的 *Thinnfeldia rhomboidalis* Ettingshausen (本文圖版 XLII, 圖 3)。標本

雖僅有一塊但形態頗具特徵。"葉體"至少爲兩次羽狀分裂,主軸比較地粗而寬,寬約4毫米,甚平,微顯極細的縱紋,正中有一條直的中肋明顯地凸起。最後倒數第二的羽片似爲線形長度不明,其寬度至少爲10厘米,可能保存較全時,其寬度當在14厘米以上。最後一次羽片爲線形至劍形(卽披針形),幾乎是對生於主軸上。羽片軸以一很寬的角度自主軸伸出,羽片軸亦相當堅強,平而直。小羽片爲卵圓形至或多或少地長三角形,頂端鈍圓偶然地亦有微尖者,其長度大致爲6—10毫米,其寬度在基部爲4—4.5毫米,各小羽片在其基部互相接合着,基部的前邊有時微微地收縮,基部的後邊微向下延。中脈和側脈的粗度幾乎大致相等,葉脈俱甚細,但極顯明。中脈以一極銳的角度自中軸伸出後,以一極微的彎曲度彎向小羽片的前端;在羽片頂部的小羽片其中脈自伸出後亦有以幾乎相同的角度直伸向前者。側脈甚鬆亦以銳角自中脈伸出。在小羽片基部的側脈多作兩次分义狀;在小羽片中部的側脈有時分义一次,有時分义一次後,其前面的义枝又分义一次,在小羽片頂部的側脈,都僅分义一次。在小羽片基部的第一條側脈常分义兩次。在羽片基部下面的第一個小羽片有時其形態和其餘的小羽片微有不同。實羽片化石未曾發現。

經過相當長的考慮,本文作者始定此僅有的一塊標本爲一新種,正如種名 *Paralobifolia* 的含意,這一個新種是接近於 *Cladophlebis lobifolia* Phillips 的。但在後者,小羽片的體積多數的標本較小,作印圓及三角形的程度亦較強,同時各小羽片的基部是多數不互相接合,小羽片基部的前邊的收縮程度亦較。多數標本的小羽片的排列似亦較鬆,不若當前標本的互相堅擠,同時各羽片的基部的上邊及下邊的第一個小羽片作極不正常的形態,其體積較其餘的小羽片大得多。另外一個印象,是當前的標本其小羽片的肌理(texture)似甚薄,而在 *Cl. lobifolia* 小羽片的肌理是比較甚厚的。還有如某一地點發現 *Cl. lobifolia* 的裸羽片化石時,也常常同時發現 *Cl. lobifolia* 式的實羽片化石。有時甚至在同一蕨葉(frond)上,其羽片的中部及前部保存着 *Eboracia* 式的實小羽片化石,其羽片的基部保存着普通的 *Cl. lobifolia* 式的裸小羽片化石(如 Raciborski[134], 1894, pl. 12, fig. 1)。而此種實羽片化石在當前的材料尙未找到。根據上述種種理由作者覺得將前的標本定 *Cl. lobifolia* 似乎尙須加以相當的保留。最有意思的是根據 Thomas[181] (1911, p. 65),最佳美的 *Cl. lobifolia* 的標本是 Raciborski 所描述的。我們查一查 Raciborski 的各圖,覺得他論文的 pl. XI, fig. 6 的標本大致可以和我們的標本相比較的。兩者的主軸的寬度及其正中凸起的中肋都是相等的;羽片及小羽片的形態及體積也大致是相等的;葉脈的型式也大致相同的。並且小羽片也是很緊擠的,而各小羽片的基部在 Raciborski 的這一塊標本,也是或多或少地互相連接着的,僅有的區别是在 Raciborski 的這一塊標本,其小羽片的側邊微彎成波狀;並且頂端較尖,作三角形的程度較甚。另外在同一塊標本上,還保存着幾枚 *Eboracia* 式的實羽片化石。

地點:陝西省延安縣,詳細地點不明,根據岩層性質確屬於延長層。
地層:層位不明。

Cladophlebis suniana **Sze 新種**

(圖版 XVIII, 圖 7—9)

根據羽片及小羽片的形態及體積,圖版 XVIII,圖 7—9 所表示的三塊碎片,頗接近 *Cladophlebis grabauiana* P'an 僅葉脈微有區别。在 *Cl. grabauiana* 側脈多數爲兩次分叉(P'an, 1936, pl. IX, fig. la)並且也有側脈分叉一次後其前面的义枝又分义一次(參看 P'an 1936, pl. X, fig. 4b)在我們的標本半數的側脈是不分义的,半數的側脈僅分义一次,絕無分义一次後其前面的义枝又分义一次者。此外還有一個重要的區别,卽在我們的標本上,小羽片的基部的下邊(卽後邊)第1條側脈自中脈的向下延的部分伸出,這一條側脈彎曲度甚強幾乎和中脈相平行,普通爲分义一次,亦有不分义者。更須指出的是在我們的標本上每一小羽片的基部的上邊(卽前邊)的第一條側脈,以一銳角自中脈伸出卽以同一方向彎向邊緣,這一條側脈是不分义的,幾乎沒有例外。作者細察潘的圖影並曾檢視原來的種型標本,覺得在 *Cl. grabauiana* 其小羽片的基部的下邊並沒有從中脈的向下延的部分伸出的一條側脈,並且其小羽片的基部的上邊(卽前邊)的第一條也都是

作分乂一次的形態的。因此我們不能毫不保留地定當前的標本爲 *Cl. grabauiana* P'an。玆定當前的標本爲 *Cladophlebis suniana* 贈榮譽於已故的孫健初同志。令人注意的,在我們所研究的材料中,雖經仔細視察尙未能找出和 *Cl. grabauiana* 完全相同的標本。玆將這一個新種的特徵描述於下:"葉體"至少爲兩次羽狀分裂。中軸狹瘦但甚堅強。羽片爲線形至劍形,頂端未曾保存,可能爲鈍圓形,互生於中軸上和中軸大致成 45°。小羽片緊擠,其基部似互相連結,頂端鈍圓。葉脈顯明,中脈向下延於羽片軸上直達小羽片的頂端,側脈微瘦於中脈,微彎不甚密,有不分乂者,有一次分乂者。在小羽片基部的下邊(卽後邊)的第一條側脈自中脈的向下延於軸上的部分伸出,彎曲度甚強,普通作分乂一次形態,亦有不分乂者;在小羽片基部的上邊(卽前邊)的第一側脈以一銳角自中脈伸出卽以同一方向伸向邊緣,到達邊緣時又微向上彎和邊成一銳角,這一條側脈幾乎沒有例外是不分乂的。

地點:陝西宜君縣杏樹坪草灣七母橋。
地層:延長層上部。

Cladophlebis sp. a

(圖版 XVIII,圖 6)

圖版 XVIII 圖 6 所表示的一塊很小的碎片根據葉脈的型式近於 *Cl. shensiensis*,但側脈比較密得多。同時其鈍而圓的小羽片的頂端亦微作尖針狀態(mucronate)這一種可能是 *Cl. shensiensis* 的一個變種,但標本究竟太破碎了,我們定爲 *Cladophlebis* sp. a

地點:陝西宜君縣四郎廟,炭河溝。
地層:延長層上部。

Cladophlebis sp. b.

(圖版 XXVIII,圖 4, 4a;插圖 1,見第 69 頁)

在圖版 XXVIII,圖 4, 4a 所表示的碎片,小羽片異常特殊,在羽片左邊的小羽片頗大,作三角形,其上邊(卽前邊)幾乎是垂直地着生於軸上,下邊(卽後邊)頗彎曲,並且在基部微微地收縮。中脈不明顯,因此葉脈作放射脈型式,所有葉脈分乂一次或兩次,彎向小羽片的兩側邊及頂部。最奇怪的是在此羽片中軸碎片的右邊似尙着生一比較正常的羽片碎片,還保留着 1—2 枚,很小的小羽片。在此種很小的小羽片中,葉脈仍作羽狀脈形態。

這一塊標本異常特殊,我們將其敍述及記載,僅僅是因爲將來參考方便起見,我們等待着將來保存較完善的材料的到來。

地點:宜君縣四郎廟炭河溝。
地層:延長層上部。

屬名 *Sphenopteris* Brongniart

1822. *Filicites* (sect. *Sphenopteris*) Brongniart p. 33.
1826. *Sphenopteris* Sternberg, I, fasc. 4, p. XV, Brongn. Prodr. p. 50.

Sphenopteris sp. (cf. *Sph. arizonica* Daugherty)

(圖版 XXVII,圖 8, 8a)

在作者所研究的材料中,有幾塊 *Sphenopteris* 的碎片,都不能作正確的鑑定的。很可能的在延長植物羣

中，有兩種至三種 *Sphenopteris*.

圖表 XXVII，圖 8，8a 所表示的碎片，是比其餘的碎片，保存略佳，但還是不能鑑定的。蕨葉（frond）作兩次分裂狀態。中軸頗細，寬不過 1 毫米。羽片互生至半對生，最初以一銳角自中軸伸出，然後以一垂直的形勢或較寬的角度向外彎出。羽片爲卵圓形及線形至劍形，其中軸亦頗狹細。小羽片作卵圓至圓形，互生至半對生，以一頗寬的基部着生於羽片軸上，其基部的後邊（卽下邊）微向下延，前邊（卽上邊）微作收縮狀。葉脈不甚明顯。中脈以銳角自軸伸出，然後向外彎出；側脈頗鬆，有分乂一次者，有不分乂者。

根據羽片及小羽片的形態及脈的型式，我們的標本頗似北美亞利桑那州上三叠紀的 *Sphenopteris arizonica* Daugherty（1941，第 99 頁，圖版 19 圖 3，4）；但根據 Dautherty 的描述及其圖版，北美的上三叠紀種，其蕨葉及羽片的中軸都比較寬而粗，並且微微地彎曲，因此可能是和我們的種不相同的。根據小羽片的形態及體積，及其基部的着生狀況，我們的種也大致和澳州下白堊紀的 Burrum 植物羣中的 *Microphyllopteris gleichenoides* O. & M.（Walkom[187]，1919，圖版 2，圖 6）可以相比較的；但這一個澳州的下白堊紀種，顯然是和我們的種不相同的，因爲其最後一次的羽片，是作狹長的線形至劍形的，並且是密密地着生於中軸上，羽片和中軸所成的角度是完全作垂直的方向的。

和北美的上三叠紀種 *Sph. arizonica* 一樣，當前的種保存孢子囊的實羽片，也尙未找到。因此其眞實的地位，尙未能決定。但這樣的種，顯然是不會屬於種子蕨的。Seward 曾經說過（1931，第 269 頁）所有中生代以及中生代以後的 *Sphenopteris* 都是蕨類（Ferns）植物。Daugherty[21] 却相信古生代的若干屬於種子蕨 *Sphenopteris* 的葉部化石一直生存至於三叠紀，不是不可能的（1941，第 99 頁）。本文作者認爲像當前的化石以屬於蕨類的成份爲最大，北美上三叠紀的 *Sph. arizonica* 似乎也不是種子蕨。

地點：陝西延長縣七里村。

地層：延長層上部。

Sphenopteris? *chowkiawanensis* Sze 新種

（圖版 XXVIII，圖 3，3a）

下面所描述的化石，雖僅有一塊標本，並且標本也很破碎，但形態異常特殊，作者決定此爲此種化石另創一個新的種名。

蕨葉（frond）作兩次分乂狀態。中軸比較地寬粗，其表面異常平滑，無縱紋及其他痕跡。最後一次的羽片和中軸成寬的角度，互生於中軸上，其羽片軸亦比較地寬粗，表面亦甚平滑。羽片寬約 9 毫米，長度不明，其兩側邊似乎是互相平行的。小羽片或多或少爲圓形，基部似不甚收縮，彼此互相緊擠。葉脈異常特緻，每一個小羽片的基部僅有一條葉脈以一銳角自羽片軸伸出後，立刻分乂，然後每一乂枝再繼續地分乂兩次至三次，因此每一個小羽片的邊緣普通有 8 條葉脈。有時多至 14 條葉脈。

我們在已經出版的文獻中，沒有找到可以和當前的種相比較的舊種，因此知道它是一個新種。因爲小羽片中並沒有中脈，這一個種是否屬於 *Sphenopteris* 在目前尙須加以保留的態度。

應該指出的是：當前的化石，根據小羽的形態以及其葉脈的型式都很似 Harris[51] 1926 年論文第 55 頁定爲 *Todites* cf. *princeps* 的一個插圖（Harris，1926 第 55 頁插圖 2A.）的。但我們的化石，其小羽片的體積大於格林蘭的標本 3 倍以上，因此兩者可能不是同種的。並且在同一地點中，我們也尙未找到 *Todites* 式的實羽片化石。

地點：陝西延長縣周家灣，標本係石油總局送來鑑定者。和本書第 63 頁所描述的 *Taeniocladopsis rhizomoides* 新屬，新種是在同一層位中所發現的。

地層：層位不明。

未曾鑑定的裸羽片 (Undetermined sterile pinnae)

(圖版 XXVIII, 圖 5,6)

圖版 XXVIII, 圖 5,6 所表示的兩塊裸羽片化石,因為保存太不完全,是根本不能鑑定的。但羽片和小羽片的形態似甚為特殊,沒有問題是代表着一個新種的。羽片軸比較地頗寬,表面頗平直。小羽片幾乎是完全對生於羽片軸上的,普通幾乎是和中軸成一垂直的角度,亦有斜着伸出者。多數的小羽片其形態頗似 *Cladophlebis*, 其基部也是全部着於羽片軸上不作收縮的形態。中脈頗粗直達小羽片的頂端。側脈型式亦頗似 *Cladophlebis*, 在小羽片基部的側脈有分叉三次者,普通的側脈分叉兩次。

地點: 陝西葭縣大會坪。
地層: 延長層下部。

3. 觀音座蓮目

觀音座蓮科

屬名 *Danaeopsis* Heer

1864. *Danaeopsis*, Heer, p. 54; pl. 2, fig. 5.
1876-77. *Danaeopsis*, Heer, p. 71; pl. 24, fig. 7.

Danaeopsis fecunda Halle

(圖版 XXIX, 圖 1—2; 圖版 XXX, 圖 1—4; 圖版 XXXI, 圖 1, 1a—1f; 圖版 XXXV, 圖 5;
圖版 XLIII, 圖 1; 圖版 LII, 圖 4)

1921. *Danaeopsis fecunda* Halle, p. 6, pl. 1, figs. 1-3.
1927. *Danaeopsis fecunda* Halle, Hirmer, p. 595, figs. 714-716.
1936. *Danaeopsis* (*Pseudodanoeopsis*) *hallei* P'an, p. 24, pl. VIII, fig. 8; pl. X, fig. 3; pl. XI, figs. 1, 2.
1950. *Danaeopsis fecunda* Halle, Lundblad, p. 17.
1951. *Danaeopsis fecunda* Halle, Sze & Lee, p. 86-91, pl. 1, figs. 1-9.
1952. *Danaeopsis marantacea* (Presl) Heer, Brick, p. 15, pl. 1, fig. 6; pl. IV, fig. 7.
1952. *Danaeopsis emarginata* Brick, p. 16, pl. 1, figs. 1-3.
1954. *Danaeopsis fecunda* Halle, P'an, p. 211.

這一個異常少見的種,直至今日,僅發現於瑞典的瑞底克地層及中國北方的延長層中。蘇聯東哈薩克的下中生代似亦有所發現(參考異名表), 在中國北方此種現已發現於陝西的延長縣、淳化縣、宜君縣、耀縣、麟遊縣、葭縣,山西的臨縣,甘肅的武威縣,可能在陝西其他各縣的延長層中還陸續可以發現。這一個種的直的分佈似亦甚長,曾分佈於延長層的下部中部及上部各層位中, 最近據潘鍾祥的論文, 此種亦發現於陝北的瓦窰舖煤系中。

1936 年潘同志研究陝北延長層化石時尚未發現保存孢子囊的實羽片化石, 潘鍾祥當時定此種的裸羽片化為*Danaeopsis* (*Pseudodanaeopsis*) *hallei* n. sp. 解放前後的幾年中, 李樹勳、何春蓀、劉增乾、張爾道、田在藝、張傳淦、梁建式等在甘肅東部及西部的延長層中, 曾發現此種的裸羽片及實羽片化石。 實羽片化石的孢子囊的形態,體積以及其排列於羽片反面的情況完全和在瑞典 Scania 所發現者相同。斯行健和李星學[79] 1952 年的論文,對於此種曾有極詳細的描述和討論,曾將此新種改正為 *D. fecunda* Halle. 這一個意見潘亦表示完全同意 (1954. p. 211)。

根據甘肅所發現實羽片及裸羽片化石及當前的陝西的山西的裸羽片化石,筆者將 Halle 1921 年及潘鍾

祥在1936年所描述的"種的特徵"特略加補充叙述於下：

種的特徵：蕨葉(frond)很大，羽狀分裂，中軸甚厚，寬約2.5厘米，羽片有分離甚遠者，亦有較爲緊擠者，作寬的劍形至線形，以一寬角自中軸伸出，在葉體上部及頂部的羽片則以銳角自軸伸出(和軸大致成45°)。羽片的寬度普通爲2—3厘米，亦有寬至6厘米者，長度不明，有長至18厘米尚未保存完全者，其最寬處似在中部，向兩端極微地緩緩狹瘦，頂端似作鈍的寬圓形，其基部的上邊及下邊普通作收縮形，但亦有向下延於軸上者。羽片作全邊形，葉膜似不甚厚。葉脈極爲顯明，中脈比較地寬厚，若干標本其中脈在羽片基部有寬至7毫米，在羽片中部寬至4毫米，在羽片的頂部寬至2.5毫米者。中脈頗平而直，上有3條較顯明的縱紋及無數很細的縱紋。側脈不甚緊擠，但亦不甚密，以一銳角自中脈伸出卽以或多或少垂直的形勢彎向邊緣，在羽片頂部的側脈較爲斜伸。幾乎所有的側脈，都是在初伸出時卽分叉一次，每一叉支到達中途時有時再分叉一次，有時不再分叉，到達邊緣時，側脈及其支脈常互相結合而成鬆的網脈。亦有少數側脈在初伸出時並不分叉，到達中途時方始分叉者。在若干羽片的向下延的部分上的側脈是直接從中軸伸出的。實羽片的形態大致和裸羽片相同，孢子囊保存在羽片的背面，除出中脈以外，羽片背面的全部幾乎全爲孢子囊所佔據。每一囊羣(Sorus)有兩行孢子囊，孢子囊作橢圓形，各孢子囊直至基部不互相接合，孢子囊面上有一條縱溝表示成熟時分裂的線，孢子囊的頂部有一小而圓的淺窪，孢子囊的體積爲0.80—0.90 × 0.65—0.75平方毫米。

實羽片的詳細形態，詳細敘述於Halle[48] 1921年的論文及斯行健和李星學[178] 1951年的論文中。

潘鍾祥[127]所描述的裸羽片化石(1936, pl. X, fig. 3; pl. XI, figs. 1—2)及斯行健和李星學所描述的裸羽片化石(1951, pl. 1, figs. 1—4)根據羽片的體積(長度及寬度)的脈的型式，沒有疑問是和Halle[48]所描述的瑞典Scania的裸羽片化石(1921, pl. 1, fig. 1)是完全一致的，尤其是潘的pl. X, fig. 3以及斯行健和李星學的pl. 1, fig. 4的兩塊標本羽片的基部的上下兩邊，都作收縮狀和Halle在種的特徵更完全相同。"with a rounded non-decurrent base"。因爲甘肅武威的完全相同的實羽片的發現，我們知道中國和瑞典的標本的同屬於一種是毫無疑問的。若干中國標本其羽片在基部向下延於軸上和Halle所描述的一塊標本不符，斯行健和李星學在1951年的p. 88曾經指出，在瑞典Scania的繼續的採集標本一定可以找出和此類似的化石的。最有意思的，在當前的材料中保存最佳的幾塊化石是本文圖版XXIX圖1,2的幾塊標本，這幾塊標本的羽片的體積頗爲巨大。圖版XXIX圖1, 1a, 1b的一塊標本寬至6毫米，長達18厘米還未保存完整。根據羽片的體積及形態，這幾塊化石實在和*Danaeopsis*的另一種卽*D. marantacea* Presl相似而尤其和Leuthardt[100]所描述的瑞士Basel的上三叠紀標本更相接近(1904, pl. XIII, figs. 1—3)但這一個歐洲種其側脈在羽片邊緣結合的形態(參看Leuthardt, 1904, pl. XII, fig. 1a)和我們的種完全不同。Leuthardt的原圖，Seward,[154] 1910年的p. 358, fig. 265B; Hirmer,[63] 1927年的p. 593, fig. 713A都已重載，他們顯然相信這些側脈在邊緣結合的形態是畫得正確的。Seward 1910年論文的p. 408對於這些側脈的描述如下："*M. marantacea*的一塊標本被Leuthardt定爲*Danaeopsis marantacea*發現於Basel的上三叠紀表示着一種奇特的葉脈；側脈初伸出卽分叉一次和其他學者所視察的一樣，但每一支脈到達近于邊緣時再分叉一次後的兩枚支脈在邊緣彼此又聚合而相連(converge)由此側脈在邊緣造成了爲一列"在邊內的環圈"(Intra-marginal loops)"假使這些側脈在羽片邊內所成爲環圈的形態是正確的，卽Leuthardt的視察，Seward的描述是對的，那末這一個歐洲種卽使在裸羽片方面，也和我們的種是不相同的。根據Schimper[148] 1874年的pl. 37, fig. 1所發表的圖這一個種的側脈在羽片的邊緣是不相結合的，Gothan[39] 1921年的p. 60, fig. 46, 1954, p. 114, fig. 92、所發表的圖也是如此。但無能如何這一個歐洲種的實羽片，孢子囊的排列和側脈的關係已經Halle詳細討論和*D. fecunda*是不完全相同的(1921, p. 8—9, pl. 2, figs. 27—30)。

*Danaeopsis*的一個屬名是Heer[59]在1864年(1864, p. 54; pl. 2, fig. 5, 1876—7 p. 71; pl. 24, fig. 1)所創的。他創立此新屬的標本是根據發現於瑞底克期的一塊實羽片化石，他相信這塊實羽片是和Jaeger[69]原先(1827, p. 28, pl. 5, fig. 5)所描述的裸羽片葉體定名爲*Marantoidea arenacea*並且後來這個這個學名被Presl[131](1838, p. 139)改定爲*Taeniopteris marantacea*是相同的。Krasser(1909, p. 22)後來以Fontaine[30] 1883年的p. 58所創的新名*Pseudodanaeopsis*代替了*Danaeopsis* Heer, Krasser[83]

在同一篇論文中指出（1909，p. 23）*Danaeopsis* 這一個屬名，不能視爲正確而堅強的，因爲這一個屬名原先被 Presl[130]（1845，p. 39）用於現代蕨類 *Danaea* 的一個"組"（Section）內。然而 Krasser 以 *Pseudodaeopsis* 一名代替 *Danaeopsis* 也是不對的。因爲 Fontaine 的新屬名是建立於 *Ps. reticulata* 的這一種植物其裸羽片中的側脈是完全互相結合而成爲標準的網脈的，Halle（1921，p. 2）已經指出。並且根據 Lundblad[102]（1950，p. 17）在最近數十年的研究中北美的 *Pseudodaeopsis* 是否眞屬於蕨類也發生了疑問，因爲根據 Fontaine 自己所給的"種的特徵"（1883，p. 59）北美的植物"其葉質（leaf substance）是很厚的而且帶革狀的"。Lundblad 相信北美的植物可能是屬於裸子植物的。Halle[48] 先前（1921，p. 3）也曾經一再地說明"Krasser 說 *Danaeopsis* Heer 這一個屬名不是堅強而有效的這爲這個名詞從前已被 Presl 用過。但這個名詞的本身並來不是一個堅強的屬名，根據現在的定名的規則它的先前的被人所用，並不是以造成足够的理由來取消 Heer 的屬名。因此根據"優先例"，以 *Pseudodanaeopsis* Font. 代替 *Danaeopsis* Heer 的意見，也不能成立的，何况還有其他的理由，將這兩個名詞合而爲一，是不受歡迎的。"

據上所述我們知道潘鍾祥將延長的植物定其屬名爲 *Danaeopsis*（*Pseudodanaeopsis*）也是沒有理由的！

Seward[154] 1910 年論文 p. 407 曾將 *Danaeopsis marantacea*（Presl）Heer 放在 *Marattiopsis* Schimp. 的屬名之內，根據 Halle（1921，p. 2）這也是不對的，因爲 *Marattiopsis* 顯然和現代蕨類 *Marattia* 無論根據裸羽片及實羽片幾乎完全是相同的。而 *Danaeopsis* 根據實羽片化石其孢子囊並不連合而成爲"聚合囊"（synangium），因此和現代的觀音座蓮蕨完全不同。Halle 再經過詳細討論後正式地指出（1921，p. 3）"我提議以限制地來用那個屬名 *Marattiopsis*，這個屬名應該用於那些其聚囊的形態以及其他的形態和現代蕨 *Marattia* 很相一致的化石"本文作者完全同意 Halle 1921 年的意見。但 *Danaeopsis* 這一個屬名，也是一個不幸的名詞，因爲其實羽片的孢子囊實彼此分離並不成爲聚合囊而可和現代蕨 *Danaea* 相比較。這一屬植物根據孢子囊的彼此分離的狀態是接近於現代觀音座蓮科的另一屬蕨類 *Archangiopteris* 的。這個意見 Halle 1921 年的 p. 3 也曾經指出。Halle 在同一篇論文中並且聲明將此種化石定其屬名 *Marantoidea* 也是不對的，其理由在本文中不再贅述，Luntblad[102] 1950 年論文的 p. 17 完全支持 Halle 的意見而認爲 *Danaeopsis* Heer 一個屬名是有效的。

Брик（1952，p. 15—16；pl. 1，figs. 1—3，6；pl. IV，fig. 7）在哈薩克上三叠紀所描述的 *D. marantacea*（Presl）Heer 及 *D. emerginata* Brick 根據羽片的形態及葉脈的型式這兩種顯然和當前延長植物是分不開的。作者仔細地觀察 Брик，的圖版覺得若干側脈的支脈在羽片的邊緣也微微地相結合的，其形態和當前的標本大致相同。當然，Брик 的標本屬於 *D. marantacea* 的可能性也是很大的。在沒有見到原來標本之前，這個問題暫不能作最後的決定，但應該着重地指出的是：*D. emarginata* 一種，很明顯地是根本不能成立的。因爲沒有同時找出實羽片化石之先，僅僅根據裸羽片的極微的不同形態，像 *Danaeopsis* 一類化石是根本不能創立新種的。而何况 Брик，的所謂 *D. emarginata* 的化石其裸羽片的形態及脈的型式也完全是和他的所謂 *D. marantacea* 的化石是相同的。作者覺得像 *Danaeopsis* 一類植物的分種，應該着重實羽片化石的不同方面。作者應該利用此一機會特別指出：要不是實羽片化石其孢子囊的排列及形態的不同，*D. marantacea* 和 *D. fecunda* 也很可能合成一種的。最後作者更強調地指出：Брик 的所謂 *D. angustipinnata* sp. n. 和 *D. bipinnata*, sp. n.（1952，p. 17—18，pl. II，figs. 3—4；pl. III，figs. 1—10）根據上述理由也是不能成立的，因爲沒有找出不同的實羽片化石。僅僅根據裸羽片排列的比較緊擠，及裸羽片的比較狹長是不够創立新種的。並且根據作者之意，此種裸羽片化石很可能是不屬於 *Danaeopsis* 的而是屬於 *Bernoullia* 的，因爲在同一地點同一地層已找出後者的實羽片化石（Брик，1952，p. 20，pl. V，figs. 1—12）。下面將再討論此一問題。

地點：陝西宜君縣四郎廟炭河溝。
陝西綏德縣葉家坪。
甘肅武威縣南營兒。
地層：延長層上部。

地點：陝西葭縣大會坪。
陝西綏德縣高家庵。
陝西延川縣延水關。
山西臨縣馬家灣。
山西臨縣第八堡。
山西永和縣烏門。
山西興縣李家凹。
甘肅華亭縣硯河口。
地層：延長層下部。
地點：陝西耀縣蕭馬河。
陝西耀縣房兒上。
陝西麟遊北馬坊。
陝西淳化縣坪底刺坪裏。
地層：延長層層位不明。

Danaeopsis? sp.

(圖版 XXXIII，圖 4；圖版 LIII，圖 7a)

圖版 XXXIII 圖 4 所表示的碎片是不能鑑定的。中軸比較地特別寬厚，寬達 5 毫米，表面頗平。兩側着生幾乎相對生的小葉 (leaflets)，小葉爲卵圓形至橢圓形頂端鈍圓，基部收縮。視其形態此種化石頗接近於 *Taeniopteris*。中脈相當地粗強，以一寬的角度自中軸伸出不下延於軸上。側脈頗鬆，亦以寬的角度自中軸伸出。多數不分义，很少地有一些側脈到達邊緣時分叉一次。這些標本是否代表着年青的 *Danaeopsis* 蕨葉 (frond) 化石，無法決定。

地點：陝西宜君縣四郎廟的炭河溝。
地層：延長層上部。

4. 觀音座蓮目?

屬名 *Bernoullia* Heer

1877. *Bernoullia* Heer, p. 88.

Bernoullia zeilleri P'an

(圖版 XXIX，圖 3, 3a；圖版 XXXII，圖 1—3；圖版 XXXIII，圖 1—3；圖版 XXXIV，圖 1—4；
圖版 XXXVII，圖 9；圖版 XLIII，圖 2；圖版 XLIV，圖 5—6；圖版 LII，圖 3；圖版 LIII，圖 2)

1903 *Pecopteris* (*Bernoullia*?) sp. Zeiller, p. 34, pl. 1, figs. 14-16.
1936. *Bernoullia zeilleri* P'an, p. 26, pl. IX, figs. 6, 7; pl. XI, figs. 3, 3a, 4, 4a; pl. XIV, figs. 5, 6, 6a; pl. XV, figs. 4, 5.
1951. *Bernoullia zeilleri* Sze & Lee, p. 90.

潘鍾祥所描述的一個最有意義的並且很爲少見的一個新種，在我們的材料中有很多保存甚佳的裸羽片以及實羽片標本，因此潘鍾祥在 1936 年論文 p. 26 所述的種的特徵應略加補充修改重述於下：

羽片一次羽狀分裂（或兩次羽狀分裂）。中軸甚強，其寬度爲 4—4.5 毫米，縱紋不顯，軸的正中部有一條顯著的凸肋。羽片緊擠至略鬆。羽片爲線形或線形或劍形，羽片的側邊作全綫形無鋸齒，亦有微彎成波浪

形者,其兩側邊大致平行,由基部漸漸地向頂部狹細,頂端為鈍圓形至半尖形。較小的羽片亦有作長橢圓形至卵圓形甚至有作圓形者(本文圖版 XXXII, 圖 3; 圖版 XLIV, 圖 6)羽片的普通長度可至 7.5 厘米,其寬度普通為 8—15 毫米,亦有較瘦於此者,半對生至互生於中軸上。 和軸成 45—80°, 甚至有垂直者。 羽片的基部的上下兩邊都作收縮狀,因此羽片的基部僅以一羽片軸(或中脈)着生於主軸上。 羽片軸(或中脈)亦比較地甚為堅強,在基部自主軸初伸出時,羽片軸可寬至 2 厘米左右。羽片軸自基部向前端緩緩地狹細直達羽片的頂端。羽片軸的正中部也有一條極細,但極為顯明的縱肋。羽片軸普通以一寬角的主軸伸出,亦有比較斜着伸出,和主軸成 45° 者。側脈頗細而密,以一銳角自羽片軸伸出後便立刻以或多或少垂直的形勢向外彎出,自基部至邊緣的任何一點繼續地分叉。側脈有互成一束一束的形勢(separate fascicles)。在實羽片標本上羽片比較地不甚緊擠,比較地短而狹瘦,比較地以一較寬的角度自主軸伸出,比較地成長橢圓形基部及頂部作收縮狀。主軸亦比較地粗強(主軸的寬度為 4—4.5 寬米,其兩側的羽片的寬度為 5 毫米),羽片的背面似全部為孢子囊所佔據,羽片的上邊似向內彎捲羽片的下邊是平舖着即不曾向內彎捲着;因此在羽片的上邊向內五分之二之處不見有孢子囊。孢子囊似排列成行,每行大致互相平行,佔據羽片的下邊自邊緣向內五分之三的全部。 據大致估計孢子囊在羽片的下邊自邊緣向內五分之三之處有 8—9 行左右。 因保存狀況關係孢子囊的形態如何尚未能明白。

當前的材料,俱經作者親自採集,材料相當豐富,裸羽片標本達 30 塊以上,標本有長達 20 厘米,還未曾保存完全者。 其原來蕨葉(frond)之大可想而知。 在我們所研究的豐富材料中,尚未見有葉體作兩次羽狀分裂者。但這並不說明這一種蕨類的"葉體"完全是一次羽狀分裂的。可能在未來的較詳的採集工作中還能找出兩次羽狀分裂的標本的。

根據潘鍾祥,延長層的化石的羽片的普通形態以及葉脈和 Zeiller 在越南東京煤田所描述的 *Pecopteris* (*Bernoullia*?) sp. 是相同的。這一點作者完全同意。潘氏更伸說道:"羽片的基部形態及葉脈當前的植物其接近於 *Bernoullia* 的成份較甚於接近其他任何屬植物,本人傾向於暫時將這個種放在這個屬之內"作者的意見延長層的化石屬於 *Bernoullia* 是沒有疑問的,支持這個意見的還有實羽片化石。 *Bernoullia* 的化石已發現於瑞士的 Basel、奧國的 Lunz 的中部上三叠紀並且於發現於德國 Franken 的的下部上三叠紀(Lettenkohle 層)。潘在論文中,未曾指出歐洲種和我們的種的區別。本文作者覺得歐洲種即 *Bernoullia helvetica* Heer 和我們的種是有相當的區別的。 即在 *B. helvetica* 其羽片的體積是較小較短其邊緣微彎成波浪狀甚至作圓裂片(lobes)的形態,在羽片的基部每一圓裂片中有 1 條顯明的中脈,中脈兩旁伸出不分叉或分叉一次的側脈,圓裂片中的葉脈型式頗似古生代的 *Pecopteris unita* 及 *P. arcuata* 的類型(參看 Leuthardt 1904, pl. XIX, fig. 3)。歐洲種的實羽片化石也和我們的種不同,其實羽片的上邊及下邊都作向內彎捲形態,因此在標本上僅可看出在中脈的兩側和中脈相平行的幾行孢子囊(普通看到 4 行,參考 Leuthardt[100], 1904, pl. XIX, fig. 4)孢子囊似彼此互相分離而不作聚囊的形態的。雖然歐洲種和我們的種是有相當的區別,但這並不說明我們的種不是 *Bernoullia*, 因為歐洲種的羽片前部的側脈型式也或多或少地成一束一束的形勢和我們的種是相同的。主軸上正中部 1 條微凸的縱肋在歐洲種也非常顯明。

最後應該指出的是在哈薩克的上三叠紀地層中, **Брик** 也描述了一種 *Bernoullia aktiubenis* sp. n. (1952, p. 20; pl. V, figs. 1—12)如果僅僅根據圖影,我們覺得她的 pl. V, figs. 9—12 是幾片'實羽片'化石沒有問題是屬於 *Bernoullia* 的。但 **Брик** 在同一圖版所表示的裸羽片化石却不完全可靠,一部分可能是屬於 *Cladophlebis* 的(譬如她的 pl. V, figs. 1, 3—4)。同一圖版的 fig. 5. 是不能鑑定的碎片,她的 figs. 2, 6—7 的幾塊標本葉脈型式也不像 *Bernoullia*. 相反的根據作者之意 **Брик** 的 pl. III, figs. 9—10 定為 *Danaeopsis angustipinnata* sp. nov. 及她的 pl. II, fig. 4 定為 *Danaeopsis bipinnata* sp. nov. 根據羽片的形態及葉脈的型式是有屬 *Bernoullia* 的可能的。根據 **Брик** 的原圖,這些標本的羽片中的側脈也有成束的形態的。無論這樣講,這些標本決不可能屬於 *Danaepsis* 的,上面已經提及了(本文第 30 頁)。

根據 Seward, 這一屬上三叠紀的植物所謂 *Bernoullia* 曾經 Heer, Krasser, 及 Leuthardt 所描述,曾經被歸屬於觀音座蓮科(Marattiaceae),但其證據是不很充足的。作者認為 *Bernoullia* 屬於此科的可能性是很大的,不過在沒有得充分證據之前,這個問題最好不要作為最後的決定。

地點：陝西宜君縣四郎廟，炭河溝。
　　　陝西宜君縣杏樹坪七母橋。
　　　甘肅華亭劍溝河。
地層：延長層上部。
地點：陝西淸澗縣城外。
地層：延長層中部。
地點：甘肅華亭縣硯河口。
地層：延長層下部。

屬名 *Cladophlebis* Brongniart

Cladophlebis (*Asterotheca?*) *szeiana* P'an

(圖版 XVI，圖 1—4；圖版 XVII，圖 1—5；圖版 XXI，圖 6)

1936. *Cladophlebis szeiana*, P'an, p. 18, pl. VI, Figs. 1-3; pl. VIII, Figs. 3-7.
1951. *Cladophlebis szeiana*, Sze & Lee P. 90.
?1952. *Cladophlebis szeiana*, Brick, p. 27; pl. VIII, figs. 1-9.
?1952. *Cladophlebis simplicinervis* Brick, p. 28, pl. II, Figs. 1-2.

這個極標準的中國上三叠紀種，在當前的材料中，找到的標本也很豐富，葉體的分裂狀態，羽片及小羽片的形態及葉脈的型式，都是極爲標準的，和潘鍾祥所描述的，毫無異緻。實羽片也曾發現，但我們的標本保存狀況略有不同，當前的標本其孢子囊不易看淸，因爲保存在小羽片的背面，此種“實羽片”標本，因爲其反面有孢子囊存在，其正面的葉脈，保存爲化石後亦不甚明顯，但此種實羽片化石和潘氏所發表的圖版 VIII 圖 6 的標本，完全同屬一種，是毫無疑問的。潘鍾祥所發表關於此種的“特徵”，甚爲詳盡，本文因爲有新的材料，比較完善，遠超過 1936 年前所發現的標本，故將潘同志的原初所給的“種的特徵”，微加修改及補充重載於下：

蕨葉至少爲 2—3 次羽狀分裂。中軸甚寬，至少和羽片及小羽片的體積相比，顯得特別寬闊，中軸在保存最佳的標本上其基部寬約 8—9 毫米，向頂部緩緩地狹細。中軸甚平，縱紋並不顯明。最後一次的羽片爲線形，微作披針形，其兩側也幾乎互相平行，向頂部漸漸地狹小，頂端鈍而圓。互生式半對生於軸上，羽片軸亦比較地甚寬，寬約 2 毫米，表面亦甚平，微微地顯出極細的縱紋，羽片頗緊擠，有時甚至互相蓋覆。位在葉體底部的羽片，分裂甚深而爲小羽片，而位在葉體頂部的羽片，其兩個側邊幾乎是全緣的，近乎單獨的小羽片。在這兩種形態的羽片之外，還有“中間型”的羽片，那就是羽片的基部深深地裂開而爲小羽片，同一羽片的前部又漸漸地不再裂開而作全緣形。發育較全的小羽片，大致爲長方形，其基部幾乎互相連合，其前面的側邊幾乎是直的，後面的側邊在近於小羽片的頂端時突然收縮，小羽片的頂端作寬的鈍圓形。葉脈非常顯明，中脈比較地粗強，在基部向下延的羽片軸上的程度頗強，到達小羽片的頂部時因分叉而變成側脈。側脈頗厚，不甚緊擠，其粗度僅微亞於中脈，側脈自伸出至直達邊緣，保存着相同的粗度，近於邊緣時，甚至微微地更變粗厚；在發育較全的小羽片上，側脈成一銳角自中脈伸出後，卽向側邊彎伸，普通都分叉一次，在極少的情形下，分叉後其前面的叉枝再分叉一次，更極少地分叉後，其後面的叉枝再分叉一次。在小羽片的基部的前半邊的第一條側脈，斜着生於中脈上；在小羽片基部的後半邊的第一側脈是從中脈的向下延的部份上伸出的，因此，此條側脈彎向側邊時，其彎曲度頗強，幾乎和中脈相平行。在發育不全的小羽片上側脈，也是以一銳角自中脈伸出的，其厚度幾乎和中脈完全相等，幾乎是完全不分叉的，僅僅是小羽片基部的前半邊的第一條側脈及後半邊的第一條側脈，有時明顯地分叉一次。在羽片的前端不再分裂而爲小羽片的部分，所有葉脈都是從羽片軸伸出時，此種葉脈多半是分叉一次後，或其前面的叉枝再分叉一次，或其後面的叉枝再分叉一次，或分叉後，其兩枝叉枝又各再分叉一次，在羽片最前端的葉脈，普通都僅分叉一次。保存孢子囊的實羽片，亦曾發現，中軸亦甚寬甚平，寬至 9 毫米，羽片軸的寬度亦比較地頗寬（約爲 1.5—2 毫米）頗平，和中軸成一寬角，羽片亦爲線形，小羽片亦爲長方形，其形態和裸羽片完全相同，小羽片亦頗緊擠，中脈向下延於羽片軸上，側

脈多數似不分叉，每一側脈之上有一圓球形的囊羣（sorus），詳細構造因保存不佳，不甚明白。似屬於 *Asterotheca* 型式。

這一個中國上三叠紀的新種，其形態非常特殊，中生代地層中所已經發現的（*Cladophlebis*）各種，幾乎沒有一個種是可以和當前的延長層的新種可以互作比較的。原著者曾將此種和山西石盒子系的 *Pecopteris atcuata*（Halle[50]，1927b，第 80 頁，圖版 19，圖版 20，圖 1—3，8—14，?4—7）互相比較，並且指出 *Cl. szeiana* 的中脈和側脈都較厚，並且在 *P. arcuata*，其葉脈之間，是有細的紋痕的，當前的中生代標本，是完全沒有這種紋痕的。這些顯明的區別，的確可以證明這兩種的不同，根據整個葉體及羽片及小羽片的形態，此兩種頗甚相似，如果不經過仔細地視察，人們幾乎將相信中國的古生代及中生代的兩種是同種的。當然如果根據實羽片的孢子囊的形態，這兩種是完全不能相比的。*Pecopteris arcuata* 的實羽片化石，已在河北開平煤田的第 11 層煤中（11e couch）發現，根據 Stockmans 和 Mathieu[165]（1939，圖版 XVIII 圖 4，4a，et 4b）屬於 *Ptychocarpus* 型式，兩位比國學者將此種名爲 *Ptychocarpus*（*Pecopteris*）*arcuatus* nov. comb.（1939，第 81 頁）。

蘇聯古植物學家 **Брик** 描述了哈薩克西部上三叠紀植物，內有幾塊化石，被定爲 *Cladophlebis szeiana* P'an（1952，第 27 頁，圖版 VIII 圖 1—9）。根據小羽片的形態及葉脈，哈薩克的標本，實在不能完全決定是和中國的 *Cl. szeiana* 是同種的，而且其側脈似乎比較細得多。相反的哈薩克的另一塊經 **Брик** 定爲 *Cladophlebis simplicinervis* 的標本（1952，第 28 頁圖版 II，圖 1，2.）倒有屬於 *Cl. szeiana* 的可能的。這一塊標本根據種名 *simplicinervis* 的含義，其側脈是不分叉的。這和中國當前的材料中的若干標本完全相同，在本文"種的特徵"一段中，曾經指出（本文第 33 頁）："在發育不全的小羽片上，側脈也是以一銳角自中脈伸出的，其厚度幾乎和中脈完全相等，幾乎是完全不分叉的。"並且哈薩克的這一塊標本，其羽片的前端不再分裂而爲小羽片，也和中國古生代的 *P. arcuata* 的若干標本及中國延長層的 *Cl. szeiana* 的若干標本完全相同。*Cl. simplicinervis* 的羽片及小羽片的形態及體積也和 *Cl. szeiana* 完全是相同的。

根據孢子囊的排列於小羽片的兩側的情况，當前的中國種，其實羽片頗似北美 Virginia 州上三叠紀中期的 *Asterocarpus virginiensis* Fontaine，但 *Cl. szeiana* 的孢子囊的構造尙未確實明白。潘鍾祥指出 *Cl. szeiana* 的裸羽片化石，也可和北美種相比較，尤其是 Fontaine[30] 的 *A. virginiensis* var. *obtusiloba*（據 Fontaine，1883，p. 45，pl. XXI. figs. 3—4；pl. XXIV，figs. 3—5；pl. XXV，fig. 1）的標本最相近似。**Брик** 的意見，似乎也是如此（1952，p. 28）。這兩種的區別，除出北美的變種，其側脈較細並且較密以外，根據 Fontaine 的報告，北美的變種在小羽片基部的下半邊，有若干側脈是從中軸直接伸出的，（Fontaine 發表的圖影，尤其是在他的論文的 pl. XXIV，figs. 3—5. 及 pl. XXV. figs. 1，1a. 此種自中軸直接伸出的脈更爲清楚）。Fontaine 的視察可能是不正確的。根據本文作者的意見。北美的變種，此種葉脈很可能也和當前的中國種一樣，是從中脈的向下延的部分上伸出的，在沒有看見原來標本以前，這個意見當然不能作最後的決定的。無論如何，如根據裸羽片的形態，北美的上三叠紀中期的種，亦應屬於 *Cladophlebis*. 根據 Krasser[83]（1909，第 108 頁），北美的種是和歐洲的上三叠紀中部的 *Asterotheca meriani*（Brongn.）Stur 是同種的。Krasser 又曾指出，"根據 Zeiller 1883 的意見 Presl 的屬名 *Asterotheca* 的創立較 Goeppert 的屬名 *Asterocarpus* 爲早"是否我們的 *Cl. szeiana* 其實羽片上孢子囊的排列也是作 *Asterotheca* 的型式呢？因爲實羽片的保存狀況還不够完美，我們不能作最後的決定；但其可能性是很大的。如果 *Cl. szeiana* 的實羽片是屬於 *Asterotheca* 的，那末這一個種屬於觀音座蓮目的成份是很大的。

Cl. szeiana P'an 一種除發現於陝西延長層外，亦曾發現於甘肅的延長層，已經斯行健及李星學報告過（1952，第 90 頁），惜尙未曾詳細加以描述。

地點：陝西宜君縣四郎廟的炭河溝。
陝西延長縣七里村。
陝西綏德縣的葉家坪。
甘肅華亭縣劍溝河。
地層：延長層上部。

地點：陝西綏德縣懷林坪。
地層：延長層中部。
地點：甘肅華亭縣硯河口。
地層：延長層下部。

裸子植物門

(一) 種子蕨綱?

屬名 *Thinnfeldia* Ettingshausen

1852. *Thinnfeldia*, Ettingshausen p. 2.

Thinnfeldia rhomboidalis Ettingshausen

(圖版 XXXIV, 圖 5, 5a.)

1852. *Thinnfeldia rhomboidalis*, Ettingshausen, p. 2, pl. I, figs. 4-7.
1894. *Thinnfeldia rhomboidalis*, Raciborski, p. 64, pl. 19, fig. 15.
1914. *Thinnfeldia rhomboidalis*, Antevs, p. 27, pl. 2, fig. 5, pl. 4, figs. 4-5.
1914. *Thinnfeldia rhomboidalis*, Gothan, p. 30, pl. 20, figs. 2, 3, pl. 21, Figs. 1, 3; Pl. 22, figs. 1, 2, pl. 3, fig. 1, etc.
1933. *Thinnfeldia rhomboidalis*, Sze 1933b, p. 47, pl. 6, figs. 1-9.
1936. *Thinnfeldia rhomboidalis*, P'an, 1936, p. 28, pl. 13, fig. 8.
(詳細異名表參看 Gothan 1914, p. 30 及 Antevs 1914, p. 27).

Thinnfeldia rhomboidalis Ett. 一種,在東亞極為稀見。直至今日,此種僅被斯行健描述於福建長汀縣的下侏羅紀,潘鍾祥描述於陝西綏德的延長層中,在當前的材料中,我們僅找到一塊碎片,形態甚為標準。羽片的基部的下邊收縮後的又微向下延,其上邊收縮,頂端鈍尖,中軸比較地堅強,寬約 3 厘米,上有極細的縱紋。羽片半對生於軸上,最寬處近於中部,此處寬約 1 厘米,兩端收縮,羽片的長度達 4 厘米。中脈最初以一銳角自軸伸出,伸出後很快地以和軸成 45° 的形勢向上伸出。直達頂端。側脈極細而密,以一極銳的角度自中脈伸出分叉數次,直,直達邊緣。"有鄰脈" 自中軸伸出。作者 1933 年曾表示和 Gothan 的意見相同,即 Schenk[145] 的 *Th. decurrens* (1867, p. 114, pl. 26, figs. 1—5), *Th. obtusa* (1867, p. 115, pl. 26, figs. 6—8), *Th. laciniata* (1867, p. 119, pl. 28, figs. 1—4) 以及 Schenk 的 cf. *Dichopteris obtusiloba* (1867, p. 120, pl. 28, figs. 9—11) 都應該和 *Th. rhomboidalis* 視為一種,雖然 Antevs[1] 曾把 *Th. decurrensis* 和 *Th. obtusa* 和 *Th. rhomboidalis* 分成三種敍述 (1914, p. 27, p. 30, p. 31). 本文作者最近的意見仍和 1933 年相同。

地點：陝西宜君縣杏樹坪七母橋。
　　陝西綏德縣葉家坪,延長層上部(潘鍾祥所描述)。
地層：延長層的上部。

Thinnfeldia major Raciborski

(圖版 XLII, 圖 3; ? 圖版 XXXII, 圖 4.)

1878. *Thinnfeldia rhomboidalis*, Nathorst p. 50; pl. I, fig. 1.
1886. *Thinnfeldia rotundata*, Nathorst, p. 120.
1894. *Thinnfeldia rhomboidalis*, Raciborski p. 64, pl. 19, figs. 9, 10, 15; pl. 21, fig. 3.
1894. *Thinnfeldia* (rhomboidalis forma) *major* Raciborski p. 66, pl. 19, fig. 8, pl. XXI, fig. 6.
1912. *Thinnfeldia rhomboidalis*, Gothan 1912, pl. 15, fig. 2.
1914. *Thinnfeldia major*, Antevs, pl. 2, figs. 6-12; pl. 3, fig. 1.

圖版 XLII，圖 3 所表示的一塊標本根據葉及羽片的全部形態和脈的型式和 Raciborski[134] 1894 年論文的 p. 66, pl. 19, fig. 5 所描述的一塊定為 *Th. rhomboidalis* Ett. 的克拉科 (Krakau) 標本完全相同，無絲毫區別。這一塊標本，被 Gothan 登載於 1912, pl. 15, fig. 2. Gothan[36] 在圖版說明特別指出："這一類型，可能是代表一個特別的種。" Antevs[1] (1914, p. 35) 將這一類型的標本定其名為 *Th. major* (Raciborski). Antevs 同時將其餘若干被 Raciborski 定 *Th. rhomboidalis* 的克拉科 (Krakau) 標本，都列入於同一異名表上 (見本文異名表)。 Antevs 對於這一個種所給的新的種的特徵茲譯述於下："葉體" 或 "蕨葉" (Wedel) 一次羽狀分裂。中軸 (spindel) 堅強，小羽片 (Friderchen) 緊擠或多或少地互生，以基部的整個寬度着生於軸上，作寬線形，可達 35 毫米長及 12 毫米寬，其頂端或為鈍尖形或為圓形。側脈從中脈伸出，細而密，分义數次。肌理 (Konsistenz) 厚而堅固。"

根據上面的所述的種的特徵，我們知道本文圖版 XXXII，圖 4 的一塊標本也很可能是屬於此種的。這一塊標本的羽片 (Antevs 所謂小羽片) 的頂端稍作鈍尖形和 Raciborski 的一塊標本稍有不同，但和 Antevs 的的標本完全相同的。在我們的兩塊標本其羽片的基部的下半部有 "鄰脈" (Nebenadern) 自中軸直接伸出甚為清楚。關於這一點，Antevs 種的特徵中，未曾提到，我們細查 Raciborski 的材料也顯然可見鄰脈從中軸直接伸出的 (參看 Gothan 1912, pl. 15, fig. 2)，最有意思的是在我們的標本其 "葉" 的頂端也有一個很大而長兩邊不分裂的頂羽片 (Endlappen)，也和 Krakau 的這一塊標本完全相同。

Gothan[36] (1912, p. 79) 及 Antevs (1914, p. 36) 先後指出，Raciborski 在同一圖版所表示兩塊碎片 (即 1894 pl. 19, figs. 12a 11b) 其小羽片上着生有 "囊羣" (sori) 此種圓形遺跡不是眞正的 "囊羣" 而是一種菌類 (pilze) 的化石。本文作者完全同意上述的意見，因為如果 Raciborski 的兩塊碎片也是屬於 *Thinnfeldia* 的，那末，不可能有 "囊羣" 的。按照 Raciborski 的圖影，此種遺跡，的確是代表一種圓形的體積很小的菌類化石。此種菌類同時寄生於這一類植物的羽片上面，和羽片同時變成了化石。Antevs 同時加以伸說道 (1914. p. 36)，就算 Raciborski 的這兩塊碎片是眞正的代表着 "實羽片" 化石 (fertile Exemplare)，這兩塊碎片也太破碎，對於鑑定上面，是沒有意義可言的。本文作者對此亦完全同意因為 Raciborski 的兩塊碎片，也實在很像 *Cladophlebis* 的碎片。更應該指出的是：就算這兩塊很小的碎片不是 *Thinnfeldia* 而是 *Cladophlebis* 其小羽片上的圓形遺跡代表 "囊羣" 或孢子囊的成份仍很小，此遺跡仍以代表菌類化石的成分為較多。正如本文的 "異名表" 所表示，Raciborski 的這兩塊碎片是不能和 *Th. major* 同屬一種的。

Antevs 再進一步指出：*Th. major* 的形態介於 *Th. rotundata* Nathorst (參看 Antevs, 1914, pl.4, fig. 1) 及 *Th. rhomboidalis* Ett. 兩種之間，而 *Th. major* 和 *Th. rotundata* 的相似更令人注意。Antevs 再加以伸說：雖然如此，以種來講，這兩個種還是不同的，因為在 *Th. major* 其標準的小羽片是作線形比較地狹而長 —— 其體積到了 35×12 毫米 —— 而在 *Th. rotundata* 其標準的小羽片是作卵圓形短而寬其體積為 22×14 毫米。另外還有區別在小羽片的位置方面，即在後者，其小羽片是比較地以一直角的形勢從中軸伸出的。Antevs 最後更加以說明：*Th. major* 和 *Th. rhomboidalis* 的兩種的不同，是在 *Th. major* 的小羽片的形態比較地為線形並且在其基部是不收縮的。本文作者完全同意上述的意見。本文圖版 XXXII，圖 4 的一塊標本的確亦接近於 *Th. rotundata* 的，但其羽片比較斜伸，並且其頂端比較尖，以屬於 *Th. major* 的成分較大，茲暫定為 cf. *Th. major*。並且本文圖版 XXXIV，圖 5 的一塊標本，因為羽片的基部收縮，頂部亦比較後縮，因此羽片的形態比較成斜方形這一塊標本顯然是屬於 *Th. rhomboidalis* 的。

根據 Antevs 的意見，*Th. major* 一種發現於 Galizien 的 Grojec 附近侏羅紀以外，還發現於瑞典的 Schonen 的瑞底克期。在 Schonen 標本發現較少，發現在 Bjuf 的 a 層至 1 層，以及 Bjuf 的 3 層及 Skromberga 的 2 層中 (a 層 zone mit *Dictyophyllum exile*; 1—3 層 Zone mit *Camptopteris spiralis*)。這些層位，根據 Harris[56] (1937, 表 2) 的意見都是屬於瑞底克期的。

地點：陝西宜君縣杏樹坪七母橋。
地層：延長層上部。
地點：陝西延安縣 (詳細地點未明)。

地層：層位不明。

?*Thinnfeldia nordenskiöldi* Nathorst

(圖版 XXXVII, 圖 6—8.)

1875. *Thinnfeldia nordenskiöldi*, Nathorst, p. 10 (382).
1876. *Thinnfeldia nordenskiöldi*, Nathorst, p. 34, pl. 6, figs. 4-5.
1878. *Thinnfeldia nordenskiöldi*, Nathorst, 1878a p. 16, pl. figs. 4-5.
1912. *Thinnfeldia nordenskiöldi*, Gothan, p. 78, pl. 14, fig. 2.
1914. *Thinnfeldia nordenskiöldi*, Antevs p. 32; pl. I, figs. 2-3; pl. 2, fig. 4; Pl. 3, fig. 3.
1922. *Thinnfeldia nordenskiöldi*, Krasser, p. 365.
1936. *Thinnfeldia nordenskiöldi*, P'an, Pl. XI, fig. 5; Pl. XII, figs. 1-6; Pl. XIII, figs. 4, 5, 6, 7.

關於這一種在我們的材料中，僅有三塊標本，保存爲一枚單獨的羽片，此種標本也很可能是代表着一枚"頂羽片"的。羽片作匙形 (spatulate) 至劍形頂部似作鈍圓形長達 9 厘米，其最寬在自基部至前端三分之二之處，此處寬到 3.4 厘米，羽片自基部至前端三分之二處爲全邊形，其前部淺裂而作圓裂片的形態，中脈不甚顯明，在標本上作一寬溝的形狀，側脈在羽片的基部，是從中軸伸出的，所有側脈俱向前彎伸，彎曲程度頗強，分叉數次，所有側脈及支脈俱彎向羽片兩側的邊緣。

當前的幾塊僅有的標本和潘鍾祥[127]所描述的特徵 (1936, p. 28) 的完全相同，不過當前的標本，似較潘鍾祥所研究的標本的羽片更寬得多，更較作匙形。本來潘的標本，其羽片的形態和瑞典的種亦略有距離。瑞典的種其羽片比較多成標準的劍形，其排列亦比較鬆稀 (參觀 Antevs, 1914, pl. 1, fig. 2; pl. 2, fig. 4)。因此本文作者的意見認爲將潘鍾祥的標本定爲瑞典的種，至少似尙須稍加保留的態度。將當前的標本，定爲瑞典的種應加保留的程度，更甚於潘鍾祥的材料，本文作者將當前的標本暫加一問號於屬名之前定爲 ?*Thinnfeldia nordenskiöldi* Nathorst，等待着未來的保存較全的材料。

根據 Antevs[1] (1914, p. 32) *Th. nordenskiöldi* Nath. 是很稀少地發現於瑞典的 Schonen 的 Palsjö 附近的瑞底克期最上部地層中 (其地層名爲 Zone mit *Nilssonia polymorpha*)。

根據 Antevs，這一個種和 *Th. speciosa* Ettingsh. 是不易區別的；並且這是很可能的，在未來的採集材料中，可以證明這兩種是同屬於一種的。至少在目前，還是以將此兩種分開的理由爲最正確。因爲一方面正如 Nathorst[107] 所指出 (1876, p. 35)，*Th. nordenskiöldi* 的體積大得多，另一方面尤其重要的是在此一種的葉脈更密得多。還有一個區別是比較次要的是：表皮構造兩種亦微有不同，根據 Schenk[145] (1867, p. 115) 在 *Th. speciosa* 其小氣孔是僅僅限於葉的背面的。

地點：陝西宜君縣杏樹坪黃草灣七母橋 (延長層上部)。

陝西綏德縣葉家坪 (潘鍾祥所描述，根據他的報告，標本發現延長層的上部及瓦窰舖煤系的下部)。

地層：延長層上部。

Thinnfeldia rigida Sze 新種

(圖版 XLI, 圖 1—3; 圖版 XLII, 圖 1—2, 2a; 圖版 XLIII, 圖 3, 4; 圖版 LII, 圖 2.)

葉體可能爲兩次羽狀分裂。葉軸甚爲堅強，寬約 3 毫米上有不規則的粗的皺紋。葉似爲劍形，在保存的標本上，最寬處約爲 9—10 厘米，向頂端漸漸狹小，頂羽片未曾保存，可能狹而長，其頂端可能作鈍圓形。羽片甚堅擠，其基部似互相結合着，其下邊微向下延，互生至對生着生於葉軸上，其基部爲最寬此處普通寬達 2 厘米，幾乎保存同樣的寬度到向前部三分之二之處，然後突然狹細，頂端鈍微彎作鐮刀形。羽片的長度普通爲 5—6 厘米，愈向葉的前端，葉愈短，最前部的羽片長約 1.2—2 厘米，寬約 1 厘米，頂部鈍而圓。羽片是全邊的，有時僅極微地彎成波浪形，羽片的肌理 (texture) 似厚而爲革狀的，其表面微現褶皺狀態。中脈比較地甚爲粗

強以一很寬的角度自葉軸伸出,直,幾乎直達羽片的頂端。側脈比較地甚細,以一極銳的角度自中脈伸出,彎曲度甚強,普通作三次分叉狀,在近於中脈處分叉一次後卽立刻再分叉一次,到近於邊緣時又再分叉一次,直至邊緣,在羽片的頂部,側脈普通作兩次分叉狀態,若干側脈明顯地自葉軸伸出分叉數次,其彎曲度更強於其他的側脈。

此一新種所代表的標本雖俱係碎片,但葉和羽片的形態頗爲特緻,在文獻中所已描述的各舊種,沒有一種和此種相接近,故知其確係一新種。在當前的材料中,"葉體"多爲一次羽狀分裂,僅有一塊作兩次分裂狀態,表示在圖版 LII, 圖 2 上如將來找到保存較全的標本時,可能其葉體有作兩次羽狀分裂者。作者完全相信:如將來找到兩次羽狀裂的標本時,其主軸上也很可能和其他兩次羽裂的 *Thinnfeldia* 的各種,有"間小羽片"的着生。

在舊文獻中比較地可以和我們的新種相比較的是 Gothan 教授在德國紐倫堡(Nuernberg)下侏羅最底部(瑞底克期)的一塊標本被 Gothan[37] (1914, pl. 21, fig. 1) 定爲 *Thinnfeldia rhomboidalis* Ettingsh., grosse Form ("*Th. decurrens* Schenk")的。這一塊紐倫堡的標本其葉的寬度和長度,羽片的體積及羽片的緊擠的狀況,都大致和當前的標本相同。但中脈是比較以一較銳的角度自中軸伸出的;側脈亦比較地甚細,並且分叉的次數,似亦和我們的標本相同,但其彎曲的程度較弱,並且根據 Gothan 其葉軸是有橫的紋線的。根據本文作者的意見,紐倫堡(Nuernberg)的這一塊標本如定爲 *Thinnfeldia rhomboidalis* 總覺得其葉和羽片的體積大得不甚相稱。將來如將種的範圍稍稍擴大,紐倫堡的這一塊標本,很可能是屬於我們的新種的。

最後應該指出的是:根據羽片的形態及體積 White[191] 所描述的一部分 *Supaia* 標本也大致可和我們的碎片相比較的,尤其是他的 *S. thinnfeldioides* (1929, pl. 14, fig. 1 及 pl. 16, fig. 3) *S. merriiami* (1929, pl. 19) 等。北美大峽谷上二叠紀的 *Supaia* 的各種其葉體的基部是作分叉狀態的,而當前的標本雖未保存完全,但作者完全確信其葉體的全部形態是不會和北美的上二叠紀標本完全相同的。

地點:陝西宜君縣杏樹坪黃草灣的七母橋。
地層:延長層上部。

Thinnfeldia alethopteroides Sze 新種

(圖版 XXXIV, 圖 6; 圖版 XLV 圖 1—1a, 2)

"葉體"一次羽狀分裂,保存較全時可能爲兩次羽狀分裂。葉爲線形至劍形。中軸細瘦寬僅 2 毫米,表面甚平。裂片(或可名爲小羽片)瘦而長,大致爲線形最寬處微近於基部,寬約 5 毫米向前端緩緩地狹瘦,頂端鈍圓有時微彎成鐮刀形。裂片的普通長度爲 3—3.5 厘米,兩側邊直作全緣形。裂片的基部其上邊微微地收縮,其下邊近於基部處微微收縮後卽微向下延。裂片斜伸於中軸上普通和軸成 45°,對生至半對生。中脈比較地粗而強以 45° 從中軸伸出,直達裂片的頂端;側脈細而密,亦大致以 45° 自中脈伸出。側脈在近於裂片的基部之處普通分叉兩次,在裂片的中部分叉一次後其前面的叉枝又再分一次,在裂片的頂部普通僅分叉一次。若干側脈自中軸直接伸出。

根據裂片的體積及其狹細而瘦長的形態當前的新種頗接近 *Th. speciosa* Ett. (參看 Gothan 1912, pl. 13, fig. 1; Antevs 1914, pl. 4, fig. 2) 但在後者,其裂片的形態作標準的劍形,其最寬處在其中部,其頂端尖銳,並且裂片的排別亦甚鬆。斯行健[168] (1933, p. 47, pl. VI) 曾描述許多定爲 *Th. rhomboidalis* erw. 的標本,其中的一塊卽他論文的 pl. VI, fig. 2 頗有屬於此種的可能。這一塊標本和其餘在長汀所發現的微有不同。裂片的體積和形態接近於當前的新種,並且側脈的型式亦大致相同的。僅有的區別是長汀的這一塊標本其裂片的基部的前邊收縮的程度及下邊的向下延的程度較甚於當前的材料,因此長汀的標本比我們的新種多接近於 *Th. rhomboidalis* Ett.

地點:陝西宜君縣杏樹坪黃草灣的七母橋。

地層：延長層上部。

Thinnfeldia laxusa Sze n. sp.

(圖版 XLIV, 圖 1—4; 圖版 XLV, 圖 3—4.)

"葉體"一次羽狀分裂，如保存完善時可能為兩次羽狀分裂。中軸比較地堅強，上有極細的縱紋。裂片(或可名為小羽片)普通為長橢圓形亦有狹細而瘦長者，其長度及寬度之比，頗有變異。基部及頂部俱作收縮狀，基部的下邊向下延於軸上。裂片的頂端，普遍作鈍圓形。裂片的排列似比較寬鬆，半對生或互生於中軸上大致以 45° 自軸伸出。中脈比較地粗強以 45° 自軸出，到裂片的頂部時，因分叉而消散。側脈細而密，普通分叉一次後其中一枚叉枝又再分一次次。若干側脈在羽片基部的下邊，由中軸直接伸出。頂羽片頗大，前端鈍圓。

上面已經提及，這一個新種的裂片(或小羽片)的長度和寬度頗有變異，圖版 XLIV, 圖 4 所表示的標本其裂片作卵圓形至長橢圓形，其寬度普通約為 5 毫米，其長度自 1 厘米至 2 厘米。圖版 XLV 圖 3, 4 所表示的標本，其寬度為 3—4 毫米長度為 1 厘米至 1.6 厘米，近於基部處上下兩邊收縮而成柄狀下邊的向下延形態仍甚清晰，圖版 XLIV 圖 1, 1a 所表示的標本其裂片狹細而瘦長，若干羽片寬僅 3 毫米，長達 2 厘米以上，其基部的上邊收縮甚強，下邊收縮後向下延的程度亦甚強，其頂端似仍鈍圓形。這種類型的標本極似 *Thinnfeldia muensteriana* (Ettingshausen[25], 1852, p. 5, pl. II, figs. 1, 2)。根據葉及裂片的形態，裂片的基部的上邊收縮下邊向下延的形態以及中脈的特別顯著的形態兩者確甚相近似。並且在 *Th. muensteriana* 其裂片的排列狀況亦甚寬鬆和我們的標本一樣。但在 *Th. muensteriana* 某一部分裂片的頂端似作尖銳形，並且根據 Ettingshausen 的意見，其側脈是以一尖銳的角度自中脈伸出的，普通是不分叉的，很少地作分叉一次的型式，因此和我們的標本不能相比，並且其側脈也好像比我們的種鬆得多。這一種最先是被 Presl[131] 定為 *Taxodites muensterianus* (1838, in Sternb. II, Fasc. VII, VIII, p. 204; pl. 33, fig. 3) 的。1852 年 Ettingshausen 改定屬於 *Thinnfeldia*。1867 年 Schenk[145] 定此種為 *Selenocarpus muensterianus* (1867 p. 89; pl. 22, figs. 1、2, 5, 6)。1936 年 Hirmer 和 Hörhammer[65] 名此種為 *Selenocarpus muensterianus* (Presl) Schenk (1936、p. 38—41; pl. VIII; IX, figs. 1—3)，根據兩位德國學者的意見認為 Ettingshausen 的另一種所謂 *Th. parvifolia* (1852 *pl.* 2, *fig.* 3) 亦顯然是屬於此種的。經過兩位德國學者的研究 *S. muensterianus* 的全部蕨葉體形態和 *Phlebopteris* (卽普通所謂 *Laccopteris*) 相近似，而是屬於 *Matoniaceae* 的。他們並且找到此種植物孢子囊。因此這一種植物屬於蕨類，已無疑問。本文作者相信當前的標本的葉體的分裂狀態是和 *Selanocarpus* 不同的。如果將來找到保存完全的標本，我們的植物其葉體可能是作兩次羽狀裂的狀態的。我們的植物，顯然是屬於裸子植物卽所謂中生代的種子蕨 (Mesozoic pteridosperms) 的。並且將來如果找到更多的材料時，很可能的，這一個種和本文所描述的 *Thinnfeldia alethopteroides* 新種是可以合成一種的。在當前的材料中，我們也有一二塊標本很難完全決定是屬於前一種或是屬於後一種的。作者暫時將此兩種類型的標本分成兩個新種敍述，等候着未來繼續採集時更多材料的到來。

地點：宜君縣杏樹坪黃草灣七母橋。
地層：延長層上部。

屬名 *Ctenopteris* Brongniart

1872. *Ctenopteris* Brongniart in Saporta Pl. Jurass. I, p. 35.
1886. *Ctenozamites* Nathorst Fl. vid Bjuf, p. 122.

Ctenopteris sarrani Zeiller

(圖版 XXXV, 圖 3—4.)

1903. *Ctenopteris sarrani*, Zeiller p. 53, pl. VI-VII, fig. 1; pl. VIII, figs. 1-2.

?1927. cf. *Ctenopteris sarrani,* Halle 1927b. p. 19; pl. V, fig. 9, fig. 10.

在我們的材料中，有兩塊標本，形態異常奇特。根據羽片及小羽片的體積及形態以及葉脈的型式，一望而知這兩塊碎片是和 Zeiller 1903 年在越南東京所描述的種完全一致的。延長層的兩塊碎片是本文作者和關佑蜀同志所採集的。Zeiller[201] 所描述的"種的特徵"（1903 p. 53）特譯述於後：

"葉體"（frond）兩次羽狀分裂，體積很大，其長度至少爲 2 或 3 米以上，寬度約爲 1 米，主軸上有縱紋在"葉體"的下半部，主軸的寬度約爲 15—30 毫米，羽片（Pennes primaires）互生至半對生，張開而直伸，其基部微彎而向下延。……羽片互相距離之處約爲 5—13 厘米，彼此有時微微地以邊互相接觸，羽片爲長的線形基部微微地收縮，其頂部鈍，其寬度爲 4—8 厘米長度至少爲 50 厘米其中軸的寬度爲 2—5 毫米，上有縱紋。

"小羽片（pinnules）張開而直，其基部互相連合，其兩側邊互相平行或微弱地互相輻合（faiblement convergents）其基部往往微向下延，其頂端鈍圓其寬度爲 15—30 毫米其長度 2—4 厘米。

"葉脈完全一致，自中軸伸出和小羽片的側邊相平行，往往向外微彎，並且微弱地向小羽片的兩側張開，頗堅擠不分叉或僅分叉一次普通甚爲顯明。"

根據上面所述我們知道東京的植物其葉體是很巨大的，這在 Zeiller 論文的 pl. VI–VII, fig. 2 所表示的一塊標本也可以看出。而我們的標本僅僅是代表着一個羽片的頂部而已。根據小羽片的形態及脈的型式，我們的標本也很可能代表着 *Ptilozamites* 的碎片，*Ptilozamites* 的"葉體"其基部是作分叉狀態的，這和 Ctenopteris 的"葉體"作羽狀分裂的狀態，完全不同。因爲保存完整的 Ctenopteris 已發現於東亞的越南東京煤田，而同樣體積及型式的小羽片的 *Ptilozamites* 如同 *Pt. nilssoni* Nathorst（=*Pt. fallax* Nath.）標本在東亞的中生代地層中尚未發現，因此本文作者認爲當前的碎片屬於 *Ctenopteris* 的成分最多，並且屬於 Zeiller 的種也是沒有疑問的。並且在 *Pt. nilssonia* 其中軸上是有橫紋的（參看 Johansson, [70] 1922, pl.6, figs. 9—13）還有一種形態是其外側的小羽片較其內側的小羽片的體積略爲長大（參看 Harris, 1936, 插圖 29, 30）。我們的標本其羽片的中軸是有縱紋的，兩側的小羽片體積完全是相等的。

Nathorst[113]（1911 將 *Ptilozamites* 和 *Ctenopteris* 合成特別的一類（special group）Seward[156]（1917, p. 511）將 *Nilssonia, Ctenis* 及 *Clenopteris* 歸於 Nilssoniales。另一頁中（p. 512）他亦曾說過：在沒有得到一定的關於生殖器官的知識以前，這是不可能的說出 *Nilssonia, Ctenis* 及 *Ctenopteris* 的三屬和現代蘇鐵目的各類植物的重要形態相一致的程度" 在同一頁中，他並且繼續加以伸說：*Ptilozamites* 和 *Ctenopteris* 可能是屬於蘇鐵植物（Cycadean）的，而 *Ctenopteris* 的表皮細胞的構造更足以支持這個意見。Antevs 在討論一篇 *Ptilozamites* 的論文之中，也曾說過：*Ptilozamites* 是介於 *Anomozamites* 及 *Ctenopteris* 之間的。（1914, p. 6）。在同一篇論文的另一頁（1914, p. 7）中，他又特別強調地指出："Zeiller 的關於 *Ctenopteris* 屬於蕨類植物的意見，顯然是非常勉強的。我們可以肯定地說，有很多情況反對着這一種意見即此屬植物是屬於蕨類的。我曾經費神凝思過 Zeiller 的討論，覺得 *Ctenopteris* 不但外表很似 *Ptilozamites,* 並且其內部構造也很接近於此屬的。最後我願再一次地指出：這不是一件容易的事，在目前來決定這兩屬植物的分類學上的位置。但很可能這兩屬都是屬於蘇鐵植物的，或者是屬於已經絕滅了的和這兩屬十分接近的門類的。"

在一篇討論格林蘭東部植物的重要著作中 Harris（1932, 第 71 頁）明白地指出。"很相同的小氣孔發現在 *Thinnfeldia, Ctenopteris* 及 *Ctenis* 的三屬植物但是最相同的小氣孔，是一種不正常的小氣孔，這些小氣孔也可見於 *Lepidopteris* 的葉部的腹面（upper side）而這些小氣孔是和 *Ptilozamites* 的小氣孔是不能區別的。這表示着這兩屬植物是可能有連帶關係的。"

本文作者相信 *Ptilozamites* 很可能的是和 *Thinnfeldia* 及 *Lepidopteris* 一樣有屬於中生代的種子蕨類（Mesozoic Pteridosperms）的可能，而 *Ctenopteris* 也很可能是屬於中生代的種子蕨類的。

地點：陝西宜君縣四郎廟炭河溝。

地層：延長層上部。

屬名 *Protoblechnum* Lesquerx

1879-84. *Protoblechnum Lesquerx,* Vol. 1, p. 188.

?*Protoblechnum hughesi* (Feistm.) Halle

(圖版 XLVI, 圖 1—6.)

1900. *Danaeopsis hughesii* Feistm., Krasser, p. 7, pl. II, fig. 4.
1927. *Protoblechnum hughesii* (Feistm.) Halle, Halle, p. 134.
1933c. ?*Protoblechnum* sp. Sze, p. 77.
1936. *"Danaeopsis" hughesii* Feistm., P'an p. 22, pl. VIII, fig. 9, pl. IX, figs. 2-5; pl. X, figs. 1, 2; pl. XII, fig. 7.
1952. *Danaeopsis hughesii* Feistm., Brick, p. 19, pl. IV, fig. 7.

保存較佳的標本，曾被潘鍾祥[127] 在 1936 年所描述過，他當時鑑定此種化石爲 "*Danaeopsis*" *hughesii* Feistm. 當前的材料比潘同志所研究者更爲破碎，但和潘同志所研究的材料是同屬一種的，是沒有疑問的。爲使比較方便起見，我們將潘同志的三塊較好的標本重印於本文圖版 XLVI、圖 1—3 上。

最有問題的是中國北方延長植物羣中的植物，是否完全和印度的植物是同屬一種的。潘鍾祥原先的意見顯然完全相信它們是同種的。徐仁同志從印度回來後，曾對本文作者表示意見，謂潘鍾祥的鑑定尙有疑問，卽中國延長層的標本不可能屬於印度的種的。作者對於潘鍾祥的鑑定也表示着懷疑。因爲印度的種其蕨葉 (frond) 的基部是作分叉狀態的。而中國延長層的標本保存不全，不能完全證明其葉體的基部也是分叉的。因此將中國的標本毫無保留地定爲印度的種，其理由是不够堅強的。不過問題是：假使完全相同的碎片發現於印度，我們將如何鑑定。本文作者完全相信此種碎片，如在印度發現，所有的古植物學者將毫不猶豫地定爲 "*Danaeopsis*" *hughesii* Feistm. 的。因此作者將當前的標本加一問號，暫放於印度種之內，等候着將來保存完全的標本的到來。

印度的標本原先被 Feistmantel[26] 定爲 *Danaeopsis hughesi* (1882, Vol. 4, Pt. I, p. 25; pls. 4—7; pl. 8, figs. 1, 5; pl. 9, fig. 4; pl. 10, pl. 17, fig. 1; pl. 18, fig. 2; pl. 19) 上面已經提及，這一種的標本如果保存較全時其葉體的基部是很規則地作分叉的狀態的；如果其葉體保存不全的碎片，它的一切形態以及羽片的體積葉脈的型式是和我們當前的延長層的化石是絲毫沒有區別的。最近三、四十年來很多學者都不相信印度的標本是屬於 *Danaeopsis* 的，因爲它的蕨葉的形態是和歐洲種 *Danaeopsis marantacea* Heer 是完全不同的。Gothan[39] 說得最爲顯明，他在教科書 (1921, p. 60) 明白地指出："在恭華那地層 (Gondwana Schichten) 所描述的 "*D*" *hughesi* Feistmantel 就是根據它的葉體的基部經常的分叉狀態是和 *Danaeopsis* 毫無關係的；囊羣 (sori) 從未曾找到，這種植物可能根本不是蕨類"。Gothan 的意見當然是完全正確的。印度的植物根本不會是屬於蕨類而是屬於種子蕨類或其他裸子植物的。應該注意的是：Gothan 雖然指出印度的植物和 *Danaeopsis* 是毫無關係的，他仍將此種植物加一 " " 符號放在 *Danaeopsis* 之內的。Halle 教授[50] (1927b) 在討論 *Protoblechnum* 的屬名字曾有下列一段極重要的意見 (1927b, p. 131)：*Danaeopsis* 一個屬名是建立於一個瑞底克種的，這個種的實羽片及裸羽片的形態是大家已經知道的。筆者從前曾經指出 (Halle[48], 1921) 這一個屬名，應該爲 Heer 所描述的一種很特殊的實羽片化石所保留，這種實羽片的孢子囊很大，彼此不相連合而成爲聚囊和現代蕨的一屬 *Archangiopteris* 是相似的。就算這個屬名大家都明白是在表示一個裸羽片的'形態屬名' (Form-genus) 的，但這個屬名的意義是不能用於這樣廣的程度，和現在普通所用的一樣。將這個屬名的意義用得很闊廣，最先是由於 O. Feistmantel. 他將這個屬名應用於'中'恭華那系 ("Middle" Gondwanas) 的、卽從此以後一般人所知道的 *Danaeopsis hughesi* Feistm. 而這個屬名的意義推廣至於如此、是沒有根據的。Gothan (1921, p. 60) 曾表示他的意見，這一植物與 *Danaeopsis marantacea* Heer 是沒有關係的、因爲其葉體是作分叉形態的，*Danaeopsis hughesi* 的葉脈和中國的標本這裏所謂 *Protoblechnum wongii* 是完全相同的：側脈是、分叉的，有時不分叉的，自中軸直至側邊都不相結合的。而另外一方

面如 *Danaeopsis* 的'屬型'所謂 *D. marantacea* Heer 以及這一屬的其他各種,其側脈在邊緣是互相結合而成一種特徵的網脈的。因此將 *Danaeopsis* 的屬名用在 *Protoblechnum wongii* 以及普通所認的 *Danaeopsis hughesi* 的植物的可能性是可以不必猶豫攷慮地加以取消的。"在同一篇論文的第134頁,Halle 更明白地指出:"普通一般人所知道的種,所謂 *Danaeopsis hughesi* 和中國的種如此相接近,使我們必須將此種放在同一屬名之下,而名其學名為 *Protoblechnum hughesi* (Feistm.) n. Comb.。這是真的,印度種的'葉體'是常常或者可能是作分叉的狀態的;但這一個區別,根據作者的意見是不够保證作為'屬的分隔'的。"應該指出的是:Halle 對於蕨葉的基部的分叉的意義一向沒有像 Gothan 和 White 那像重視。他最後決定將印度種也放在 *Protoblechnum* 屬名之下,而主張定印度種為 *Protoblechnum hughesi* (Feistm.) Halle (1927b, 第134頁)。White[191] 在其1929年所發表的名著 Flora of the Hermit Shale Grand Canyon, Arizona 中創立一個新屬 *Supaia*, 他並且在此書第60頁特別指出"……另外一方面將印度種 *Danaeopsis hughesi* 改屬於 *Glenopteris* 或 *Problechnum* 都是不可能的,因為其蕨葉的發育的形態是根本不相同的。印度種的葉體是屬於 *Supaia* 的類型的,因此我願印度種改定其屬名為 *Supaia*。"在同一篇論文第68頁中,White 又伸說道:"被認為和 *Danaeopsis hughesi* 相一致的標本,曾被記載於山西中部的石盒子系及山東省。這些中國中部及東部的植物依據描述其葉體都是不分叉的。因其如此,按照我的判斷這些化石都不應該和印度種放在同一屬名之下,印度種據我看來是屬於 *Supaia* 的。……"。不管 White 的意見是否正確,最有意思的是在山西東南部武鄉縣的石盒子系地層中,楊敬之,王水兩同志在1954年發現一種 *Protobeechnum wongii* Halle 的蕨葉分叉的標本,同時周志炎在古生物研究所的標本儲藏室內,也找到了一塊 *Protoblechnum wongii* 的一塊幼年的蕨葉分叉的標本(此標本的標簽已經失去,根據岩石的性質,屬於華北的石盒子系,似無疑問)。更有興趣的是在河北峯峯煤田的石盒子系中也找到一塊這個種的分叉的蕨葉標本(周志炎、張善楨、張璐瑾[17], 1955, 第167—171; 插圖1)根據此種重要發現,斯行健[174,175] 最近曾作一篇論文(1955, 中國科學, 4卷1期,及古生物學報3卷1期)證明中國種和印度種。實在非常接近;並且證明此兩種應該放在一個屬名之下:中國種應定為 *Protoblechnum wongii* Halle, 印度種應該定為 *Protoblechnum hughesi* (Feistm.) Halle, 斯行健在此論文中,同時證明 White 的屬名 *Supaia* 是應該在取消之列的。講到這裏,應該提及南美古植物學家 Frenguelli 的意見。 Frenguelli[32] 在1943年的論文第289頁中,曾將印度種 *Danaeopsis hughesi* Feistm. 以及其他若干恭華那古大陸區被人曾經定為 *Danaeopsis* 的化石,放在他的新屬名 *Diplasiophyllum* 之下,並且認為是屬於 *Thinnfeldia* 系統之內(Thinnfeldia series)的。Lundblad (1950, 第17頁)對於 Frenguelli 的分類方法,認為不能滿意。她說道:"Frenguelli 的分類是完全根據材料的外表形態的;可是令人抱憾的,是他沒有去做試驗來攷慮這些葉部化石的表皮構造," Frenguelli 的重要論文不在作者手頭,因此本書作者對於他的新屬名的創立以及他的新的分類,不能作進一步的討論。但本書作者深深相信,他的新屬名 *Diplasiophyllum* 根據最近的山西東南部的重要發現也應該和 White 的 *Supaia* 一樣,同在取消之列的。 Gothan 在1954年出版的教科書(和 Weyland 合作)中第113頁中,再次地伸說道:"印度種和 *Danaeopsis* 是沒有絲毫關係的。 但這些植物顯然是和恭華那古大陸區的瑞底克(Rhaetic)期的"Thinnfeldien"尤其是和 *Dicroidium* 是有親緣關係的。"關於這一點本書作者,不作肯定的意見,但至少可以決定的是:如果印度種是和 *Dicroidium* 有親緣關係的話,那末中國種即 *Pr. wongii* 也應該和 *Dicroidium* 一類的化有同樣的親緣關係的。Gothan 在最新的教科書中沒有提到 *Diplasiophyllum* 他顯然是沒有承認這個屬名。不管怎樣說,陝北中生代延長層所發現的碎片和恭華那古大陸區尤其是印度的古生代的植物即"*Danaeopsis*" *hughesi* 相近似的程度,較甚於和中國古生代的植物即 *Protoblechnum wongii*。本書作者既完全和 Halle 教授的意見相一致,即印度種應該定為 *Protoblechnum hughesi* (Feistm.) Halle. 那末陝北延長層的植物,也應該暫定為 ?*Protoblechnum hughesi* (Feistm.) Halle. ?(n. sp.)更有意義的是:原先蘇聯奧勃魯契夫院士(Обручев) 1893—1894 在陝西北部所採集的部分化石經 Krasser 定名 *Danaeopsis hughesi* Feistm. 的標本是和當前的標本是完全相同的東西。可能是在同一地層中找到的根據 Krasser[82] 1900年論文第6頁的敍述化石發現於一個村莊名為三十里舖(San-Schi-Li-Pu)的附近的溝內。這個地點是在陝西的北部,在由吳堡縣(黃河邊)至綏德州的路上,差不多在離綏德州城東北12—15公里之處………地層的岩性是一種綠色砂岩及灰綠色頁岩。………更往西走好像都

是更新的地層，而往東走經黃河東岸至山西，較老的地層出現了，而到了柳林鎮，石炭紀的煤層出現了。" Krasser 當時相信含 *Danaeopsis* 的地層是有恭華那植物羣的親緣關係並且是屬於二叠紀（"Wohl Perm"!）的！因爲在同一地層中還發現他所鑑定的所謂 Cordaitaceenblätter（1900, pl. II, figs. 2—3）他並且相信這些葉部化石是屬於 *Noeggerathiopsis hislopi* (Bunb.) Feistm. 的（1900, p. 7）。根據潘鍾祥，1936, pl. 1 的陝北油田地質圖，與勃魯契夫院士採集植物化石的地點，顯然完全在延長層出露的地區範圍以內。而更有意思的是 Krasser 敍述的含植物化石地層的岩性所謂綠色砂岩及灰綠色頁岩也完全和延長層符合，而他在敍述中所謂更向西走都是更新的地層，更向東走經黃河東岸至於山西老的地層出現，也是完全和潘的圖相符合。而 Krasser 所鑑定的並且認爲是 *N. hislopi* 的所謂 Cordaitaceenblätter 也就是本文所定的 *Glossophyllum? shensiense* 新種。這些化石潘在 1936, p. 31 定爲 *?Noeggerathiopsis hislopi* (Bunbarg) 的。潘鍾祥當時也曾相信是可以和越南東京的相同化石完全同樣的東西，並且也相信是有恭華那植物羣的親緣關係的（1936, p. 38, 39）。下面將再提及此一問題。最後應該再指出的是被 Брик 所毫不保留地鑑定爲 *Danaeopsis hughesii* Feistm. 的哈薩克上三叠紀化石碎片（1952, p. 19, pl. IV, fig. 7）也毫無疑問是和我們的延長化石是完全相同的東西。至於他的在同一圖版所表示的其他碎片（1952, pl. IV, figs. 1—6）是否是一樣的東西，作者認爲是很有問題的。至少 Брик 的 pl. IV, fig. 6 的碎片根據本文作者的意見，也應暫加一問號放在印度種之上亦卽應暫定爲 *?Protoblechnum hughesi* (Feistm.) Halle 的。

地點：陝西安定縣窰坪。
地層：瓦窰堡煤系底部。
地點：陝西宜君縣四郎廟炭河溝。
　　　陝西綏德縣葉家坪。
　　　陝西綏德縣三十里舖。
地層：延長層上部。
地點：陝西綏德縣高家庵。
地層：延長層下部。

（二）蘇鐵植物綱

屬名 *Sphenozamites* Brongniart

1849. *Sphenozamites* ex part Brongniart, Tab. gen. Végét. foss. p. 61.
1868. *Sphenozamites*, Zigno, Cicad foss. Alp. ven. p. 14.
1870-72. *Sphenozamites*, Schimper, Traité de Pal. Vég, II, p. 70.

Sphenozamites changi Sze 新種

（圖版 XXXVI, 圖 1—2; 圖版 XXXVII, 圖 1—5; 圖版 XXXVIII, 圖 1—3.）

Sphenozamites 在地層上的分佈雖然可自二叠紀至侏羅紀，但世界各處發現此屬植物的地點並不算多，所已描述的種名，也是很稀少的。在東亞此屬植物發現更少，迄至今日僅發現鄂西下侏羅紀的香溪煤系及越南的少數地點的上三叠紀末期至下侏羅紀（Counillon,[19] 1914, p. 7）。在當前的延長植物羣的材料，發現標本較多，惟俱係碎片，且俱係保存於硬的砂岩中，比較保存較佳的一塊標本，表示在本文圖版 XXXVI, 圖 1 上。這一塊標本其葉部的保存狀況並不是平舖展開着，而是中軸兩側的羽片彼此成一銳角，（不到 35°）插入砂岩之中。因此標本的全部不易攝影，我們將此標本的兩邊攝成兩個圖影，本文圖版 XXXVI, 圖 1a 是表示着這塊標本的右側的羽片；圖版 XXXVI, 圖 1b 是表示着這塊標本的左側的羽片。

葉及羽片都很巨大。葉一次羽狀分裂，在我們的碎片上，葉的長度達 26 厘米，估計其原來的長度，至少

達100甚至150厘米以上。葉的寬度在我們的碎片達17厘米以上,在材料中有若干單獨保存的羽片其長度有達10厘米者,則原來葉的寬度至少當在20厘米以上,中軸似比較狹瘦,在我們的標本僅爲4—5毫米左右可能是受標本保存爲化石時受壓擠的緣故。中軸似甚平,上有極細的縱紋。羽片可能是互生至半對生於中軸上的,但在我們的標本,保存大致作對生的形態。羽片爲標準的斜方形,體積巨大普通其長度爲8—10厘米,其寬度爲5—7厘米,有長度及寬度較大於此者,羽片的邊緣頗直,作全緣形,無任何鋸齒,頂端爲寬圓形,基部突然收縮,着生於軸上。着生於軸上的一點的羽片寬度,普通爲4—5毫米,所有的葉脈都從中軸通過此處,而放射至葉的邊緣及頂端,葉脈爲標準的扇狀脈,非常狹細而緊密,每一厘米約有脈50條或更多於此,脈都隨便地繼續分叉數次,在羽片下邊的脈都大致和下邊的平行,羽片的上邊的脈都斜伸達於邊緣和邊成45—50°的角度。

上面已經提及 *Sphenozamites* 一屬植物的"直的分佈"是很長的,可自二叠紀直至侏羅紀。地層上的分佈,最早的一種爲 *Sp. rochei* Renault(1896[137] p. 327、1893 pl. 81, fig. 1),發現於法國 Autun 的下部二叠紀。這一個古生代末期的種,其羽片的體積(2.5×1 厘米)及其長橢圓形(oblong)的形態是和我們的種是根本不相接近的。根據 Seward[156](1917, p. 588)這一個種的羽片頗似 *Noeggerathia foliosa* Sternb. 並且和侏羅紀種 *Sphenozamites geylerianus* Zigno(1873—85[203], p. 107, pl. 39, figs. 1—2)相近似的。這一個意大利的侏羅紀種 *Sp. geylerianus* 也因其羽片的體積及形態(斜的長橢圓形至橢圓形"oblique-oblong-elliptics")和我們的種不能互相比較。另外一個 Zigno 所描述的 *Sp. rossii* Zigno(1873—85, p. 114, pl. 40, figs. 5, 6),根據 Seward(1917, p. 589),其羽片邊緣的不規則鋸齒,乃是原來作全緣形的羽片受撕破的現象,Seward 並認爲此種可和 *Otozamites beani*(L. & H.)相比較。*Sp. rossii* 也因其體積及形態和我們的種相離甚遠。*Sp. lanceolatus* Zigno(1873—85, p. 112, pl. 39, figs. 3—5)正如其種名所含意,其羽片是比較多作劍形的,其頂端是尖銳的。

和我們的種可以勉強地相比較的是一個法國種 *Sp. latifolius*(Brongn.)Saporta(1875[142], II, p. 188, pl. 112—113, figs. 1—3),但這一個體積較小並且其羽片是比較地多成圓形的,根據 Seward(1917, p. 589),這一個法國上侏羅紀種是接近於英國下白堊紀初期的 *Sewardia latifolia* 的。(Seward, 1895, p. 174, pl. II, figs. 1, 2; pl. V, fig. 1; 1919, p. 105, fig. 674)。根據羽片的體積和形態兩者的確是很近似的,但在法國種其中軸上並無支持羽片的,很堅強的向下彎曲的鈎的刺狀之物的,並且根據 Seward[157] 的意見,*Sewardia* 很可能是屬於銀杏科的。

根據羽片的體積,我們的種可和 *Sphenozamites belli* Seward(1917, p. 568, fig. 629)相比,但這一個英國 Stonesfield 的中侏羅紀種,其羽片是作楔形的,其羽片以近於基部爲最寬,漸向頂部狹細,頂端是尖(acute)的。這一個英國種其羽片的體積的長度約爲9厘米,近於基部的最寬處其寬度約爲4厘米。

北美 Virginia 上三叠紀種 *Sphenozamites rogersianus*(Fontaine[30], 1883, p. 80; pl. 43, fig. I; pl. 44, figs. 1, 2; pl. 45, figs. 1—2)其羽片的體積更爲巨大若干標本其羽片的長度可達23厘米,最寬處可達11.5厘米。羽片的形態也至爲特殊,以其頂部爲最寬向其基部漸漸地狹細,近於基部處突然地收縮而成爲"柄"狀着生於中軸上。羽片的整個周圍的形態爲楔形的橢圓形。另外一個最令人奇異的形態是脈和脈之間的很擠很密的橫條(cross-bars)。這一個北美上三叠紀中期種,雖其地層的時代和我們的延長層比較接近,和我們當前的新種是不能相比的。

另外一個南美阿根廷的瑞底克種 *Sphenozamites geinitzianus* 爲 Kurtz 所記載(Bodenbender[7], 1902, p. 40; Seward[156], 1917, p. 589)這一個南美種其地層時代大致也可和延長層相對比,但我們從未曾見到其化石的圖影及其形態的描述,因此不能和我們種作比較。很可能的這一個南美種是和我們的種相接近的。

Counillon[19]所描述的越南的瑞底克期至下侏羅紀的新種 *Sphenozamites marioni*(1914, p.7, pl. III, figs. 5, 5a)也和我們的種不能相比,因爲羽片的體積較小(其長度爲4.8厘米,最寬處在其中部約爲2厘米)羽片的形態也不相同,其上邊是向上凸起,彎向兩端的其下邊是直的。Counillon 描述其羽片的形態爲卵圓形至不等四邊形(即歪方形"Leur contour est largement ovale, trapézoidal")。這一個越南種是和我們當前的新種是相當的距離的。

在鄂西的香溪煤系的下部地層中謝家榮及趙亞曾[67] 曾在秭歸縣的游家河找到了幾塊化石經周贊衡同志鑑定爲 *Sphenozamites* sp. (Hsieh & Chao 1925, p. 61; Sze, 1949, p. 1) 同樣的化石,後又經筆者 (Sze[172], 1949, p. 25) 1937 年在湖北南漳縣東鞏鎮的陳家灣的香溪煤系中找到。秭歸的化石其形態及體積,因未曾見到其標本,不知是否和南障縣的標本是完全相同的。秭歸和南障相距不甚遠且屬同一地層,兩者完全相同是可能的,但南障的標本,因受戰爭影響,作者曾保存於武昌,後又全部遺失。筆者 [172](1949, p. 25) 曾經指出,此種和越南的 *Sp. marioni* Counillon 是可以相比的。但作者應該利用此一機會再次地指出,香溪系的標本雖其體積和越南的種相近似,羽片的形態多少有些區別,香溪系的種,其羽片是比較多成斜方形的。因此香溪系的種也很可能是代表一個特別的種的。作者希望在未來的採集工作中,在鄂西的香溪系中找出更多的 *Sphenozamites* 化石以證實之。

以羽片的體積而論,我們的種最接近於北美上三叠紀中部的 *Sphenozamites rogersianus* Fontaine (Fontaine[30] 1883, p. 80; pl. XLIII, fig. 1; pl. XLIV, figs. 1,2; pl. XLV, figs. 1,2)。但這一個北美的三叠紀植物,根據 Fontaine 的描述以及根據他發表的圖影,葉脈比較我們的種鬆得多,並且脈和脈之間是有橫肋的。這些橫肋 (cross bars) 根據 Fontaine 的解釋是羽片的表皮上的細粒,因爲保存而爲化石時曾受擠縮,這些細粒伸長而變成横紋或橫肋,橫互於脈和脈之間的。

作者定當前的新種爲 *Sp. changi* 贈榮譽於已故的章鴻釗老夫子,他的崇高的人格,敦厚的風度,淵博的學問及獎勵後進的精神,曾得到中國全體地質同志的思慕。

Sphenozamites 一個屬名最先爲 Brongniart 所創立,他將此屬名認爲是 *Otozamites* 一個亞屬 (Subgenus),他同時說明 *Sphenozamites* 的羽片在其基部是不和 *Otozamites* 一樣而成爲耳狀的,他同時指出:這一個"亞屬"可能成爲一個單獨的屬,後來 Zigno 就將此亞屬脫離 *Otozamites* 而單獨成爲一屬直至今日爲人所承認。此屬植物,可能也是蘇鐵植物的一份子,但直至今日尚未能找出生殖部分的化石,也未能知道其表皮構造及小氣孔的形態,根據 Seward (1917, p. 587) 這個名字的含意雖似和現代的一屬蘇鐵 *Zamia* 有關,但最好不要太快決定其植物學上的地位。在 Gothan 最新出版的教科書中,*Sphenozamites* 一屬,已正式地將其歸於蘇鐵植物類了 (Gothan & Weyland[42], 1954,第 295 頁)。

地點: 陝西宜君縣杏樹坪七母橋。

地層: 延長層上部。

蘇 鐵 植 物 綱?

屬名 *Drepanozamites* Harris

1932. *Drepanozamites* Harris 1932b, p. 83.

Drepanozamites? *p'ani* Sze 新種.

(圖版 XL, 圖 1, 1a, 2.)

關於這一個形態奇特的種,在我們的材料中,僅有兩塊碎片。"葉"一次羽狀分裂,中軸甚平,寬約 5 毫米,葉的長度不明,可能在 40–50 厘米以上。羽片以在其基部爲最寬,基部寬約 15–16 毫米,羽片的長度不明,估計當在 4 厘米左右。羽片互生於中軸上,其上邊較彎在基部突然收縮,羽片的下邊比較直,在基部微向下延。中脈在其基部甚爲粗強,但不明顯,以一銳角自中軸伸出後卽向外,大致和羽片的下邊相平行,中脈伸至中途到達羽片的中部及前端時更比較地模糊,卽其粗度已減退和側脈的粗度大致相等。大多數的側脈很明顯地是從中脈以一極銳的角度伸出的,若干側脈顯然是從中軸直接伸出的,側脈彎向羽片的上下兩個側邊直達邊緣在羽片頂部的側脈,當然是彎向羽片的頂端的。側脈似不甚擠,普通分叉兩次,很偶然地若干支脈到達邊緣時又再分一次。

這兩塊碎片的屬名,非常難定,作者經過相當猶豫以後始決定用一問號定爲 *Drepanozamites*. 這一個屬

名是 Harris 1932b. 所創的,他同時加以簡單的說明,他說（1932 b, p. 83）"根據普通形態以及葉脈 *Drepanozamites* 頗似 *Otozamites*（和此屬不同之點,在表皮構造）並且在較少的程度下，頗似 *Sphenozamites* 及 *Plagiozamites*. 它的表皮構造又好像和 *Sagenopteris* 相一致，一切形態尙不能完全決定此屬植物的親緣關係。"

這一屬植物的"屬型"名爲 *D. nilssoni*（Nathorst）Harris, Harris 1932b, p. 83 曾將前人所定的不同學名列於下列的這一個異名表:

1878.. *Otozamites nilssoni* Nathorst 1878c, p. 26.
1878. *Adiantites nilssoni* Nathorst 1878c, p. 53, pl. 3, fig. 11.
1879. *Adiantites nilssoni*, Nathorst, p. 56.
1879.. *Adiantites agnitus* Nathorst, p. 57, pl. 11, figs. 11, 11a.
1886. *Adiantites nilssoni* Nathorst, p. 120.
1932b. *Drepanozamites milssoni* (Nath.) Harris p. 83, pl. 8, figs. 1, 2; Textfigs. 44, 45.
1937. *Drepanozamites nilssoni* (Nath.) Harris, p. 27.
1933b. *Rhacopteris*(?) *gothani* Sze p. 42; pl. 11, figs. 1-3.

根據上列的異名表上的各種前人所定的不同的屬名我們卽立刻明白，Harris 所創的屬名 *Drepanozamites* 是不會有中脈的。這在 Harris（1932, p. 83）所述的種的特徵中以及這篇論文 p. 84, 及 p. 85 的插圖 44 及 45 F,G 也可以看出來的。關於種的特徵中，他明白地指出"脈狹瘦，所有的脈都從羽片基部的着生於軸上的一點放射散佈出去,隨便地分叉,………"

我們的碎片,葉的形態及體積,以及羽片的形態及體積者和 *D. nilssoni* Harris 幾乎是完全相一致的,並且其很平而寬的中軸形態也完全相同。所不同的是在我們的標本是在羽片的基部，自中軸以一銳角伸出的一條不甚顯明但極粗厚的中脈,並且大多數側脈雖然也是成放射而散佈出去的形態的,但很明顯地是以一極銳的角度自中脈伸出的。因此如果將當前的植物定爲 *Drepanozamites* 是有相當的勉強的。和 *Drepanozamites* 一樣，我們的植物的全部形態也接近於 *Otozamites, Sphenozamites* 及 *Plagiozamites* 的，惟一的不同是上述的三屬,都是沒有中脈的,其葉脈的型式都是屬於放射脈的類型的。Harris 不能完全決定 *Drepanozamites* 的分類學上的地位,當前的標本似乎也不能完全決定的。最可惜的是:當前的碎片和所有延長層所發現其他一切標本相同,沒有保存着炭質薄膜,因此不能用浸解方法來研究其表皮構造及小氣孔的類型，來和 *Drepanozamites* 以及其他各屬植物互相比較。這一個新種是贈榮譽於潘鍾祥同志的。

最後更應該特別指出的是:本文作者 1933 年所定的幾塊 *Rhacopteris? gothani* 的江西萍鄉標本，Harris 曾列入於 *D. nilssoni* 的異名表之內,他並且加以詳細討論,說這些標本是的確屬於 *D. nilssoni* 的（1937, p.）。他說:"Sze（1933b. p. 42）最近描述幾個中國標本定其學名爲 *Rhacopteris*(?) *gothani*，這些標本根據形態及葉脈是完全和格林蘭的標本相同的,並且可能是同屬一種的。"作者完全同意將萍鄉的標本歸於 Harris[56] 所創的屬名 *Drepanozamites*，但不同意將格林蘭的種和萍鄉的種視作一種，萍鄉的標本,顯然是代表着一個新種,因爲其羽片的上邊是彎曲成波浪狀並且有成爲圓裂片（lobes）的傾向的,這和格林蘭及瑞典的所有標本其羽片的上邊完全是直的作全緣形態是完全不同的。本文作者擬定萍鄉的標本爲: *Drepanozamites gothani*（Sze）。

地點: 宜君縣四郎廟炭河溝。
地層: 延長層上部。

屬名 *Sinozamites* Sze 新屬

本文作者想信最好爲延長層所發現的一種奇特的葉部化石，另創一個新的屬名。這個新屬名 *Sinozamites* 的含意是此種化石到現在爲止僅發現於中國,並且因爲葉的形態及其平行脈的型式是接近於現代蘇鐵類的一屬 *Zamia* 及中生代的 *Zamites* 的。

Sinozamites leeiana Sze 新屬,新種

(圖版 XXXIX, 圖 1—3; 圖版 L, 圖 4; 圖版 LIII, 圖 5.)

着生葉的枝部化石其寬度至少爲 24 厘米,長度不明。中軸比較地甚爲狹細,寬僅 2 毫米,上有極明顯的縱紋。葉對生於中軸上,以一寬角自軸伸出,葉爲線形,其頂端似爲截形其基部突然地收縮而以一寬約 1 毫米長的短"柄"着生於軸上。葉着生於軸上似不緊擠,其互相距離之處約爲 14 毫米至 3 厘米,葉的長度約爲 12.5 厘米;其寬度約爲 1.3—1.5 厘米。葉的頂端及前半部的兩側邊都作長伸的細齒形態但此種細齒顯然並非眞正的齒而是葉或羽片撕破後的形態。葉的肌理(texture)似不甚厚。脈甚爲顯明,所有的脈都輻合(converging)於葉的基部的短柄上然後向外伸出在基部分叉一次後再繼續地自由分叉數次直達頂端,兩側的脈亦有伸向側邊者。脈大致互相平行,在葉的前部,每一厘米有脈 21 條。表皮構造,未曾明白;生殖器官化石尙未找到。

根據葉的體積及其形態 *Sinozamites* 或多或少地有些像古生代末的 *Tingia*, 尤其是像 *T. crassinervis* 及 *T. carbonica* 兩種的狹長的葉;但在 *Tingia*, 葉的基部並不是突然收縮作短柄的形態的,並且其葉脈也較粗較鬆;此外其他一切態如葉的四行佈置的狀況 *Tingia* 和 *Sinozamites* 是完全不能相比的。

Du Toit[33] 在南非洲的上部開羅層所描述的一屬奇異的植物定名爲 *Moltenia dentata* (1927, pt. 2. 第 380 頁 20) 其葉的體積及形態,多少可和我們的化石相比較,但南非的植物其葉的側邊有顯明的鋸齒幾乎直達基部,葉的基部雖亦稍有收縮,但仍微微地向下延於軸上,脈是作 *Pseudoctenis* 的型式的。Du Toit 相信他的新屬有屬於本勒鐵目(Bennettitales)的可能。

在現代的蘇鐵植物其葉的形態及體積可以略作比較的是 *Endocephalartos* 但在後者的葉片是比較地多成劍形的,其頂端尖銳,其基部雖然也曾收縮但並不收縮而成爲"柄"狀的,並且其葉脈也較鬆,葉的肌理也似較厚。葉的兩側邊的鋸齒也是作標準的堅強的,尖銳的的齒狀,並且在葉片的後半部也有鋸齒,齒的分佈也比較似有規則的,因此和當前的新屬是不能相比的。若干種 *Endocephalartus* 雖然其鋸齒,也是限於葉的頂端的,但其葉的形態又和我們不相同,其頂端是漸漸地狹細的,其基部也是漸漸地狹細的。其他現代蘇鐵類植物的葉,還沒有可以和我們的化石相比較的。

這一個新種的命名是貢獻給筆者的老師李四光教授的。

地點:宜君縣杏樹坪黃草灣七母橋。

地層:延長層上部。

(三) 銀杏植物綱

屬名 *Ginkgoites* Seward

1919. *Ginkgaites* Seward, Fossil Plants IV, p. 10.

Ginkgoites chowi Sze 新種

(圖版 XL 圖 3; 圖版 XLVII, 圖 2.)

這一個新種以葉的形態頗似中國的鐵鏟爲其特徵。葉的長度至少爲在 5 厘米以上,寬度約爲 6.5 厘米。葉柄頗堅強寬達 4 厘米,其長度不明。葉的基部幾乎成寬的截形,葉膜頗寬闊,肌理帶革狀,表面微現褶皺。葉的邊緣幾乎爲全邊形其前邊可能淺淺地裂開。脈不甚密,由基部放射地伸出分叉數次直達邊緣。

最標準的一塊標本,表示在圖版 XL, 圖 3 上。此標本以葉的形態如鐵鏟令人特別注意。圖版 XLIII, 圖 2 的這一塊化石,保存更不完全,其扇狀脈亦甚疏鬆,可能是同屬於一種的。此新種以其葉的不深裂爲其

特徵,而接近於現代的 *Ginkgo biloba.* 在新生代的地層,葉膜不甚深裂的 *Ginkgo* 化石,發現比較多;在中生代早期的地層中,此種類型的 *Ginkgo* 葉部化石,是非常少見的。潘鍾祥[127] 在延長植物羣中所描述的 *Ginkgo magnifolia* Fontaine (1936, p. 29; pl. XII, figs. 9, 10; pl. XIV, fig. 4),葉的體積亦甚巨大,但葉膜比較深裂,可能和我們的標本是不同種的。我們的種因爲葉膜不深裂比較接近於 *G. antarctica* (Saporta) (Du Toit 1927, pt. 2, 第 368 頁 16A). Thomas (1911, p. 74, pl. IV, fig. 8) 在 Kamenka 所描述的 *G. polaris* Nathorst 也大致可以和我們的種相比較因爲其葉膜僅在前端淺淺裂開。不過 Kamenka 的標本葉的基部比較多成楔形的,並且標本保存不全無法作更進一步的比較。

我們的新種也頗似奥國 Lunz 上三叠紀的 *Ginkgoites lungzensis* (Stur) Florin 的若干標本,尤其似 Kräusel 1943, pl. I, fig. 7 的一塊標本。這一塊 Lunz 的標本其葉膜也很寬,基部作寬的心形和我們的標本較相近似。但 Lunz 的多數標本其葉的前部是深深地裂開的,因此是否和我們的完全同屬一種,不能决定。

此一新種贈榮譽於周贊衡同志,他是中國第一個研究古植物學的學者,他生平以一絲不苟的人格,虛懷若谷的風度,爲中國地質界所敬佩。

地點:陝西宜君縣杏樹坪的七母橋。

地層:延長層上部。

Ginkgoites sp.

(圖版 XLVII, 圖 3, 4.)

兩塊很小的碎片,保存極不完全。葉的基部作楔形,葉前部似裂開而爲4個裂片。葉柄細長,脈不甚明顯。此種碎片頗似大石[121] (Ôishi) 所研究的一塊定爲 *G. digitata* (Brongn.) 的標本 (1940, pl. 38, fig. 9),日本的這一塊標本和當前的碎片一樣是否眞屬於此種,是很可懷疑的。

地點:陝西宜君縣杏樹坪黃草灣七母橋。

地層:延長層上部。

屬名 *Glossophyllum* Kräusel

1943. *Glossophyllum* Kräusel, Palaeontogr. 87, B. p. 61.

Glossophyllum? *shensiense* Sze 新種

(圖版 XXXVIII, 圖 4, 4a; 圖版 XLVIII, 圖 1—3; 圖版 XLIX, 圖 1—6; 圖版 L, 圖 1—3; 圖版 LIII, 圖 7b; 圖版 LV, 圖 5.)

1900. Cordaitaceenblätter *Noeggerathiopsis hislopi* (Bunb), Krasser, p. 7, pl. II, figs. 2, 3.

?1903. *Noeggerathiopsis hislopi* Zeiller 1903, p. 149, pl. XL, figs. 1-9.

1936. ?*Noeggerathiopsis hislopi* (Bunburg), P'an, p. 31; pl. XIII, figs. 1-3.

這一個最先被潘鍾祥 (1936, p. 31, pl. XIII, figs. 1—3) 定爲 ?*Noeggerathiopsis hislopi* (Bunbury) 的種,在當前的材料中,比較豐富,並且保存也比較完善。以體積及一切外表的形態而論,我們的標本似乎更接近於恭華那區的種。潘的描述如下"葉的長度達 8.5 - 9.5 厘米,寬度達 1.2 厘米。葉漸漸地狹細而到達一個狹的基部,葉的頂部收縮而作鈍圓形。這一個種具有特徵的縱脈每一厘米約有脈 17—20 條。脈在葉膜的各處分叉數次。"我們的新的材料較潘所採集的葉的寬度和長度變異頗鉅,最寬的葉其寬度幾達 4.5 厘米,(圖版 XLIX, 圖 2)。最普通的標本其最寬處的寬度大致爲 3—4 厘米,其長度達 23 厘米尙未保存完全(圖版 XLVIII, 圖1—3)。另外一塊標本(圖版 XXXVIII, 圖 4, 4a) 其寬度爲 2 厘米 (可能爲 2.5 厘米),其長度達

12 厘尚未保存完全，這一塊標本，葉的基部保存比較完善，基部的寬度約爲 2 毫米左右。在我們的材料中，葉的頂端及基部多數未曾保存，在圖版 XLIX，圖 1 所表示的一塊化石，其頂端雖亦破碎不全，但收縮而作鈍圓形的形態甚爲顯著。最小的標本表示在圖版 L，圖 2，2a 及圖版 LV，圖 5，這些標本長約 5—6.5 厘米寬僅 2 厘米，但其形態仍甚爲標準，大致同潘所描述的標本（圖版 L，圖 1）相一致的。

如果僅僅根據葉的寬度及其長度以及其一般形態及葉脈的型式，當前的材料，實在和恭華那區古生代的 *Noeggerathiopsis hislopi* 是完全一致的。我們試查一查文獻譬如 Seward & Sahni[160]，1920，Palaeontologia Indica n. ser. Vol. VII, No. 1, pl. I, figs. 8—10 及 Feistmantel[26]，1882，Palaeont. Ind. Ser. XII, Vol. IV, pl. XIV, figs. 1—3, 9；pl. XX, figs. 6, 10 更爲明白。*Noeggerathiopsis* 也發現於盎格蘭區的上二叠紀（Нейбург[115]，1948，p. 208—232 pl. 50—63），多數的標本，似乎也和當前的材料相一致的，尤其是 Нейбург 論文的 pl. 50—54 的各圖及 pl. 59，pl. 61 的各圖和我們的種更相一致。這是很可懷疑的，盎格蘭區的材料可分裂而爲如此多的種。如果我們將當前的材料，也分成多種敍述，也是一樣沒有任何意義及科學根據的。作者完全相信，當前的材料雖然葉的形態及體積頗有變異，它們是的確代表着一個種的。但這一個種是否應該毫無保留地定爲 *Noeggerathiopsis hislopi* 呢？根據最近的知識，我們覺得這一個意見也應該加以相當的保留的。因爲我們的種也很似奥國 Lunz 地方的上三叠紀的定爲 *Glossophyllum florini* Kräusel 的很多標本的，而這一個上三叠紀種原先也曾被 Krasser 定爲 *Noeggerathiopsis* 的（1910，p. 121）。1943 年 Kräusel[81] 經過詳細的研究並根據表皮及小氣孔的構造，將 Lunz 的種，創立一個新屬爲 *Glossophyllum* 並定其新種名爲 *G. florini*（1943，p. 61—72）。根據表皮及小氣孔的構造，Kräusel 相信 Lunz 的種是屬於銀杏植物的。他這樣說（1943，p. 70）："它（指 *Glossophyllum*）的分類學上的地位因此非常清楚，它既不是松柏植物，也不是苛達狄植物（Cordaiten）而是銀杏植物（Ginkophyten）." Kräusel 並且在其論文第 62 頁中說道："Krasser 曾將 Lunz 的標本和越南東京的上三叠紀的葉部化石相比較，這些葉 Zeiller（應該是不對的 Wohl zu unrecht!）是定爲 *Noeggerathiopsis hislopi* 的。" Kräusel 在討論 *Glossophyllum* 一屬植物之末（原文 p. 72）再特別強調地指出："*Glossophyllum* 現在僅限於 Lunz 但同樣的植物可能在中生代分佈甚廣，不過將這些化石詳細地加以討論是沒有價值的，如果在我們沒有知道這些葉化石的關於解剖方面的知識以前。" Kräusel 對於東京的化石再討論一下，這種化石 Zeiller[201] 是定爲 *Noeggerathiopsis hislopi* Bunb. 的（1903，149 pl. 40，figs. 1—6），他這樣說："Krasser 將 Lunz 的標本和東京的化石相比較是完全正確的：因爲就所有我所知道的化石標本，以外表的形態而論，東京的化石的確和我們的 *Glossophyllum* 是最相接近的。這些標本似乎是不可以毫無保留地定爲那個學名（指 *N. hislopi*）的。印度恭華那層的化石根據形態及葉脈，以及解剖方面的構造是和 *Glossophyllum* 是很不相同的，可能根本不是銀杏植物（Seward & Sahni[160]，1920，4 pl. 1）。很可能的東京的葉部和印度的化石是根本沒有關係的。但東京的化石是否眞正是 *Glossophyllum* 呢？我們尙須等待着將來的證明。" 本文作者認爲支持這個意見的，是在東京除葉部化石外，還有枝幹部的化石，這些化石，Zeiller 自己也定爲"枝幹化石的碎片，可能是屬於 *N. hislopi* 的"（1903，pl. 40，figs. 7—9 各圖版說明）。在當前的材料中，我們也看到一塊相似的標本（本文圖版 XLIX，5，5a 圖）下面將再提及。這些枝部化石無疑地是屬於 *Glossophyllum* 的，因爲或多或少和 Lunz 的枝部化石相似的。

上面已經講過，我們的標本潘鍾祥是定爲 *N. hislopi* 的，他自己認爲他的標本是和 Zeiller 的是完全相同的，因爲他在異名表上，曾將東京的標本列入（1936，p. 32）。可惜的是，潘鍾祥在 1936 年所發表的重要論文 Kräusel 似未曾見到，否則他一定也會加以討論的。最成問題的是，上面已經提及，根據體積及一切外表的形態而論，我們當前的材料更接近於恭華那區古生代的種。因此將當前的材料用一個問號？定爲印度古生代的種是完全正確的。同時我們的材料也接近於 Lunz 上三叠紀的化石，而這些化石根據 Kräusel 最近的研究是定名爲 *Glossophyllum florini* 的。雖然我們的材料未曾保存炭質薄膜不能研究其表皮構造，因爲其地層時代大致可以對比，我們將當前的材料，暫定爲 *Glossophyllum*？似乎也是完全正確的。作者經過很久的考慮以後，決定採用後者的定名方法。

Glossophyllum 這一個屬名是 Kräusel 1943 所創造的，它的"屬的特徵"根據 Kräusel（1943，p. 71）應該如下：

"枝幹部所着生的葉是作螺旋狀排列的；葉堅強，皮革狀，全緣形，或多或少成舌形，直，或彎成鐮刀形其最寬處在其中部，頂端鈍圓，葉向下部緩緩地狹細，最後幾乎狹細如柄狀，其基部微微地較凸，在此處有2條維管束（卽脈）穿進，脈在葉的下半部分叉後，繼續地分叉，最後造成很多或多或少地的平行脈。葉的上下兩表皮都有小氣孔，下表皮較多。小氣孔直列成帶，每帶以無小氣孔的帶互相隔離。在氣孔帶中，小氣孔成很密的，不規則的排列的許多縱行。小氣孔的方向佈置也是沒有規則的，但大致是照着脈的方向延長的。"一唇形"（einlippig）爲1—2圈副衛細胞所包圍，保圍細胞微微地下陷，副圍細胞爲4—7個細胞所組成，多數副衛細胞有'乳頭突起'向着竅孔。上表皮的小氣孔基本上是一樣的構造，但數目較少，其排列成帶的佈置比較不顯明，其小氣孔常常是照着脈的方向佈置的。表皮細的壁是直的，有圓形的乳頭突起，乳頭突起的強弱大同。"

Glossophyllum florini 的"種的特徵"如下：

"葉的長度爲6—25厘米，寬度爲6—26毫米，維管束（卽脈）的數目爲5—15，普通爲6—8，基部的脈自第一次分叉以後，然後其內邊的（卽位在葉的中部的）的一條支脈先再分叉一次，然後其外邊的（卽位在葉邊的）的一條支脈再繼續地分叉。小氣孔的密度頗有變異（每一毫米見方處爲7—32個）較外面的一圈副衛細胞普通發育不完全，兩極和兩側的副衛細胞（polare und seitliche Nebenzellen）形態相同，因此至少在下表皮的小氣孔的整個形態是或多或少成圓形的，上表皮的小氣孔是比較作伸長形延着脈的方向伸長的，表皮細胞的'乳頭突起'的發育強弱不同。"

Kräusel[81] 在敍述時曾經提到他的材料異常豐富，他的葉的長度及寬度及其葉脈是根據數十塊標本統計的結果的（1943, p. 63 插圖1及65—66的統計表）。他在種的特徵中雖然說脈的數目爲5—15普通爲6—8，但他在原文 p. 63 中又提到有一塊標本（原文 pl. IV. fig. 11）有20條脈。根據浸解方法的結果也證明這一塊標本，是另一種植物！

在當前的材料中；葉的長度和寬度亦變異甚鉅，但我們僅有十餘塊標本，因此用不着用統計的方式。不過應該明白地指出的是，我們的標本其長度及寬度，都超過 Lunz 的所有化石，葉脈的數目亦顯然較 Lunz 的化石爲多，同時葉的最寬處似乎是在葉的前半部，而不是其中部。至於葉的基部是否最先也祇有2條脈通進，因爲基部都未曾保存，未能確實證明。顯然我們的種是和 Lunz 的化石不同的，而是代表另一種植物甚至可能是另一屬植物的。最有意思的根據 Kräusel, Lunz 的種，葉是螺旋地着生於一個枝幹上的（1943, p. 64, 插圖4; pl. VII, fig. 9）。同樣的枝幹在我們的材料中也找到了兩塊（本文圖版 XLIX, 圖5, 6）枝幹的寬度和 Lunz 的化石大致相同，並且在葉遺落後的如眼睛狀的葉痕兩者也完全一致。可惜的是我們的標本沒有炭質薄膜，無法用浸解方法研究其表皮及小氣孔的構造。根據 Kräusel, Lunz 的葉其基部最初是祇有2條脈通進的這是銀杏植物葉的特徵並且小氣孔的構造是和銀杏植物相一致的。在同一篇論文中他又敍述了一種 *Ginkgoites lunzensis*，它的表皮及小氣孔的確和 *G. florini* 是屬於同一類型的。Lunz 的葉部化石屬於銀杏植物是可能的。我們的化石的屬於銀杏植物是尙須加以保留的態度的，因爲上面已經提及葉的基部未曾保存而且表皮構造也未明白。總而言之，我們的化石其植物上的地位尙未能完全決定。我們的化石，定爲印度的種是必須加以保留的態度的，定爲 Lunz 的屬名，也必須是加以同樣保留的態度的。因爲延長層及 Lunz 的含化石層其地質時代是大致可以對比的，作者決定暫定我們的化石爲 *Glossophyllum? shensiense* Sze 新種，等候將來的證明。

圖版 LV，圖5所表示的一塊很小的標本，長僅5厘米，其最寬處在葉的前半部，此處寬約11毫米，頂部鈍圓，脈細而密。這一塊標本的體積和形態頗似 *Torellia*（=*Feildenia*）但脈較多而密，因此不可能屬於 *Torellia*。很可能的這一塊小型葉部化石也是屬於 *G. shensiense* 的。應該指出的是，在 Lunz 的同一地層，小型的葉部化石也發現很多，Kräusel 也俱定爲 *G. florini* 的（1943, pl. II, figs. 9, 10, 11; pl. IV, figs. 3—7; pl. VI, figs. 11, 12; pl. VII, fig. 3; pl. VIII, fig. 1）。更有意思的是，Lunz 有一塊化石，也和同一地點的其他化石不同，其最寬處是在葉的前半部而不是在葉的中部的（葉的長度爲5.6厘米最寬處的寬度爲11毫米，頂端亦作鈍圓形），其葉脈似亦甚細而密，和我們的化石完全一樣。Kräusel 仍定此塊標本爲 *G. florini*,（1943, pl. VIII, fig. 1），在圖版說明上（1943, p. 91），他說明這是一枚"形態不正常的，匙形的葉"（"Anormal geformtes, löffelformiges Blatt"）。

從這種小型的葉部化石的完全相同的一點來看，我們也覺得我們延長層的大型葉部化石屬於 *Glossophyllum* 的可能性也是很大的，何况上面已經提及在我們的材料中，也有一塊枝幹部化石而這塊枝幹部化石也和 Lunz 的枝幹化石完全一致的。我們將當前的化石的"種的特徵"簡述之於下：

Glossophyllum? *shensiense* sp. nov.

種的特徵：葉的長度爲 5—28 厘米（標本上保存爲 25 厘米，未曾保存保存完全）最寬處在葉的前半部，此處的寬度自 1.1—4 厘米，脈細而密，自基部分叉後繼續地分叉數次各支脈大致互相平行，頂部的脈，輻合於頂端。每一厘米有脈大致爲 14 條。表皮構造，未曾明白。枝幹部化石寬約 1 厘米，上有大致成螺旋狀排列的葉痕，葉痕如眼睛狀，橫列於枝上，其高度僅爲 0.5 毫米，寬度爲 3—4 毫米，兩側角尖銳。葉痕的寬度和葉的基部（本文圖版 XXXVIII，圖 4）的寬度大致相同。

越南東京煤田的化石，潘鍾祥曾將其和延長層的化石列於同一異名表內。Kräusel（1943，第 62 頁，72 頁）也相信它可能是屬於 *Glossophyllum* 的。本書作者的意見是：東京的化石也應該定其屬名爲 *Glossophyllum*?。最有意義的，是在東京煤田也曾發現相同的枝幹化石（Zeiller，1903，pl. 40，figs.7—9）。是否東京的種和我們的種是完全相同的呢？本書作者暫時採取保留的態度，第一，因爲根據當前的材料，陝北的標本，其多數葉部是要寬闊的多，並且形態也多少是不同的。第二，東京的化石似可暫定爲 *Glossophyllum*? *zeilleri* (Seward) n. Comb. 因爲 Coggin Brown[14]（1938）曾在雲南找到和東京相同的植物羣，經 Seward 暫時鑑定，其化石名單發表於 Sahni[140] 1936 年的文章中，其中之一定爲"*Pelourdea zeilleri* sp. nov."。Sahni 的原文，我們無法找到，根據 Coggin Brown，好像 Seward 和 Sahni 的意見，雲南的標本是沒有疑問地和東京的種即 Zeiller 所定的 *Noeggerathiopsis hislopi* 是相同的。應該特別指出的是：雲南的材料曾經 Sahni 帶至巴黎，得到礦業學校的 Painvain 教授的允許，和 Zeiller 當年所研究過的所有"種型"化石相比較後得出的結論是，雲南的材料和東京植物羣有不可否認的親緣關係的，並且沒有一種化石是和華恭那植物羣的種是相同的（參看 Coggin Brown[14]，1938；Sze[172]，1949，第 52 頁）。筆者最後的意見是：如果經過種種事實證明，陝北的化石是和雲南的被定爲 *Pelourdea zeilleri* 的標本（Sahni 的文章及圖及其原來的化石，我們尚未見到！）是完全相同的，那末，*shensiense* 的一個新種名，應該取消之，而這一個種應該定名爲 *Glossophyllum*? *zeilleri* (Seward) nov. Comb.

或多或少相似的葉部化石，也於最近發現於中國的二叠紀地層中，曾經斯行健定名爲 *Pelourdea hallei* sp. nov.（斯行健[176]，1955，第 198 頁）在這篇論文中，作者完全支持了 Halle 教授在 1927 年所給的關於 *Pelourdea* 的"狹的定義"，並且指出：*Glossophyllum* 是一個天然的屬名而 *Pelourdea* 是一個形態屬名，兩者的關係和 Walchia 之於 *Lebachia*，*Phoenicopsis* 之於 *Windwardia* 似乎是相等的。因此作者認爲延長層的化石似乎暫定爲 *Pelourdea*（*Glossophyllum*?）*shensiensis* 亦無不可，當然 Lunz 的標本根據同樣理由，似乎也可以定爲 *Glossophyllum*（*Pelourdea*）*florini* 的。最有意義的是中國的二叠紀化石，其葉基也明顯地證明了是僅有兩條葉脈的，因此也和 Lunz 的化石一樣是屬於銀杏植物目，或者是接近於此目的（參閱斯行健，1955d，第 199，圖版 I，圖 1，1a）。

最後應該特別指出的是：Halle[46]，1910a 年（Arkiv，f. Bot.，Bd. 9，No. 14，p. 1—5，pl. I，figs. 1—6）所發表的幾塊瑞典 Scania 的瑞底克期的幾塊定名爲 *Phyllotenia*(?) *hadroclada* Halle 的化石，Kräusel 似乎沒有注意，因爲他在他的重要著作中始終未曾提及。這幾塊瑞典瑞底克期的化石，根據本文作者之意是有屬於 Lunz 的 *G. florini* Kr. 的可能的。兩者的枝部化石完全一致，葉的着生狀况亦完全一致，葉的體積和形態，也和 Lunz 的小型葉部化石完全一致。葉脈是平行脈，最寬的碎片中有脈 10—12 條，也和 Lunz 的化石完全相同。不過 Halle 曾經指出，脈是不分叉的（1910，p. 3；pl. I，fig. 6），但在同時說明（1910a，p. 2）"我們祇能追隨每一條脈到很短的距離，等到看不見時，脈似乎分叉而爲兩個支脈"很可能的，瑞典的標本其葉脈也是分叉的。不過 Halle 在原文 p. 2 中指出："枝幹的葉痕中有幾個小而不清楚的小點痕，它們的數目及其佈置狀况不能正確决定，它們好像至少有三點，可能還要多，橫列地佈置着的。"如果 Scania 的葉的基部至少有 3 條甚至多條維管束（參觀 Halle 1910a，pl. 1，figs. 2—5）通進的，那末不可能和 Lunz 的標本同屬一種了。但這一點，Halle 當時可能是直覺的視察（Subjective interpretation）可能是看錯了的！根據

Lundblad (1950, p. 50) 這一個瑞典種,後被改爲 *Yuccites hadrocladus* (Halle) Florin 的。她並且伸說道:"它的表皮構造和 Florin 1937 Textfig 8a 的構造是不相同的。" Florin 1937, Textfig. 8a 的表皮構造是屬於 *Sphenobaiera pancinervis* Florin 的。可惜的是 Lundblad 並未曾說明所謂 *Yuccites hadrocladus* (Halle) Florin 一個種的表皮及小氣孔的構造的形態,否則我們可以完全决定瑞典的標本是否和 Lunz 的同屬一種了。如果將來經過種種事實證明,兩者完全同屬一種,那末根據優先例 Lunz 的化石似乎也應該可定爲 *Glossophyllum hadrocladum* (Halle) 的!應該再指出是:瑞典的標本,也曾經 Seward (1917,第 280 頁) 改定爲 *Pelourdea hadroclada* (Halle) Seward 的。

Брик 在哈薩克的上三叠紀所描述的 *Yuccites spathulatus* Pryn. 根據上面的討論很可能的是和我們陝北延長層的種是相同的 (參看 Брик,[9] 1952,圖版 XV, 圖 1—12)。

地點: 陝西宜君縣四郎廟炭河溝。
陝西宜君縣杏樹坪七毋橋。
陝西延長縣渠口村河北岸。
陝西綏德縣三十里舖的一個溝內。
地層: 延長層上部。
地點: 陝西綏德縣沙灘坪。
地層: 延長層中部。
地層: 甘肅華亭縣硯河口。
地層: 延長層下部。

屬名 *Sphenobaiera* Florin

1936. *Sphenobaiera* Florin, p. 101.

Sphenobaiera crassinervis Sze 新種

(圖版 IX, 圖 5, 5a)

這一個很有意義的種可惜僅有一塊標本,並且保存也不很完善。根據葉的分叉狀態尤其是根據沒有明顯的葉柄的狀況,我們知道,這一塊標本是屬於 Florin[28] 1936 年所創的新屬名 *Sphenobaiera* 的。

葉作長楔形,體積頗巨大,在標本上僅作一次分裂狀態。裂片亦作長楔形,彼此互成一銳角。裂片的長度不明,其最寬處在標本上爲 1.5 厘米,裂片的頂部是否可再分裂一次或二次尚未明白。葉基的寬度約爲 5 毫米,其寬度和每一裂片的基部的寬度幾乎完全相等。葉基的長度不明,在標本上保存的長度約爲 4.5 厘米左右。葉脈頗粗,數次分叉,每一厘米約有脈 11—12 條。

雖然僅有一塊標本,並且保存不全,但這塊標本顯然是代表着一個新種的。可惜的是:炭質薄膜未曾保存,我們不能利用浸解方法研究其表皮及小氣孔的構造。

Sphenobaiera 一個屬名是 Florin 1936 年所創立的。根據外表形態而論, *Sphenobaiera* 和 *Baiera* 的區別是:前者是沒有明顯的葉柄的,而後者是有比較顯明的葉柄的。根據這一個理由, Florin 决定歐洲上二叠紀底部 (Kupferschiefer) 的 *B. digitata* Brongn. 以及中國二叠紀 (上石盒子系) 的 *B. spinosa* Halle 及 *B. tenuistriata* Halle 都應該改屬於 *Sphenobaiera*。因此 *Sphenobaiera* 的直的分佈可自古生代末期直至中生代 (下二叠紀至下白堊紀), 而 *Baiera* 是限於中生代的 (上三叠紀頂部至下白堊紀)。 Florin (1936 第 105 頁) 對於他的新屬 *Sphenobaiera* 所給的"屬的特徵"如下:

"葉沒有清楚地分出的葉柄,葉作楔形向基部漸漸地狹瘦,葉的全部形態或多或少地爲狹瘦的三角形,並且或多或少地深深地分裂而爲 2 個至 5 個主要裂片,這些裂片分爲兩部分,每一主要裂片又可再分裂一次,或再分裂數次。整個地說其葉脈是扇狀脈。"

根據上述的"屬的特徵"當前的一塊僅有的標本屬於 *Sphenobaiera* 是不成問題的。上面已經提及我們的葉是分裂而爲2個主要裂片的，是否每一個主要裂片在其頂部還再可分裂一次，我們還未明白，但其可能性是很大的。

Florin（1936 第108 頁）曾將前人所描述的 *Baiera* 各種認爲應該改屬於 *Sphenobaiera* 的列成一表：

Sphenobaiera Florin

種型：*Sphenobaiera spectabilis* (Nath) Florin

種	主要文獻（有圖影）
amalloidea (Harris) Florin	Harris, 1935, 第32頁。
angustifolia (Heer) Florin	Heer, 1878, 第24頁，及1880, 第14頁。
crestosa (Schenk) Florin	Schenk, 1871, 第5頁。
czekanowskiana (Heer) Florin	Heer, 1876a, 第56頁。
digitata (Brongn.) Florin	Brongniart, 1828, 第69頁；Heer 1876b, 第7頁；Weigelt 1928, 第476頁。
foliosa (Font.) Florin	Fontaine, 1889, 第213頁。
furcata (Heer) Florin	Heer, 1877, 第84頁；Leuthardt 1903 第7頁。
ikorfatensis (Seward) Florin	Seward, 1926, 第96頁。
leptophylla (Harris) Florin	Harris, 1935, 第30頁。
longifolia (Pomel) Florin	Pomel, 1847, 第339頁；Heer 1876a 第52頁；Thomas, 1913a 第243頁。
multifida (Font.) Florin	Fontaine, 1883 第87頁。
paucinervis Florin	Florin, 1936 I. 第109頁；II. 第38頁。
paucipartita (Nath.) Florin	Nathorst, 1886 第94頁。
pulchella (Heer) Florin	Heer, 1876a, 第114頁。
raymondi (Renault) Florin	Renault, 1888, 第325頁；Zeiller 1906, 第202頁；Florin, 1937 II. 第40頁。
robusta (Arber) Florin	Arber, 1917, 第56頁。
schenki (O. Feistm.) Florin	Feistmantel, 1889 第72頁。
spectabilis (Nath.) Florin	Nathorst, 1906, 第4頁；Johansson 1922, 第45頁；Harris 1926 第99頁。
spetsbergensis (Nath.) Florin	Nathorst, 1897, 第53頁；Florin 1937 II, 第39頁。
spinosa (Halle) Florin	Halle, 1927b 第191頁。
tanganyikensis (Seward) Florin	Seward, 1934, 第385頁。
tenuistriata (Halle) Florin	Halle, 1927b 第189頁。

在上述的各種以內，很少是可以和我們的種相比較的。根據地層的時代以及葉的體積和裂片的形態或多或少地可以和我們的種相比較的是 Fontaine[30]，1883 年所描述的北美維基尼亞州的上二叠紀中部（Virginia-Keuper）的 *Sphenobaiera multifida*（Fontaine）Florin（Fontaine, 1883、第 87 頁；圖版 XLVI；圖版 XLVII, 圖 1, 2）。正如種名 *multifida* 所含意，北美的種是以葉的分裂次數甚多爲其特徵的，（Fontaine 論文的圖版 XLVI、圖 1 的標本葉作 5 次分裂的狀態），並且其葉基也較寬。中國延長層的種顯然和北美的種是不同種的。

根據葉基的狀態，斯行健[172] 在鄂西香溪煤系所描述的 *Baiera huangi*（1949，第 32 頁圖版 7，圖 1—4）也顯然是屬於 *Sphenobaiera* 的。

地點：陝西省黃龍縣（詳細地點不明）。

地層：層位不明。

?*Sphenobaiera furcata* (Heer) Florin

（圖版 XLVII，圖 6, 6a, 6b）

1865. *Sclerophyllina furcata* Heer, p. 54; pl. 2, fig. 2.
1877. *Baiera furcata* Heer, p. 84; pl. 29, figs. 30-31; pl. 30, fig. 4c; pl. 36, fig. 4.
1901. *Baiera furcata* Leuthardt, p. 126.

1903. *Baiera furcata* Leuthardt, p. 7; pl. 2, figs. 1-4; pl. 4, fig. 1; pl. 3.
1923. *Baiera furcata* Kräusel, p. 83; pl. 3, figs. 2-4; pl. 4, figs. 3, 4.
1932. *Baiera furcata* Ôishi 1932b, p. 348, pl. L, figs. 2A-3.
1935. *Baiera furcata* Harris, p. 37.
1936. *Sphenobaiera furcata* Florin, p. 108.
1943. *Sphenobaiera furcata* Kräusel, p. 81; pl. XI, figs. 1-5; pl. XIII, figs. 8-11; pl. XIV, textfigs. 9-12.
1955. *Sphenobaiera furcata* Kräusel u. Leschik, p. 21; pl. 21, figs. 9-10.

在材料中，僅有一塊標本。根據葉的分叉狀態及葉的寬度，當前的化石頗似歐洲上三叠紀中部的一種 *Sphenobaiera furcata*。因爲標本太少，同時其保存狀況太壞，我們暫加一問號於屬名之前。和瑞士 Basel 植物羣中的標本一樣，我們的化石，葉部也是作兩次分叉狀態的，在我們的標本上也保存着很少的炭質薄膜；經利用浸解方法後，我們所得的結果不甚滿意。表皮細胞的形態也或多或少地和瑞士 Basel 及奧國 Lunz 的標本大致相似，是成長方形或多角形的，細胞壁也是很直的。小氣孔保存不佳，“乳頭突起”（Papillae）也未曾找到。如果將來找到更多並且保存較佳的標本，非常可能的延長層的化石是屬於 Lunz 及 Basel 的中部上三叠紀的種的。根據 Leuthardt[98, 99] 這一個種的葉是分叉兩次的，根據 Kräusel 這一個種將來也許可以找出三次分叉的標本的。

根據葉的分叉狀態，我們的化石也多少可和格林蘭東部的下侏羅紀種 *Stenopteris dinosaurensis* (Harris[56], 1937, 第 37 頁，插圖 A–C）相比較的。根據表皮構造我們的化石也大致可和格林蘭東部的另一個種相比較卽 *Stenopteris astartensis*（Harris 1932, 第 77—78 頁，插圖 A–E），最後提到的一個種也是發現上三叠紀末期卽瑞底克期（Lepidopteris Bed）的。Harris (1932, 第 75 頁）曾經指出：“*Stenopteris* 的碎片極容易被誤認爲 *Czekanowskia*，它的分叉狀況也和後者多少相似，就是表皮構造也頗有些相同。”

最後應該指出的是：當前的延長層化石實以接近於歐洲上三叠紀中部的 *Sphenobaiera furcata* (Heer) Florin 的成分爲最多。這一種化石是决不會屬於 *Czekanowskia* 的。

Sphenobaiera furcata 一種也爲大石（1932b, 第 348 頁；pl. L, figs. 2A–3）描述於日本的成羽（Nariwa）植物羣。日本的化石和延長層所發現者葉的寬度及其分叉狀況是大致相同的。日本的標本，似乎也應該加一個問號於屬名之前。

地點：山西興縣李家凹。
地層：延長層下部。

屬名 *Psygmophyllum* Schimper

1869—74. *Psygmophyllum* Schimper Vol. 2, p. 192.

Psygmophyllum? sp.

（圖版 XLVII，圖 5）

圖版 XLVII，圖 5 的標本，作者最初頗以爲是可以和格陵蘭上三叠紀的一塊，最初被 Harris[55] 定爲 *Baiera boeggildiana* (1935, p. 28; pl. 4, fig. 2)，後來又改爲 ?*Sphenobaiera baeggildiana* (Harris) Harris (1937, p. 58）的標本相比較的。經過仔細視察，作者覺得陝北的化石其葉脈比較細而密並且葉的着生狀態也和格林蘭的化石是不相同的。陝北的化石，葉頗似互生或半對生於狹細的中軸上的。葉爲標準的楔形，頂部保存不全，似係作截形。葉脈細而密分叉數次，在葉的基部伸出，究有脈幾條，因標本保存不佳，未能完全决定。

根據葉的着生狀態以及葉的全部形態。當前的化石，頗接近於古生代石炭紀的 *Psygmophyllum flabellatum* L. & H. 一類化石的類型。但葉脈從未互相結合而成爲網脈。當前的化石，似亦可和非洲南部二叠紀石炭紀的 *Psygmophyllum kidstoni* Seward 相比較，後者的葉脈也不作網狀的。

地點：陝西宜君縣杏樹坪草灣七母橋。

地層：延長層上部。

裸子植物門？

（四）開通植物目（Caytoniales）

屬名 *Sagenopteris* Presl

1838. *Sagenopteris* Presl in Sternberg p. 164.

Sagenopteris spatulata Sze 新種

（圖版 XXXV，圖 1，1a）

這一種的特徵是在生長成全的葉的羽片作匙形的形態。

羽片的數目爲 4，俱着生於一個公共的柄的頂端，柄的寬度爲 2.5 毫米，其長度不明，估計其原來的長度當大致和羽片的長度相等，當在 6.5 厘米左右。柄頗平，上無一切紋線。"小葉"自柄的頂端放射地伸出，作標準的匙形，其最寬處在自基部向前三分之二之處，此處的寬度約在 18 毫米左右，自此處向基部緩緩地狹細直至基部，基部的寬度大致和柄的寬度相等，在 2.5 毫米左右。小葉自其最寬處向前又突然收縮至寬度 11 毫米左右，然後極遲緩地向前狹細，到達頂端時又突然收縮而爲鈍圓形，葉脈在標本上因受保存狀況的關係不甚明顯。中脈似較粗，直達頂端，有時不甚明顯。側脈極細以極銳的角度自中脈伸近，微彎而達側邊及頂部，其支脈互相接合而成爲狹長的網脈。羽片的邊緣作全線形。

這一個極爲少見種，在我們的材料中，僅有一塊標本，表示在圖版 XXXV 圖 1，1a 上。這一塊標本是石油總局李德生及馬繼祥同志在 1951 年 11 月於宜君縣四郎廟所採集的。雖然祇有一塊標本，但小葉（卽羽片）的形態甚爲特緻，在這塊標本，中脈有時甚爲顯明，有時比較模糊。Halle[47] 在1910b, p. 7 在討論 *Sagenopteris nilssoniana* Brongn. sp. 的文章中曾經指出："中脈的發育的程度，在這一個種變異頗大，在其他 *Sagenopteris* 的各種也是同樣的，這對於區別'種'，是沒有多大價值的。"在我們的材料中還有另外一塊碎片是一個單獨保存的小葉的底部碎片（本文圖版 XXXV，圖 2，2a）。因爲不是在同一地點所採集的，作者暫定爲 *Sagenopteris* sp. 在這一塊碎片上葉脈非常顯明，中脈更爲特出，厚約 1 毫米，側脈同樣地以一銳角自中脈伸出，若干個側脈幾乎大致和中脈平行，側脈互相結合而成狹長的網脈。這一塊碎片可能也完全是和上述保存完善的標本是同屬一種的，換言之這一塊碎片完全可能是屬於我們的新種 *S. spatulata*。

和我們的新種最相接近的是 *Sagenopteris undulata* Nathorst，這一個種直至今日僅發現於瑞典的 Bjuf 及 Höganäs 的瑞底克期至下侏羅紀。這一個瑞典種正如其種名所含意其發育成全的小葉的邊緣是彎曲成波浪狀的（參看 Halle, 1910b, pl. I, fig. 77）其小葉的每一個側邊，彎曲有 4—5 個波浪形的鈍齒其最寬處在羽片的中部因此比較多成劍形的。而在我們的標本其每一側邊僅於羽片自基部至前端三分之二之處彎成一波，且不完全作鈍齒形，羽片的最寬處在其前部，因此比較地多成匙形。

小葉的形態及體積大致可和我們的標本相比較的，還有 du Toit[23] 所描述的南非上開羅層的 *S. longicaulis* (1927, p. 325，插圖 4)。這一個種也和 *S. undulata* 一樣其小葉的邊緣是成波浪形的，而最令人注意的是小葉的基部尚有一個較狹的柄着生於總柄之上。另外一個可以比較的種是 Thomas 的 *S. kamenkensis* (1911, p.59, pl. I, figs. 10、11)，這一個 Kamenka 的種，根據 Thomas 的描述，其小葉的邊緣也是彎曲成波浪形的（Crenulated）但小葉俱甚破碎，無法作正確的比較。非常可能的 Thomas[18] 在同一地點所描述的 *S. phillipsi* (Brongn.) (1911, p. 60, pl. I, fig. 9) 是和他的 *S. kamenkensis* 是同屬一種的。

其他舊文獻中尚無有舊種可和我們的新種相比較的。瑞典瑞底克期頂部至下侏羅紀的 *S. nilssoniana* Brongn. sp. 其小葉普通較短較寬，其最寬處在其中部也比較地多成劍形的，其羽片的邊緣是不彎成波形的，

因此和我們的種更不相同。*S. phillipsi* 是一個比較普通的種曾被記載於歐洲的很多地點,北美及澳洲以及南極大陸的侏羅紀。這一個種的形態和我們的種不同,因其小葉或作狹長的線形或作卵圓形至劍形的(Seward, 1910, p. 480, fig. 327A, B)。其他已描述的 *Sagenopteris* 尚有十餘種,不再作詳細比較。在東亞 *Sagenopteris* 曾有數種被記載於日本,即 *S. petiolata* Ôishi, *S. nilssoniana* (Brongn.) Ward, *S. pancifolia* (Brongn.) Ward 及 *S.? inequilateralis* Ôishi (參看 Ôishi, 1940 p. 360—364, pl. XXXVII, pl. XXXVII, pl. XLI, pl. XLVII)。

所有各種和我們的種完全不同。在福建永安的坂頭系(下白堊紀的韋爾登期)中,筆者[171] 也曾描述幾塊碎片定名爲 *S. yunganensis* Sze 及 *S.? dictyozamioides* Sze (1945, p. 47—48, figs. 19, 20) 都是一些破碎的羽片和當前的種是根本不能相比較的。

Sagenopteris 很久被認爲是一種水中的蕨類相信是屬於蘋科 (Marsileaceae) 的。此種葉部化石常和 *Caytonia*, *Gristhorpia* 等化石在一起找到的。 Thomas 及其他古植物學家相信是屬於 Caytoniales 的,並且認爲可能是最古的被子植物。 Caytoniales 的植物學上的地位曾被許多學者加以討論如 Thomas[183] (1925, 1931), Kräusel[80] (1926), Zimmerman[204] (1930), Harris[52,54] (1931, 1932b) 以及其他學者。Harris 認爲 Caytoniales 是種子植物的單獨的一部類 (Phyllum), 其地位和本勒鐵目及銀杏目是同等的。他並且說: Caytoniales 應該歸於裸子植物,因爲其子房在受粉時是張得很開的,雖然在果實成熟時是關緊的,但這並不能否認此目植物和被子植物的關係,被子植物在受粉時,有些時候可能是同樣的。Hirmer[63] (1937, p.271—287) 嚴厲地反對此目植物屬於被子植物,他經過詳細的討論認爲 Caytoniales 是中生代的種子蕨類。最有意義的是 *Sagenopteris* 是 *Caytonia* 的葉部化石, 却始終無人加以反對, 而這兩種化石却從來未曾找到連接及着生在一起的標本。

地點: 陝西宜君縣四郎廟炭河溝。

地層: 延長層上部。

Sagenopteris sp.

(圖版 XXXV 圖 2, 2a)

僅有的一塊很小的碎片,係作者和關佐蜀同志所採集的。此碎片代表着一個小葉的基部葉脈極爲顯明,中脈堅強寬約 1 毫米,側脈甚細,自中脈以一極銳的角度伸出,若干側脈幾乎和中脈相平行,側脈及其分叉後的支脈彼此互相結合而成狹而細長的網脈。

此碎片可能代表着一個新種,也很可能是代表着上述的 *S. spatulata* 的一個單獨保存的小葉碎片。

地點: 陝西宜君縣杏樹坪七母橋。

地層: 延長層上部。

(五) 裸子植物內分類不明的化石

屬名 *Desmiophyllum* Lesquerx

1878. *Desmiophyllum* Lesquerx, p. 322.

1904. *Desmiophyllum* Lesquerx emend. Solms-Laubach, p. 6 et seq.

Desmiophyllum sp.

(圖版 LIII, 圖 6)

關於這一類單獨保存的狹長而作劍形的並且含有並行脈的葉部化石,在此次作者所研究的材料中,僅找

到一塊標本，表示在圖版 LIII，圖 6 上。這一塊標本根據體積及形態而論，應該和斯行健 1931 年所發表的論文第 28 頁所討論的 *Podozamites lanceolatus* f. *latior* Sze，也就是 Heer 1876 年所定的 *Podozamites lanceolatus latifolius* Schenk (Heer[60], 1876, Fl. Foss. Arct. 4, p. 109; pl. 26, figs. 5, 6, 8b–c) 一類的化石是完全可以比較的。因爲材料太少而且保存不佳，玆暫定爲 *Desmiophyllum* sp. 這是一個"籠統的屬名" (Sammelgattung) 凡是中生代的一切狹長的並且含有並行脈的，無法知道其確實的植物學上的地位的葉部化石，都可定爲 *Desmiophyllum* sp. 這一個屬名按照 Lesquerx 的定義是和 *Cordaites* 是相同的。但根據 Lundblad[102] (1950，第 49 頁)，古生代的苛達狄植物目是否還繼續生存於中生代的問題，曾被 Florin 研究過的。Florin 曾經研究過若干中生代的被定爲 *Desmiophyllum* 的葉部化石的表皮構造，他得到的結論是這些化石都無足够的證據可以證明在中生代時還有苛達狄目的繼續生存着。當前的延長層的化石至少是不够來詳細討論這個問題的。

地點：陝西淸澗縣王家渠。
地層：延長層中部。

（六）生殖部分的化石

屬名 *Swedenborgia* Nathorst

1876. *Swedenborgia* Nathorst, p. 66 (1878a, p. 30).

Swedenborgia cryptomerioides Nathorst

（圖版 LI，圖 1—3）

1876. *Swedenborgia cryptomerioides* Nathorst p. 66.
1878a. *Swedenborgia cryptomerioides* Nathorst, p. 30, pl. 16, figs. 6-13.
1884. *Swedenborgia cryptomerioides*, Saporta, p. 528; pl. 70, figs. 1-2).
1919. *Swedenborgia cryptomerioides*, Antevs, p. 48; pl. 70, figs. 1-4.
1935. *Swedenborgia cryptomerioides*, Harris, p. 108; pl. 18, figs. 8, 10-18, 21, 22; Pl. 19, figs. 5-8, 20-22.
1935. *Swedenborgia cryptomerioides*, Ôishi & Yamasita p. 439, figs. 1-3.
1937. *Swedenborgia cryptomerioides*, Harris, p. 65.
1938. *Swedenborgia cryptomerioides*, Ôishi & Huzioka, p. 97.
1940. *Swedenborgia cryptomerioides*, Ôishi, p. 416.
1949. *Swedenborgia cryptomerioides*, Sze, p. 37, pl. 15, fig. 28.

Harris[55] (1935, p. 107) 對於此種曾有詳細的敍述玆譯述之下："球果 (cone) 是早凋的，所有研究的標本好像都是已經成熟的，其所有的種子幾乎都已落下。中軸頗狹，"球果鱗片" (cone-scale) 螺旋地着生於中軸上，無其他附屬物。每一枚"球果鱗片"有一個瘦柄，柄的頂端較寬，頂端分裂而爲 5 個幾乎相等的堅強的裂片 (lobes)，裂片掌狀式張開。背面是凹的有一個小的凸起點從柄上凸出，卽苞鱗 (bract-scale) 伸至凹處。腹是凸的，每一裂片的基部也有一個小的凸起點 (out-growth)，在那裏可能是種子着生之處。所有的標本，都經看出有 5 個小的凸起點因此我們可以決定，每一個"球果鱗片"正常地是着生 5 個種子的。種子爲卵圓形，可能是扁平的，其基部微微地凹進，其邊緣有微弱的翼部寬約 0.5 毫米，翼至種子的頂部卽消失，在此處有一小的凹槽 (notch) 此處爲伸出的珠孔所佔據。種子是倒轉的，珠孔面向球果的中軸。……"圖版 LI，圖 1、1a、1b 所表示的一塊標本其球果的體積及形態和格林蘭的標本完全一致。中軸寬約 4 毫米。球果鱗片螺旋地着生於軸上。每一鱗片有一個狹而細的柄，柄寬約爲 1—1.5 毫米，長約 1 厘米，頂部微微地較粗，頂端分裂而爲掌狀形張開的狹長的裂片，裂片寬約 1 毫米，長約 4—5 毫米。鱗片是以一個很寬的角度幾乎是垂直地自中軸伸出的。種子已落下，在標本的右側上角還可以看見單獨保存的種子（圖版 LI，圖 1、s）。

種子的體積及形態也和瑞典的標本完全一致，種子作卵圓形，寬約3毫米，長約4.5毫米，邊緣的翼部至為明晰。最有意義的，是在我們的標本上還保存着很多分裂的放射狀張開着的裂片部分佈置如星形地展開着，（圖版 LI，圖 1b）。和格陵蘭的標本不同，我們的標本每一球果鱗片的頂部是明顯地和正常地分裂而為6個裂片的，因此我們的標本其每一鱗片，是着生6個種子的。不過僅僅這一點區別決不是分種的理由，本文作者完全相信中國的標本是格林蘭的是和同屬一種的，並且很可能的在未來的採集工作中，在格林蘭也可以找出標本，其每一鱗片的頂端是正常地分裂而為6個裂片的。

前人曾經指出 *Swedenborgia* 式的球果頗似柳杉（*Cryptomeria*）。Harris 認為經過他的研究後此屬化石和柳杉的球果確甚相近，主要的區別是柳杉球果的鱗片比較堅固（solid）而其各部分比較地鎔合很緊。而柳杉球果鱗片的分裂而為裂片的形態，也就可以表示是一種原始的形態（primitive feature）。*Swedenborgia* 也很像其大致同地質時代的 *Cheirolepis*（Hörhammer[66]，1933），並且也很像古生代的 *Voltzia*（Walton[189]，1929），但 *Swedenborgia* 和此兩屬並且幾乎和所有松柏類植物立刻可以區別出來，因為其球果鱗片是有一個細長而狹瘦的"柄"的。Harris 指出，這些相似之點從進化方面的觀點出發是非常重要的。有很多屬已經絕滅的松柏類，其球果鱗片的形態是精緻的（eleborate structure），而 *Swedenborgia* 如果和現代的杉科和羅漢松科相比較，不如先和這些化石的松柏類各屬列成一類。Harris 因為在格陵蘭的同一地層找到 *Podozamites* 的葉部化石很多，相信 *Swedenborgia* 式的球果是屬於葉部化石 *Podozamites*，尤其是 *P. schenki*，*P. agardhianus* 等種的類型的。Harris 又指出在瑞典的許多地點 *Swedenborgia* 也是和 *Podozamites* 及其他各屬松柏植物一起找到的。非常奇怪的在我們的當前材料中，*Podozamites* 沒有看到一塊沒有問題的標本，雖然在潘鍾祥所研究的材料 *Podozamites* 是比較不很少的（1936，pl. 14，figs. 1—3；pl. 15，figs. 1—3）。相反的在我們的同一地點即宜君縣四郎廟炭河溝 *Glossophyllum? shensiense* Sze 的葉部化石是很多的，而這一個地點 *Podozamites* 還沒有發現，雖然在未來的採集工作中，這一個地點也一定會發現的。在同一塊標本（圖版 LI，圖 1）的左側的一張狹長而帶楔形的葉部碎片是屬於 *G.? shensiense* 的（在圖上未曾照出）。在同一塊標本的反面還保存着枝幹部化石（圖版 XL，IX，圖 6）此種枝幹部化石上面已經提及是屬於 *Glossophyllum?* 式的葉部的。當然這兩種化石，根據作者之意，可能是不會有直接的連帶關係的。

Swedenborgia cryptomerioides Nath. 在東亞曾被大石及山下（Ôishi et Yamasita）描述於日本成羽區的成羽系（見異名表）。也被斯行健[172]（1949，p. 37，圖版 15，圖 28）描述於鄂西的香溪煤系。

地點：陝西宜君縣四郎廟炭河溝。
　　　陝西宜君縣杏樹坪七母橋。
地層：延長層上部。

屬名 *Stenorachis* Saporta

1875. *Stenorachis* Saporta, A. Pl. CXVII.
1879. *Stenorachis* Saporta, A. p. 193.

?*Stenorachis*（*Ixostrobus?*）*konianus* Ôishi et Huzioka

（圖版 LI，圖 4—6）

1938. *Stenorachis*（*Ixostrobus?*）*konianus* Ôishi et Huzioka, p. 97, pl. XI (V) Figs. 7, 7a.
1940. *Stenorachis*（*Ixostrobus?*）*konianus* Ôishi p. 415.

以體積及形態而論，圖版 LI，圖 4—5（正負兩面）及圖 6 所表示的三塊碎片極似二位日本學者在日本成羽植物羣所描述的 *Stenorachis*（*Ixostrobus?*）*konianus* Ôishi & Huzioka，根據二位學者的描述，日本的標本是有"一個堅強的木質的中軸，長約3.5厘米，寬約2毫米，中軸上顯出縱肋（維管束？），在中軸上部伸出的附屬物（*Appendages*）是垂直地着生於軸上的；在中軸的上部向中部以至下部的附屬物和中軸所成的

角度亦漸漸地減小，所有的附屬物都是螺旋狀體置於軸上的。附屬物非常堅擠，其寬度由其前端向其基部漸漸地變厚，下延於中軸上。附屬物的頂端分爲裂片 (lobes)，在裂片的基部，頗似有一個小的卵圓形的東西，表示着有小孢子囊的存在，但無法確實證明之。在每一條附屬物上有一條或兩條縱紋，可能代表着維管束。”

根據上面的描述，本文圖版 LI，圖 4—6 的標本，實在有屬於這一個種的可能。二位日本學者在論文中特別指出，*S. konianus* 極似 Harris 在格陵蘭東部下侏羅紀 (Thaumatopteris zone) 所描述的 *Ixostrobus groenlandiscus*，這一個種被 Harris 認爲是屬於 *Podozamites* 的雄球花 (male cone) 的，因爲兩者常在一起找到的。但日本的標本其“附屬物”比較厚得多，並且附屬物的頂部也好像和格陵蘭的種有所不同。二位學者同時將日本的標本和波蘭的一種 *Ixostrobus* Raciborski 1892 (1892, p. 15, pl. II figs. 5—8, 20b) 相比較，並且認爲波蘭種是和格陵蘭的比較更相接近。二位日本學者最後決定將日本的種定其屬名爲 *Stenorachis*，因爲這一個屬名是比較沒有約束 (Non-committal) 的。對於上述的意見筆者表示完全同意，因爲標本保存狀況，有如日本的標本及當前的化石，與其定爲 *Ixostrobus*，毋寧暫定爲 *Stenorachis* 要妥當得多。或多或少相似的標本，也曾發現於鄂西的香溪煤系，經斯行健[172] 定爲 *Stenorachis lepida* Heer (1949，第 33 頁；圖版 15，圖 12，13)。

本文圖版 LI 圖 4—5 所表示的兩塊標本，係代表一個植物體的正負兩面 (Part & counterpart)，保存實不佳，不能作正確的鑑定，爲參考方便起見，暫定爲 *?Stenorachis* (*Ixostrobus?*) *konianus* Ô. et H.

地點：陝西宜君縣四郎廟炭河溝。
地層：延長層上部。

屬名 *Conites* Seward

1919. *Conites* Seward, Fossil Plants IV, p. 351.

Conites sp.

(圖版 LVI，圖 3)

1936. Problematicum P'an, p. 33; pl. XII, fig. 8; pl. XIII, figs. 10, 11; pl. XV, fig. 6.

圖版 LVI，圖 3 所表示的化石是和潘鍾祥[127] 在 1936 年定爲“疑問的化石”的是相同的。潘在敍述中也曾經指出：它們可能是代表着松柏植物的生殖部分的化石的。“球果”作卵圓形至長橢圓形，長約 3 厘米，寬約 12 毫米。中軸不甚明顯四週着生很多鱗葉 (scale-leaves)，種子保存也不甚明顯。這一類化石是屬於松柏科的球果化石的意見，可能是沒有問題的。因爲種子的保存狀況不明顯，這一類球果化石究竟屬於何種植物的，我們不能說出比較肯定的意見。因此我們暫定此類化石爲 *Conites* sp.。*Conites* 也不過是一個“形態屬名”而已。根據潘鍾祥 (1936，第 34 頁)，這一類化石在延長層的下部及中部是發現很多的。在當前的豐富材料中，我們僅僅找到一塊化石，其層位是屬於延長層上部的。

根據潘鍾祥 (1936，第 34 頁)，這一種球果式的化石在綏德縣的沙灘坪常和 *Noeggerathiopsis hislopi* 以及其他的狹長的 *Desmiophyllum* 式的葉部化石在一起發現的，而在其他地點則常和一種大而寬的 *Cordaites* 相似的葉部化石在一起找到的。根據本書作者之意，這一種球果化石顯然是不會和這些葉部有直接的連帶關係的。最重要之點而值得令人注意的是：在潘所研究的材料中，也有很多闊而寬的和 *Cordaites* 相似的化石，他在 1936 年的論文中並沒有加以描述；這些寬而大的葉部化石，在本書中已經包括在 *Glossophyllum? shensiense* 一種之內，很可能的潘所謂狹長的 *Desmiophyllum* 式的葉部化石也有一部分是屬於此種的。

地點：陝西，宜君縣四郎廟炭河溝。
地層：延長層上部。

地點：陝西綏德縣沙灘坪。

地層：延長層中部。

地點：陝西綏德縣高家庵。

地層：延長層下部。

屬名 *Carpolithus* Wallerius

1847. *Carpolithus* Wallerius, Nathorst 1920, p. 16.

Carpolithus spp.

（圖版 LVI，圖 8—14, 8a, 9a, 10a, 11a, 12a, 13a, 14a）

Halle 教授[50]曾經指出（1927b，第 212 頁），這一個屬名 *Carpolithus* 的歷史曾被 Nathorst[114]詳細報道過（1920，第 16 頁），他提到這一個屬名是最初爲瑞典的一個礦物學家 Wallerius 在 1847 年引用的。 Halle 在“山西古生代植物”的一本著作中[50]，曾引用了這一個“暫時的名詞”描述了若干種子化石。他並且指出這些種子化石是和前人所描述的種屬是不相同的，並且不够創立新的屬名的。本書作者跟隨這一個定名的方法而將延長層的所有種子化石籠統地定爲 *Carpolithus* spp. 本書圖版 LVI，圖 8—14 所代表的化石，其性質顯然不是完全相同的，很可能它們是屬於兩個種或三個種的。大部分化石其表面是很平滑的，但是其側邊好像是有“翼”部的，“翼”部寬僅 0.5—1 毫米。很可能的當前的一部分化石是屬於銀杏目，也有一部分是屬於松杉目的。一部分化石很可和 Harris 所描述的格陵蘭東部的化石相比較，這些化石 Harris 定爲 *Allicospermum* 的。（Harris[55]，1935，圖版 11，圖 7—9）。最有意義的是：在當前的材料中有一塊化石，種子的頂上是有一個鈍的針頭的（圖版 LVI，圖 8，8a）。這一類種子形態是異常特殊的，並且很可能是代表着一個新屬的。

地點：陝西四郎廟炭河溝。

地層：延長層上部。

疑 問 的 化 石

疑問的化石 a（Problematicum a）

（圖版 XXVIII 圖 7—8）

在延長縣的七里村的延長層，還發現若干疑問的化石。在兩塊灰綠色的砂岩標本上，保存着無數化石的痕跡，全部似作伸長形的。好像上部較寬，微向下部狹小，其兩側附生着的葉膜（lamina）上顯出很粗很狹的褶皺。這樣的化石其植物學上地位不易決定，很可能是屬於蘇鐵植物類的。我們在新舊文獻中沒有找到同樣的化石。作者暫定當前的材料爲 *Problematicum*，等候保存較全較好的化石。

地點：陝西延長縣七里村。

地層：延長層上部。

疑問的化石 b（Problematicum b）

（圖版 LVI，圖 4）

這一種化石形態異常奇特。其下部肥而寬，頂端伸出狹長而彎曲的尖齒五枚。整個形態微似現在的擎

蘘。究係何種化石，根本不能決定。很可能的，這些化石也是 *Equisetites* 的葉鞘碎片。但既無樹幹化石連在一起亦不能作最後的決定。化石右側有許多 *Neocalamites* 的葉部化石保存在一起。

地點：宜君焦家坪。
地層：延長層上部。

疑問的化石 c (Problematicum c, *Muscites* sp.)

(圖版 LVI，圖 5，5a)

圖版 LVI，圖 5，5a 所表示的一塊標本基本上是不能鑑定的，但我們還加描述，因爲這一塊化石頗似一般學者定名爲"擬蘚屬" Muscites 的化石。*Muscites* 的一個屬名，最初是 Brongniart 所創立的，這一個名詞顯然是代表一種"形態屬名"或"籠統屬名。" Seward[152] 教授曾給予這個學名一個簡單的定義 (1898，第 238 頁)："幹部狹細，線形，分叉或不分叉，上生無柄的葉，葉膜很薄，沒有葉脈，或者有一條中脈，葉是螺旋地着生於幹軸上面的。" 根據這個定義，當前的標本很可能是屬於這個學名之下的。最重要並且最有意義的是在我們的圖版 LVI，圖 5a 的一個放大三倍的圖上還清楚地可以看出幹軸上面的葉座狀態 (Polsterbildung or Polsterwuchs)。根據 Gothan[39] (1921，教科書，第 36 頁)，這些葉座狀態也可以在一個古生代種定名爲 *Muscites polytrichaceous* Renault et Zeiller 的幹軸上面看出的。這一個古生代種是發現於法國上石炭紀地層中的 (Fl. foss. Commentry, Ren. et Zeill. [138] 1888，圖版 41，2—4)。關於這一個古生代種的植物學上的地位，Gothan 曾經這樣說道 (1921，第 36頁)："它的外表眞的很有像蘚類植物，並且在它的幹軸上面還保存和現代的若干蘚類的幹軸上的相似的葉座狀態；不過它的分類學上的位置還是不能十分肯定的。" 雖然這一個古生代種也沒有保存生殖部分的化石，Seward[152] 可是相信這一個種是可以放在蘚類之內的。他這樣說 (1898，第 239 頁)："這一種的描述者指出它們的化石的密簇的狀態，它們的很小的體積以及葉的薄膜狀的性質，都針指着這些化石是有屬於蘚類的可能的，雖然生殖部分的化石還沒有發現。" 根據本文作者之意，這一個種的確很像蘚類化石，但一切證據是還不够充足的。同樣的話也可以應用到當前的延長層化石。因爲我們的化石，其生殖部分也還沒有明瞭，作者覺得最好的辦法不如暫時將當前的化石定名爲 Problematicum c (*Muscites* sp.)。

在舊文獻中有不少化石原先定名爲"擬石松" (*Lycopodites*) 或"擬卷柏" (*Selaginellites*) 後來被改爲"擬蘚" (*Muscites*) 的。(如 Lesquereux 的 *Lycopodites meeki* 發現於北美的石炭紀) 所有這些化石都沒有充分的證據證明它們是可以代表蘚類化石的。同樣的話 Seward 也曾經指出過了。

在新生代地層中，也有不少種蘚類化石曾被人描述，比方說 *Muscites torifolius* Caspary, *Muscites ferrugineus* Ludwig……等等。最後提及的種 *M. ferrugineus* 是有一狹細的幹部，上面着生很緊擠的卵圓形而尖銳的葉。蒴是作杯形的，着生於一個短柄上，蒴有圓的裂口，其邊上無齒。根據 Seward (1898，第 241 頁)，這個種的證據也不很充足足以證明其和現代蘚類的某一屬是有直接關係的，最好的辦法是不如暫用一個比較沒有約束的屬名如 *Muscites* 來鑑定這些化石。最後他又伸說道"在沒有看到原來標本之前，我們無法決定 Ludwig 的描述是否正確；假使蒴的鑑定是可靠的，那末這一種化石是代表着最古的蘚類"子囊體"化石了！" 新生代地層中比較可靠的化石，好像是 Weber 所描述的 *Hypnum lycopodiöides*，這一個種的化石的圖影重載於最近的 Gothan 和 Weyland[42] 的教科書中 (1954，第 68 頁，插圖 48)。

在中生代地層中，蘚類化石被描述的不多。可以提出的是英國下侏羅紀的 *Najadita*，根據 Gothan (1921，第 36 頁)，這些化石同樣是靠不住的，都很像"擬石松"和"擬卷柏"的。

地點：延長縣城南。
地層：延長層上部。

根 部 化 石

Radicites sp.

(圖版 LVI, 圖 6—7)

Radicites 是一個普通的學名,應用於植物化石的根部化石的,大部分無疑是屬於木賊目的。很多相同的化石曾被不少學者定名爲 *Radicites, Pinnularia, Myriophyllites*……等等。當前的化石其中軸有達到 4—5 毫米寬者,中軸有不規則地排列的很小的圓形印痕,顯然是代表着其周圍的小根遺落後的痕跡。小根(或名附屬物)是作細線的寬僅 1 毫米或不到 1 毫米,其前端是尖銳的。是否其前端有分叉者尙不能證明。這些標本好像證明這一帶的植物,是本地生長的,因爲這些根部化石是向岩層的各個方向伸展着的。因爲在同一地層及同一地點中已經發現很多 *Neocalamites* 式的葉部,幹部及髓部石核。我們相信這些根部化石以屬於 *Neocalamites* 的成分爲較多。同樣的根部化石也發現於石炭紀及二叠紀大致和中生代的化石沒有重要區別。古生代的標本一般學者都籠統地定爲 *Pinnularia,* 這一個學名是 Lindley 和 Hutton[101] 所創立的,一般學者都一致承認這些根部化石是屬於 *Calamites* 的。

或多或少相似的根部化石也曾發現於山東的坊子煤系,曾被矢部和大石定爲 *Pityocladus shangtungensis* Yabe & Ôishi[195] (1928, 第 12 頁;圖版 4, 圖 2—3) 相信它們是屬於松杉目的枝部化石的。這兩位日本學者曾將這些化石和 *Abietites* 及 *Laricopsis* 相比較。筆者[168] 在一本 1933 年發表的定名爲"中國中生代植物"的專著中,曾經指出這樣的比較是沒有意義的。作者曾經說過 (Sze, 1933b, 第 39 頁):"假使沒有知道球果化石和表皮構造之前,將這些化石和現代松杉科植物的任何比較是沒有意義的,而況且這些化石並不是着生葉的枝部化石而僅僅是根部化石而已。"

我們細讀古植物學文獻,覺得有很多相同的化石曾被前人定爲松杉植物的枝部化石的。比方說 Thomas[181] 在 Kamenka 所描述的 *Abietites densifolia* (1911,第 79 頁;圖版 4, 圖 16; 圖版 5, 圖 12) 以及 Fontaine 所描述的北美中生代的定名爲 *Laricopsis longifolia* 及 *Laricopsis latifolia* 等化石。根據作者的意見這些化石都應定爲 *Radicites* sp. 此外如 Du Toit[23] 在南非的上開羅層所描述的 *Elatocladus* sp (1927, 第 392 頁, 圖版 23, 圖 4) 也是屬於這一類型的。Du Toit 曾將他的化石和德國佛郎根曾被 Schenk 所描述的 *Palissya brauni* Endl. 相比較。這顯然是不對的,因爲 Schenk 的標本是無疑地屬於松杉科的,因爲他不但同時找到其球果化石,並且其葉部化石是有明顯的中脈的。除此以外,在佛蘭根的化石,我們並且已經知道它的表皮構造,這和 Du Toit 的化石是完全不同的。

若干保存較佳的相同化石最近曾發現於哈薩克的侏羅紀地層中。Брик[9] (1952, 第 60 頁; 圖版 21, 圖 3) 定其名爲*Equisetites hallei* Thomas。這是完全正確的,這些化石是屬於木賊綱的,但將這些根部化石鑑定爲一種根據樹幹化石而創立的屬名和種名,似乎還太快些。因此作者認爲哈薩克的化石,亦應暫定爲 *Radicites* sp. 因爲這個學名是比較地不受約束的。

地點: 陝西宜君縣四郎廟炭河溝。
地層: 延長層上部。

屬名 *Taeniocladopsis* Sze 新屬

下面所描述的一種非常奇特的化石,不能安置在已經發表過的舊屬名之下,因此我們必須爲此種化石創一個新的屬名。根據化石的一般形態,這一個種或多或少地有些像泥盆紀的一種最古陸地植物 *Taenioclada* ("*Haliserites*") *decheniana* Kr. u. Wld. 但我們的化石是不作分叉的狀態的,而且在化石的兩側邊還保存着極狹細的,寬僅 1 毫米左右的根狀附屬物。下面的關於 *Taeniocladopsis rhizomoides* n. g. 的"種的特徵"也

同時可以當作"屬的特徵"用，因爲在這一個新屬之內，現在僅發現一個種。

Taeniocladopsis rhizomoides Sze 新屬，新種

(圖版 LIV，圖 1，1a；圖版 LV，圖 1—4)

根部化石？"根"寬約 5—12 毫米，其長度不明。表面平滑，正中似有一條狹細的，寬不到 1 毫米的維管束由基部直通至頂部。四週有狹長的，寬僅 1 毫米左右的"根狀附屬物。"此種"根狀附屬物"其長度似至多不過 3.5 厘米，其正中也或明或暗地有一條非常狹細的維管束，自其基部直達前端，前端尖而銳。"根狀附屬物"和"根"互成一個寬的角度，兩者互成的角度也有 45° 左右者。"根狀附屬物"似不十分緊擠。此種根部化石好像是排列在一個平面上的。

當前的"根部化石"究竟是屬於本書所描述的何科及何屬植物的，尚不易完全決定。根據圖版 LV，圖 1—3 的三塊標本，此種"根部化石"在其基部似乎是一種類似 *Neocalamites* 的"主根"互相連接着的。此種類似 *Neocalamites*的"主根"，每一節是很短的，高度不過 1 厘米。表面的直肋頗細並且頗密直肋在關節上是彼此互生的，有時也有對生着的。根據上述的理由，我們覺得當前的根部化石可能是木賊綱的，而尤其是屬於 *Neocalamites* 的成分較多。根據每一塊標本此種根部化石的保存於一個平面上的狀況，非常可能，此種根部化石是輪生於一個 *Neocalamites* 式的主根上面的。

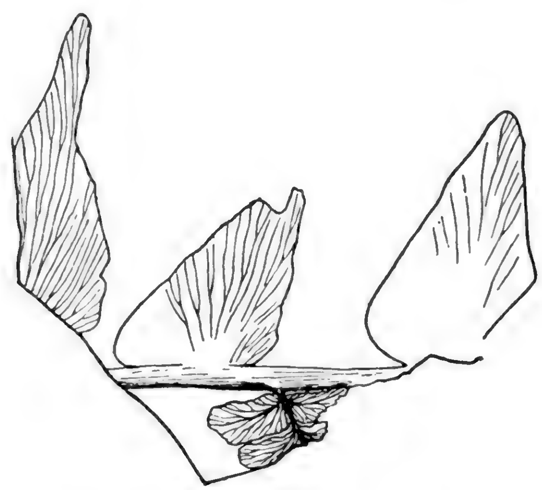

插圖 1　*Cladopteris sp.* b 描述於本書第 26 頁上。這塊標本的右邊的正常的羽片的碎片，是直接着生於主軸上的。在標本上比本書圖版 XXVIII，圖 4，4a 上的照片要淸楚得多。

根據"根"的着生於一個平面上的狀態，當前的中國的上三叠紀標本，實在頗有些像兩塊古生代標本；根的體積和形態，兩者也完全相同。這兩塊古生代標本是表示在 Kidston 和 Jongmans[77] 在 1915—1917 年所發表的著作"歐洲西部的蘆木（*Calamites*）化石"圖版 140，圖 1，2 上。這兩塊古生代化石的"根"好像是成"關節狀"（articulate）的，那就是說"根"的上面，好像可以看出幾個或暗或明的"節"（nodes）的。"根"的正中部，在圖上至少沒有看出一條顯明的"中脈"，並且根的周圍好像也沒有"附屬物"（appendages）即"小根"（rootlets）着生於其上；至少在這兩塊古生代標本"根"的周圍所着生的"小根"或"附屬物"是非常稀少的。

地點：陝西延長縣周家灣。

地層：層位不明。

三. 結　　論

(一) 延長植物羣的植物學上的性質

本書所研究的材料,總結的說共包括下列各種分屬於各門類之下:

苔蘚植物門?

Thallites sp.

蕨類植物門

I. 木賊綱

木賊目:

Equisetites sarrani Zeiller
Equisetites sthenodon Sze 新種
Equisetites brevidentatus Sze 新種
Equisetites acanthodon Sze 新種
Equisetites deltodon Sze 新種
Equisetites sp. (Strobili of *Equisetites*)
Equisetites? sp. (Cf. *E. rogersi* Schimper)
Neocalamites carrerei (Zeiller) Halle
Neocalamites carcinoides Harris
Neocalamites brevifolius Sze 新種
Neocalamites rugosus Sze 新種
Neocalamites sp.
Neocalamites? sp.

II. 蕨　綱

1. 眞蕨目:

紫萁科(卽薇科)

Cladophlebis (*Todites*) shensiensis P'an

馬通蕨科

Phlebopteris? *linearifolia* Sze 新種

2. 眞蕨目屬於何科未定

Cladophlebis raciborskii Zeiller
Cladophlebis cf. *gigantea* Ôishi
Cladophlebis kaoiana Sze 新種
Cladophlebis graciles Sze 新種
Cladophlebis ichünensis Sze 新種
Cladophlebis stenophylla Sze 新種
Cladophlebis paralobifolia Sze 新種
Cladophlebis suniana Sze 新種
Cladophlebis sp. a.
Cladophlebis sp. b.
Sphenopteris sp. (Cf. *Sph. arizonica* Daugherty)
Sphenopteris? *chowkiawanensis* Sze 新種

未鑑定的裸羽片化石 (Undetermined Sterile Pinnae)

3. 觀音座蓮目

觀音座蓮科

Danaeopsis fecunda Halle

Danaeopsis? sp.

4. 觀音座蓮目?

Bernoullia zeilleri P'an

Cladophlebis (*Asterotheca*?) *szeiana* P'an

裸子植物門

I. 種子蕨綱?

Thinnfeldia rhomboidalis Ettingshausen

Thinnfeldia major Raciborski

?*Thinnfeldia nordenskiöldi* Nathorst

Thinnfeldia rigida Sze 新種

Thinnfeldia alethopteroides Sze 新種

Thinnfeldia laxusa Sze 新種

Ctenopteris sarrani Zeiller

?*Protoblechnum hughesi* (Feistm.) Halle (?新種)

II. 蘇鐵植物綱

Sphenozamites changi Sze 新種

Sinozamites leeiana Sze 新屬,新種

Drepanozamites? *p'ani* Sze 新種

III. 銀杏植物綱

Ginkgoites chowi Sze 新種

Ginkgoites sp.

Glossophyllum? *shensiense* Sze 新種

?*Sphenobaiera furcata* (Heer) Florin

Sphenobaiera crassinervis Sze 新種

Psygmophyllum? sp.

IV. 開通植物目 (Caytoniales)

Sagenopteris spatulata Sze 新種

Sagenopteris sp.

V. 裸子植物內分類不明的化石

Desmiophyllum sp.

VI. 生殖部分的化石

Swedenborgia cryptomerioides Nathorst

?*Stenorachis* (*Ixostrobus*?) *konianus* (Ôishi et Huzioka)

Conites sp.

Carpolithus spp.

根部化石

Radicites sp.

Taeniocladopsis rhizomoides Sze 新屬,新種

疑問的化石

Problematicum a.

Problematicum b.

Problematicum c. (*Muscites*? sp.)

在緒論中已經提及潘鍾祥同志 1936 年所發表的延長層植物羣共爲 15 種，其中的 ?*Schizoneura gondwanensis* Feistmantel 似爲 *Neocalamites carcinoides* Harris 的一種保存狀況，兩者葉的寬度是相等的。另外

如 *Cladophlebis* cf. *roesserti* Zeiller 的關係也異常不明。很可能的這一個種是 *Cladophlebis* (*Todites*) *shensiensis* P'an 的一種變異形態的化石，在當前的材料中 *Cl. shensiensis* 的小羽片形態也是變異甚大的。並且越南東京的 *Cl. roesserti* 和陝北的 *Cl. shensiensis* 的實羽片化石是完全相同的。Harris 曾經指出 Zeiller 的標本和這一個種的"種型"卽 Presl 的原始標本是完全不相同的，所以 *Cl. roesserti* Zeiller 一個學名是不能成立的。此外潘同志的種屬和本文所描述的完全相同的有 *Cladophlebis shensiensis* P'an, *Cladophlebis szeiana* P'an, *Cladophlebis gigantea* Ôishi, *Bernoullia zeilleri* P'an, *Danaeopsis fecunda* Halle (=*D. hallei* P'an), *Thinnfeldia rhomboidalis* Ettingshausen, ?*Protoblechnum hughesi* (Feistm.) Halle (= "*Danaeopsis*" *hughesi* Feistm.), *Glossophyllum? shensiense* Sze (= 潘鍾祥的 ?*Noeggerathiopsis hislopi* Banbury), *Conites* sp. (= 潘的 Problematicum)。除出完全相同的化石以外，潘同志所發表的種屬，在本篇所未曾描述的尚有下列 3 種:

Cladophlebis grabauina P'an (屬於蕨目而科名未定者)

Ginkgoites magnifolia Fontaine (屬於銀杏植物綱)

Podozamites lanceolatus L. & H. (屬於 Podozamitales 目)

本文所描述的 62 種化石，再加上潘的 3 種，我們目前所已經知道的延長植物共爲 65 種左右。其中 20 爲舊種，25 爲新種(舊種中屬名和種名都尙有疑問者 4 種，新種中屬尙有疑問者 4 種)，屬名已定而種名未定者共 17 種(其中屬名尙有疑問者 4 種)，屬名和種名俱有問題者爲 4 種，種名已定而屬名尙有疑問者 4 種，分類不明的化石 1 種，未鑑定的裸羽化石 1 種，疑問的化石 3 種；全部 65 種化石，分屬於各個不同的類別，有如下表(有括弧者係新種)

苔蘚植物門	1	(0)
木賊目	13	(6)
蕨綱	20	(8)
種子蕨綱	8	(3)
蘇鐵植物綱	3	(3)
松柏目	0	(0)
Podozamitales 目 (未譯)	1	(0)
銀杏植物綱	7	(3)
開通植物目 (Caytoniales)	2	(1)
生殖部分化石	4	(0)
分類不明化石	1	(0)
疑問的化石	3	(0)
根部化石	2	(1)
全部化石 65 種		(25) 種 (新種)

根據上表我們知道延長植物羣組成的分子以蕨綱 (Filicineae) 爲最主要佔全部的最大多數其中眞蕨目有 16 種，觀音座蓮目有 4 種共計有 20 種之多，其中新種有 8 種之多，此外最令人注意者爲木賊綱中的木賊目共計 13 種而新種有 6。除蕨綱及木賊目之外，最特出者爲種子蕨綱共有 8 種而新種佔有 3；銀杏植物綱爲 7 種，其中新種有 3；蘇鐵植物綱共 3 種，全係新種；開通植物目 (Caytoniales) 有 2 種，其中之一爲新種；生殖部分的化石爲 4 種；分類不明的化石爲 1 種；疑問的化石爲 3 種；根部化石爲 2 種；苔蘚植物化石爲 1 種 (可能有 2 種) Podozamitales 目有 1 種。

延長植物羣的組成分子的最令人不能忽視的事實，是松柏植物的特別缺乏，在上表僅有 1 種，而此種是否眞屬於松柏目，尙不無疑問。這一種卽 *Podozamites lanceolatus* (L. & H.) Braun. 這一個種的形態實介於蘇鐵類及松柏類之間，因此其眞實的地位不易決定。此屬在 1843 年爲 Braun[8] 所創立 (1843，第 36 頁)，他頗疑此屬植物係蘇鐵植物綱的一屬 *Zamites* 的一種特別的類型。此後的古植物學家對於此屬植物的知識，並沒有多所增加。直到 1867 年 Schenk[145] 曾報道了一塊標本，其基部是有鱗狀葉的 (1867，第 160 頁圖版 36，圖 3)，他立刻表示他的意見，他說 *Podozamites* 是屬於松柏植物的。後來的學者對於此屬植物的

最重要的報道是 Nathorst[113]，他指出了兩點：(1911，第1—10頁) (1) *Podozamites* 的生殖部分化石是 *Cycadocarpidium*; (2) *Podozamites* 不是葉部而是苗部卽枝部(Sprosse)化石，它的基部是有鱗狀葉片包圍着的。一直到今天，古植物學者尙未能完全決定此屬植物究係松柏類* 或是蘇鐵類。很可能的 *Podozamites* 是和松柏類及蘇鐵類都有關係的。正如 Nathorst, Seward 以及 Schuster 所相信的一樣 (參看 Seward 1911，第51頁)，這一屬植物，應該暫定爲裸子植物門當中的一個特別的"科"來看待。斯行健[166] (1931，第15頁) 以及此後的論文都是用一個問號將此屬植物附在松柏植物綱之下的。Gothan[42] 在其最近出版的教科書 (Gothan & Weyland, 1954，第252頁及316頁) 中將 *Podozamites* 一屬單獨成一目名爲 Podozamitales，並且說明：這一個目和松柏目相接近的程度，較甚於蘇鐵植物。更令人不能忽視的是 *Podozamites lanceolatus* 一種是東亞的瑞底克期至里阿斯期 (Rhaetic-Liassic) 的各地層中分佈最廣並且常爲每一地點的最豐盛的化石，在延長植物羣中，除潘鍾祥所研究的材料中有若干化石以外 (本文圖版 LII，圖1，圖版 LIII，圖1)，本文作者所研究的材料則特別缺乏。僅有的一塊化石是有屬於 *Podozamites* 的可能的，是本書第56頁圖版 LIII，圖6所描述的暫定爲 *Desmiophyllum* sp.。筆者1951年陝北的旅行在宜君一帶曾特別注意此屬化石，但未曾找到其痕跡。根據潘鍾祥[127] (1936，第35頁)，*Podozamites* 僅僅發現於延長層的上部的，在下部地層中從未曾找到其痕跡。

延長植物羣的組成分子第二個令人不能忽視的事實是：蕨類植物門 (Pteridophyta) 的種屬佔據全部54％以上，其中木賊目有3種，眞蕨目有16種，觀音座蓮目有3種，已如上述。除蕨類植物門外，延長植物羣的組成分子以種子蕨類爲主共有8種，分佈於3屬。蕨類植物門的木賊目爲 *Neocalamites* 及 *Equisetites* 所組成，其中的5個新種，都是異常特殊的化石。眞蕨目則以 *Cladophlebis* 爲主，除潘1936年所描述的兩種新種 *Cl. shensiensis* 及 *Cl. szeiana* 已甚爲特緻外，本書所描述的新種6個如 *Cl. kaoiana, Cl. gracilis, Cl. ichünensis, Cl. stenophylla Cl. paralobifolia* 及 *Cl. suniana* 也都是很特別的化石。*Cladophlebis* 一屬的多數種的保存孢子囊的實羽片化石都是作 *Todites* 的形態。其孢子囊的形態及其佈置狀況和現代紫萁科 (卽薇科 Osmundaceae) 的一屬僅生存於南非、新西蘭及澳洲地區的 *Todea* 大致可以比較的。因此 *Cladophlebis* 的多數種 (少數種如 *Cl. exilis* 屬於海金砂科，*Cl. arguta* 及 *Cl. lobifolia* 是屬於桫欏科的) 古植物學者都用一問號放在紫萁科之下的。本書第16，17頁所提到的及圖版 XV，圖1—16所表示的實羽片化石，其孢子囊的形態及佈置狀態，屬於 *Todea* 及 *Todites* 類型的，此種實羽片化石作者相信是屬於 *Cl. shensiensis* 的。因此至少 *Cl. shensiensis* P'an 一種是屬於紫萁科 (卽薇科) 的。*Cl. szeiana* P'an 其裸羽片的形態及葉脈接近於古生代的 *Pecopteris arcuata* Halle 其實羽片的形態接近於北美中部上三叠紀的 *Asterocarpus virginensis* Fontaine,，裸羽片的形態亦和北美種相近似。因此 *Cl. szeiana* 似肯定的不屬於紫萁科的。Fontaine 1883 第41頁特別指出他的 *Asterocarpus* 頗似裹白科，這個意見顯然是不正確的。很可能的這一個種是屬於觀音座蓮科的，因爲實羽片的形態是接近於古生代的 *Asterotheca* 的。其餘的 *Cladophlebis* 各種，因尙未找到其實羽片化石，都暫歸眞蕨目，屬於何科未定的項目之下，其中可能有一部分是屬於紫萁科的。此外如 *Phlebopteris? linearifolia* 是一個新種，其實羽片化石未曾發現，根據裸羽片的形態有屬於 *Phlebopteris* 的可能。其屬於馬通蕨科，不是完全不可能的。至於 *Danaeopsis fecunda* Halle 根據實羽片的孢子囊的形態及其排列狀況似現代的馬蹄蕨 (*Archangiopteris*) 其屬於觀音座蓮目是沒有疑問的。此種的實羽片化石除發現於瑞典 Scania 瑞底克期外，僅發現於甘肅的延長層中 (本文圖版 XXXI)。是否本書所描述的所有 *Danaeopsis* 標本都是屬於這一個種呢？作者暫不作完全的決定，但相信是很可能的，因爲如果我們將所有裸羽片，因其體積的變異而創造了許多新種名是非常不便的。本書第31頁圖版 XXXIII，圖4；圖版 LIII，圖7所表示的 *Danaeopsis?* sp. 也非常可能是這一個種的最年青蕨葉 (frond) 化石。*Bernoullia* 一屬是非常特殊的植物。這一屬植物的裸羽片及其葉脈以及實羽片的形態都異常特殊，其地位雖未能作最後的決定，但多數古植物學家相信其屬於"觀音座蓮目"的可能性爲最大。Hirmer[63] (1927，第591頁) 將其暫附於觀音座蓮目之下，

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* 有人將 *Podozamites* 和現代松柏科的一屬 *Agathis* 相比較。在下三叠紀發現的松柏類一屬 *Albertia*，其葉部也大致和 *Podozamites* 相似，尤其是 Schimper 和 Mongeot[140] 1844；圖B的一塊標本更爲相似。但一直到今天，這兩屬植物的眞實關係尙未明白，因爲缺少"球果"等類化石的知識，同樣的話斯行健1931，第16頁已經指出過了。

並且說明道:"此類植物具有和觀音座蓮目很相似的，但不够十分明白的生殖器官。"這一屬植物的直的分佈也至爲特別，和 *Danaeopsis* 一樣是發生在歐洲的上三叠紀初期的而其最繁盛的時期爲上三叠紀中部（本書第 32, 88, 89, 93 頁），*Bernoullia* 也曾經繼續生存於越南東京的瑞底克期至里阿斯期中（本書第 32 頁）。根據潘鍾祥[128] 最近的著作（1954, 第 211 頁）認爲 *Danaeopsis* 甚至也可發現於陝北瓦窰堡系的底部地層中。講到這裏應該特別指出的是 *Cladophlebis szeiana* P'an 其孢子囊的詳細構造，雖尙未明白，其屬於觀音座蓮目的可能性，也不是完全沒有的。

延長植物羣的第三點令人不能忽視的事實是 *Thinnfeldia* 一屬特別繁盛共有 6 種而新種有 3 個。此屬植物的正確地位迄今未能決定。Lundblad[102]（1950, 第 34 頁）用一個問號將其歸於種子蕨綱（Pteridospermae?）。和 *Lepidopteris* 一樣，筆者相信 *Thinnfeldia* 是有屬於所謂"中生代的種子蕨類"（Mesozoic Pteridosperms）的可能的。Seward[154]（1910, 第 537 頁），Harris[56]（1937, 第31 頁），Darrah[20]（1939, 第 94 頁），Emberger[24]（1944, 第 303 頁）及 Arnold[4]（1947, 第 239 頁），Mägdefrau[105]（1953, 第 256 頁）都相信 *Thinnfeldia* 是種子蕨類。Gothan 似乎和從前的意見一樣，到現在還不甚相信在中生代時還有種子蕨類的。他在其最近出版的教科書 1954, 第 270—271 頁中將*Thinnfeldia, Dichopteris, Lepidopteris, Cycadopteris*……等定爲"中生代的各種不同的外表和蕨類相似的植物"（"Mesozoische äusserlich farnartige Pflanzen verschiedener Art"），並且特別指出："這些植物不是蕨類而是裸子植物類（Gymnospermen），甚至可能是屬於比裸子植物類還要較高的門類中的"（"……die keine Farne waren, sondern zu den gymnospermen oder gar zu noch hoher stehenden Pflanzensippen gehört haben"）。對於這些植物，甚至可能是屬於比裸子植物類還要較高的門類的意見，本文作者不能表示同意。除 *Thinnfeldia* 外，本文所描述的植物還有兩種如 *?Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.) 及 *Ctenopteris sarrani* Zeiller 都有屬於種子蕨類的可能的。Zeiller[201]（1903, 第 52 頁）曾經指出 *Ctenopteris* 是種子蕨類的一份子。Seward（1910, 第 548 頁）曾將其列於種子蕨類，不過特別加以說明："很可能的這一屬植物不是眞正蕨類，而好像是蘇鐵植物類（Cycadophyta）的一份子或是其他已經絕滅的門類中的一份子"。Gothan 在其最近出版的教科書（1954, 第 315 頁）中認爲 *Ctenopteris* 是和 *Nilssonia* 一類（*Nilssonia* gruppe）的植物相接近的。*?Protoblechnum hughesi* (Feistm.) Halle (? sp. nov.) 一種，假使鑑定無誤，那末，延長植物羣中的發現此種植物，是值得令人特別注意的事，因爲這一個事實如果根據 Gothan 的說法，那就成爲古生代時恭華那植物羣絕滅以後，逃來中國北部避難，幸而遺存的一種孑遺植物了（參看斯行健[174], 1955a, 第 18 頁；Sze[175], 1955b, 第 207 頁）。但如屬名前的問號所表示，延長層中的這一種植物的鑑定的正確性是根本須加以極大的保留的。關於越南東京的所謂 *Danaeopsis hughesi* 的鑑定也不可靠，本書第 98 頁中已經指出過了。

延長植物羣的第四點令人注意的事實是蘇鐵植物類的不甚豐盛。蘇鐵植物是中生代的尤其是瑞底克期至里阿斯期以及中侏羅紀最繁盛的植物門類之一。最令人注目的事實，是瑞底克期至侏羅紀最繁盛的各屬如 *Pterophyllum, Zamites, Otozamites, Ptilophyllum, Nilssonia* ……等化石在延長層中都沒有找出其痕跡。在當前的材料中，作者僅有機會描述了三種卽 *Sphenozamites changi* sp. nov., *Sinozamites leeiana* gen. et sp. nov. 及 *Drepanozamites? p'ani* sp. nov. 俱係新種。*Sphenozamites*是一屬非常少見的植物，在東亞的中生代地層中最初僅發現於越南（Councillon[19], 1914, 第 7 頁圖版 3 圖 5, 5a），後又記載於鄂西的香溪煤系（Hsieh, Chao[67], 1925, 第 6 頁；Sze[172], 1949, 第 25 頁）。當前的新種其斜方形的葉寬闊無比，更屬少見。同樣寬闊或更較寬闊的 *Sphenozamites* 亦發現於北美維基尼亞州的所謂 Virginia-Keuper 地層中（中部上三叠紀），但葉的形態和脈的型式俱和我們的種不同。Seward[157]（1919, 第 587 頁）將 *Sphenozamites* 歸於"蘇鐵植物的葉部化石，無法屬於一定的科名之下"的項目之一下。他並且特別加以說明："關於 *Sphenozamites* 的構造及其生殖部分的知識，我們一點也不知道，雖然這一個屬名對於描寫的目的甚爲有用，是僅僅地建築在葉部化石的基礎之上的；在沒有得到其他的論據之前，我們不要太快地猜想這一個屬名是包含着植物學上的親緣關係的"。Seward 的意思是指 *Sphenozamites* 的含義是"楔形的 *Zamites*"但不一定和蘇鐵植物類的 *Zamia* 及 *Zamites* 有很近的關係的。Gothan 在最近的教科書（1954, 第 292 頁及第 295 頁）中將 *Sphenozamites, Anomozamites, Otozamites, Zamites, Dictyozamites, Pterophyllum* ……等一律都歸於"蘇鐵植物葉部化石"

("Blattreste von Cycadophyten") 的項目之下。本書作者同意此一意見,認爲 *Sphenozamites* 爲蘇鐵植物的葉部化石,其可能性是很大的。本書所描述的新屬 *Sinozamites* 的創立,也僅僅是根據葉部化石的,其構造及生殖部分的知識也完全未曾明白。但作者相信這一屬似乎也是蘇鐵植物類的"本勒蘇鐵目"(Bennettitales)的葉部化石。作者希望在未來的採集工作中,能找出可靠的論據,解釋 *Sinozamites* 的眞實的植物學上的地位。至於 *Drepanozamites? P'ani* Sze 一種,很可能的不是蘇鐵植物的葉部化石,況且我們的種,或多或少地顯出一條中脈,其屬名的正確鑑定是尙有問題的。根據 Harris (1937, 第 27 頁),他的 *Drepanozamites nilssoni* (Nathorst) Harris 種是屬於蘇鐵目的 (Cycadales) 的。

延長植物羣的第五點令人注意的事實是:雖然侏羅紀時頗豐盛的銀杏植物類如 *Ginkgo* 的各種, *Ginkgoites* 的各種及 *Baiera* 的各種在延長層中並未出現,但延長層中也含有 *Ginkgoites* 的一個新種,以及一個 *Ginkgoites* sp.。而 *Glossophyllum? shensiense* 的發現(此種葉部化石在延長層上部地層豐盛無比),更令人特別注意,因爲這一個種很可能是和奥國的 Lunzer Keuper (上三叠紀中部)植物羣的 *Glossophyllum florini* Kräusel 是有很近的關係的。在我們的材料中也找出了或多或少地和 *G. florini* 相同的枝部化石(本書圖版 XLIX, 圖 5, 6)。這一個種的雄花化石 *Antholithus wettsteini* Krasser 在我們的材料中,尙未發現。本書所描述的 *Psygmophyllum?* sp. 也是一種非常特殊的葉部化石,其屬於銀杏植物類也不是不可能的。

延長植物羣的第六點令人注意的事實是發現開通植物目 (Caytoniales)的葉部化石 *Sagenopteris*,其中一種保存甚爲完全。這一類植物根據 Thomas,是最古的被子植物。Hirmer[64] (1937, 第 271—289 頁)相信它是中生代的種子蕨類的。Harris[56] (1937, 第 31—39 頁)也相信它是屬於種子蕨類的。Gothan 在其教科書(1954, 第 323 頁)中將這一個目,單獨地列入於裸子植物門之下。至於 *Sagenopteris* 式的葉部化石,從前古植物學者都相信是一種蘋科 (Marsileaceae)的葉部。自從 Thomas 將其和 *Caytonia* 式的種子化石合併以後,至今尙無人加以懷疑。所令人注意的是 *Sagenopteris* 式的葉部化石在中國中生代的地層除延長層外,僅在福建的板頭系(下白堊紀初期)中找到若干保存不全的化石,其他地層至今尙未曾找到其痕跡。在日本方面山野井 (Yamanoi) 及山口 (Yamaguti) 的上三叠紀以及成羽 (Nariwa) 及岡山 (Okayama) 的成羽植物羣(大石定爲瑞底克期)。以及其他地方的來馬 Kuruma 層(下侏羅紀)及 Kiyosue group (上侏羅紀)及手取 (Tetori) 系(上侏羅紀)直至領石系 (Ryôseki 系下白堊紀初期)(參看大石[121], 1940, 第 360—364 頁)。都發現了 *Sagenopteris* 式的葉部化石。*Caytonia* 式的種子化石及 *Caytonanthus* 式及 *Gristhorpia* 式的生殖部分化石。在東亞的中生代地層中從未曾發現。

關於生殖部分的化石,在延長植物羣中除圖版 V, 圖 4; 圖版 VII, 圖 5—7 所表示的木賊科的子囊穗 (Strobili of *Equisetites*)化石外,還發現了 *Swedenborgia Cyrptomerioides*, *?Stenorachis* (*Ixostrobus?*) *konianus*, *Conites* sp. 以及 *Carpolithus* spp. 等。*Swedenborgia cryptomerioides* 除發現於延長層以外,還發現於鄂西的香溪煤系;在日本發現於成羽 (Nariwa) 植物羣。在日本的同一地層中還發現了另外一種 *Sw. major* Harris (大石, 1940, 第 416 頁)。正如種名 *cryptomerioides* 所含義,這一種形式的球果是接近於現代僅生存於中國及日本的柳杉 (*Cryptomeria*) 的。因爲其球果鱗片 (Zapfenschuppen) 和柳杉相似,在其頂部是分裂而成爲若干裂片的。因此 *Swedenborgia* 式的生殖部分化石是有屬於松柏目的可能的。Harris[55] (1935, 第 107 頁)根據此種化石在格陵蘭東部常和 *Podozamites* 在一起找到的事實,相信它是屬於 *Podozamites* 的。Harris (1935, 第 147 頁)同時相信他的 *Ixostrobus* 式的雄花化石也是屬於 *Podozamites* 的。本書作者對於這些意見不能表示完全同意,作者相信 *Podozamites* 的球果化石應該還是 *Cycadocarpidium* 的。本書所描述的 *?Stenorachis* (*Ixostrobus?*) *konianus* Ôishi & Huzioka 的標本是根本不能鑑定的。很可能的這一種生殖部分化石是銀杏植物的雄花化石。在延長層中還發現了若干種子化石,可能代表着好幾種;因保存不佳兹暫籠統地定爲 *Carpolithus* spp. 一部分種子化石無疑地是屬於銀杏植物的,一部分可能是屬於種子蕨類及其他門類的。延長層的 *Conites* sp. 很可能是屬於松柏植物的。

本書圖版 LIII, 圖 6 所表示的 *Desmiophyllum* sp. 可能是 *Podozamites* 的一個變種。如保存較全,這些化石可以定爲 *Podozamites lanceolatus* forma *latior* Sze (Sze[166], 第 28 頁)的。

本書圖版 XXVIII 圖 7、8 所表示的"疑問的化石" Problematicum a，很可能是屬於蘇鐵植物的，並且很可能是屬於本勒鐵目的。又 Problematicum c（圖版 LVI，圖 5，5a）很可能是蘚類化石。

本書所描述的兩種根部化石（圖版 LIV，圖版 LV；圖版 LVI 圖 6，7）很可能是木賊目 *Neocalamites* 或 *Equisetites* 的根部化石。

總結的説，從植物學的性質來看，延長植物羣的組成分子給人以一極明顯的印象，即此植物羣是不可能是屬於侏羅紀的。將此植物羣定爲上三叠紀是非常合適的。其理由有二：(1) 在延長植物羣中以木賊目、眞蕨目、觀音座蓮目及種子蕨類爲主，這些都是古生代最繁盛的植物。延長植物羣中既以屬於此種科目的植物佔極大多數，則其時代的必較侏羅紀爲古是沒有問題的。在東亞瑞底克期至里阿斯期地層中，到處可以找到的蕨類化石如 *Dictyophyllum*，*Clathropteris*……等以及在里阿斯期至中侏羅紀地層中到處可以發現的 *Coniopteris* 在延長層亦未見其痕跡。在未來的採集工作中，作者相信在延長層中發現 *Dictyophyllum* 及 *Clathropteris* 的可能性，不是沒有的；因爲這兩屬也曾發現於歐洲及北美的上三叠紀中部（Mittler Keuper）地層中。(2) 在延長植物羣中，侏羅紀最豐盛的各屬蘇鐵植物葉部化石如 *Zamites*，*Otozamites*，*Ptilophyllum*，*Pterophyllum*，*Nilssonia*……等化石都未曾找到。又如侏羅紀最常見的各種銀杏植物葉部化石如 *Ginkgoites sibirica*，*G. lepida*，*C. hermelini*……以及 *Baiera gracilis*，*B. guilhaumati*，*B. lindleyena*……等以及和銀杏植物相接近的 *Czekanowskia*，*Phoenicopsis* 的各種亦都未曾發現，都是說明延長植物羣較普通在東亞認爲瑞底克期至里阿斯期以及中侏羅紀的植物羣完全不同，而其地層時代必定是較老，更不容懷疑。支持這個意見的更有一個重要的反證，即侏羅紀時最繁盛的松柏植物，在延長層中亦幾乎完全絕跡。而 *Podozamites* 的發現，亦僅僅在一兩個地點中，多數地點尚未找到，尤令人特別注意。

總之延長植物羣的組成分子及其在地層上的發生次序都說明這一植物羣是較老於以 *Dictyophyllum* 及 *Clathropteris* 爲主的越南東京植物羣及中國南方的安源植物羣的。

（二） 延長植物羣的發現地點及其直的分佈

在討論延長植物羣的植物學上的性質以後，我們應該敍述此一植物羣在每一個發現地點的組成狀況及每一種化石在地層上的直的分佈的情况。

1. 宜君縣四郎廟的炭河溝

層位：延長層上部

Thallites sp.
Equisetites acanthodon Sze 新種
Neocalamites carrerei (Zeiller) Halle
N. carcinoides Harris
N. rugosus Sze 新種
N.? sp.
Cladophlebis szeiana P'an
Cl. shensiensis P'an
Cl. cfr. *gigantea* Ôishi
Cl. raciborskii Zeiller
Cl. kaoiana Sze 新種
Cl. sp. a.
Cl. sp. b.
Phlebopteris? *linearifolia* Sze 新種
Danaeopsis fecunda Halle
D.? sp.
Bernoullia zeilleri P'an
Ctenopteris sarrani Zeiller
?*Protoblechnum hughesi* (Feistm.) Halle (?新種)
Drepanozamites? *p'ani* Sze 新種

Glossophyllum? shensiense Sze 新種
Sagenopteris spatulata Sze 新種
?*Stenorachis* (*Ixostrobus*?) *konianus* Ôishi & Huzioka
Swedenborgia cryptomerioides Nath.
Carpolithus spp.
Conites sp.
Radicites sp.

這一個地點的化石，大半是本書作者1951年之冬親自採集的，其地層的層位爲延長層的最上部。岩石爲黃色的粘土質頁岩，故化石的保存，大都十分完善。可惜的是植物的炭質薄膜俱未曾保存，因此不能利用浸解方法研究其表皮及小氣孔的構造。這一個地點共發現27種左右，就單獨的地點而論，植物的種屬是不能算很少的。在這些種之內，*Cl. shensiensis* 的標本發現最多，這個種顯然是這一個地點最豐盛的植物，常常是成堆地出現的。次之如 *Cladophlebis szeiana*, *Cl. raciborskii*, *Danaeopsis fecunda*, *Bernoullia zeilleri*, *Glossophyllum? shensiense* 及 *Neocalamites*……的各種發現也甚多。*Neocalamites rugosus* 的形態異常特殊。*Sagenopteris*, *Swedenborgia* 及 *Glossophyllum?* 的發現更令人異常注意。*Bernoullia*, *Danaeopsis* 及 *Glossophyllum* 都是歐洲的上三叠紀中部 (Lunzer Keuper 及 Basler Keuper) 地層最標準的化石。*Ctenopteris sarrani* 是越南東京的一種特殊植物，標本的保存頗爲巨大。而在此地發現甚爲破碎但十分標準的化石，尤令人注意。?*Protoblechnum hughesi* 一種的鑑定，雖不可靠，但此地發現其碎片，尤令人不能忽視。因爲這一個種是古生代末恭華那古大陸的重要份子，其發現於中國北方中生代的事實，除出以孑遺植物意義來解釋以外，尙無他種理論可以解釋之。從謹愼的觀點出發，暫加一個問號於屬名之前。這些標本，也很接近於中國上石盒子系的 *Protoblechnum wongii* Halle 的。

2. 宜君縣杏樹坪的七母橋

層位：延長層上部

Cladophlebis shensiensis P'an
Cl. graciles Sze 新種
Cl. ichunensis Sze 新種
Cl. stenophylla Sze 新種
Cl. suniana Sze 新種
Bernoullia zeilleri P'an
Thinnfeldia rhomboidalis Ettingshausen
Th. major Raciborski
?*Th. nordenskiöldi* Nathorst
Th. rigida Sze 新種
Th. alethopteroides Sze 新種
Th. laxusa Sze 新種
Sphenozamites changi Sze 新種
Sinozamites leeiana Sze 新種
Ginkgoites chowi Sze 新種
G. sp.
Glossophyllum? shensiense Sze 新種
Psygmophyllum? sp.
Sagenopteris sp.
Swedenborgia cryptomerioides (Nathorst)

這一個地點的化石，也是作者親自採集的，共有20種。其層位僅僅微低於第一個地點。岩石爲灰色略帶綠色的砂岩。這一個地點最豐盛的化石爲 *Bernoullia* 及 *Glossophyllum?*，次之爲 *Thinnfeldia* 的各種，而 *Cladophlebis* 及 *Sphenozamites* 的發現亦不甚少。這一個地點的最特殊而最令人感到興趣的是 *Sinozamites leeiana*（新屬，新種）。這一種化石雖然我們尙不能知道其表皮構造及生殖部分的知識，其爲蘇鐵植物並且是

木勒鐵目的一屬新的葉部化石的可能性是很大的。此外尤令人注意的是 *Sphenozamites* 此種化石在東亞是發現很少的。 *Thinnfeldia* 的發現而且發現的種很多更不容忽視。 *Psygmophyllum?* 也顯然是異常特殊的葉部化石。

3. 宜君縣焦家坪(根據地點,下列兩種化石似屬於瓦窰堡系的,但根據"母岩"的性質是屬於延長層的。)

層位: 延長層上部

Equisetites deltodon Sze 新種
Neocalamites sp. (僅有葉部化石,文中未敍述)
疑問的化石 b (Problematicum b)

標本係黃紹顯,鞏志超,蹇質良三同志所採集。一個奇特的*Equisetites*新種的發現於此地,令人異常注意。

4. 延長縣七里村

層位: 延長層上部

Equisetites sarrani Zeiller
E. sp. (strobili of Equisetites)
Neocalamites carcinoides Harris
N. brevifolius Sze 新種
Cladophlebis szeiana P'an
Cl. shensiensis P'an
Cl. cfr. *gigantea* Ôishi
Sphenopteris sp. (cf. *Sph. arizonica* Daugherty)
疑問的化石 a (Problematicum a)

這一個地點的標本是石油總局寄來鑑定的。岩石多爲灰色略帶綠色的砂岩,其層位亦爲延長層的最上部。岩石的顏色及性質和第二個地點卽宜君縣杏樹坪七母橋的岩石完全相同,兩者的層位是否完全可以對比,尙不敢決定,但其可能性是很大的。這一個地點發現最多並且保存異常佳美的是 *Neocalamites carcinoides*, 其他如 *Cladophlebis shensiensis* 及 *Cl. szeiana* 在此地亦頗有發現,保存亦佳。 *Cl.* cfr. *gigantea* 在別處很少找到,在此地亦有所發現。 *Sphenopteris* sp. 雖不易鑑定,但其形態頗接近於北美亞利桑那州的上部三叠紀的 *Sphenopteris arizonica* 尤令人注意。 *N. brevifolius* 是一個新種是一個異常特殊的種,僅發現於此地。木賊科的子囊穗化石在此地亦發現甚多。 Problematicum a 是一種疑問的化石,其屬於何種門類尙未能決定,可能是屬於蘇鐵植物的。

5. 綏德縣葉家坪

層位: 延長層上部

Cladophlebis shensiensis P'an
Cl. szeiana P'an
Cl. grabauiana P'an
Thinnfeldia rhomboidalis Ettingshausen
?*Th. nordenskiöldi* Nathorst
?*Protoblechnum hughesi* (Feistm.) Halle (?新種)
Podozamites lanceolatus (L. & H.) Braun
Danaeopsis fecunda Halle

這一個地點的化石,係潘鍾祥1936年曾經描述過的。這一個地點的最突出的事實是 *Podozamites lanceolatus* 的發現,因爲這一個種是延長層的其他地點尙未找到過的。根據這一個地點的發現此種化石的事實,我們相信其他各地點的發現 *Podozamites* 化石,也是完全可能的。 *Cladophlebis grabauiana* 在別處亦未曾發現。

6. 綏德縣,三十里舖附近溝內,約離縣城東北 12—15 公里

層位: 可能爲延長層上部

?*Protoblechnum hughesi* (Feistm.) Halle (?新種)
Glossophyllum? shensiense Sze 新種

這一個地點，雖僅發現了兩種化石，是具有特殊的歷史意義的。因爲這兩種化石是奥勃魯契夫院士在1893—1894年所採集的。第一種化石經克拉梭定爲 *Danaeopsis hughesi* 的，第二種則定爲 ?*Noeggerathiopsis hislopi* 的。自從克拉梭的論文發表以後地質學家及古生物學家一直相信中國北方中生代時是有恭華那植物羣的混入的。並且這兩種化石此後又經很多學者加以詳細討論過的(如 Gothan[38]，1915，第270頁；Halle[50]，1927，第138頁；Sze[166]，1931，第7頁等)。

7. 延長縣烟霧溝
層位：延長層上部
Cladophlebis shensiensis P'an

這一地點也僅有一種，係石油總局送來鑑定的。

8. 延長縣馮家村溝
層位：延長層上部
Neocalamites rugosus Sze 新種

係石油總局送來研究的標本。這一種因其彎曲的皺紋而令人異常注意。此種皺紋係樹幹內部的皮層(Cortex)的表面形態(Ornamentation of the outer surbace of cortex)。在一塊標本上，還保存一部分外皮層，其表面的細的直肋至爲明顯，故知其屬於 *Neocalamites*。此種除發現於此地外，還發現於宜君縣四郎廟的炭河溝。

9. 延長縣城西渠口村
層位：延長層上部
Neocalamites sp.
Glossophyllum? shensiense Sze 新種

兩種化石標本是石油總局送來研究的。

10. 延長縣城南
層位：延長層上部
Problematicum C. (*Muscites*? sp.)

11. 清澗縣附近
層位：延長層中部
Bernoullia zeilleri P'an

此種係潘鍾祥1936年所發表的。

12. 清澗縣王家渠
層位：延長層中部
Desmiophyllum sp.

僅有一枚碎片，此種碎片很可能是屬於 *Podozamites lanceolatus* f. *latior* Sze.

13. 延長縣懷林坪
層位：延長層中部
Cladophlebis szeiana P'an

僅有一種是潘同志1936年所研究的。

14. 延長縣石家溝
層位：延長層中部
Cladophlebis shensiensis P'an

僅有一種，也是潘同志所發表的。

15. 綏德縣沙灘坪

層位：延長層中部

Cladophlebis cf. *gigantea* Ôishi
Cladophlebis shensiensis P'an
Glossophyllum? *shensiense* Sze 新種
Conites sp.

都是潘所研究過的標本，第三種潘同志 1936 年定爲 ?*Noeggerathiopsis hislopi* (Bunburg) 這一個種在這一帶似亦發現頗多。最後的一種，潘曾定爲 Problematicum.

16. 綏德縣高家庵

層位：延長層下部

Ginkgoites magnifolia (Fontaine)
Danaeopsis fecunda Halle
Cladophlebis shensiensis P'an
?*Protoblechnum hughesi* (Feistm.) Halle (?新種)
Conites sp.

五種化石都是潘 1936 年所發表的，第二種當時曾定爲一個新種 *D. hallei* P'an，第四種當時被定爲 "*Danaeopsis*" *hughesi* Feistm.。最後一種被定爲 Problematicum。

17. 綏德縣橋上

層位：延長層下部

Cladophlebis shensiensis P'an

也係潘 1936 年所描述的，僅有一塊非常破碎的碎片，登載於潘的論著圖版 IV，圖 16. 在同一地點還發現保存較全的若干標本，被定爲 *Cladophlebis* (*Todites*) cf. *roesserti Zeiller* (nov Presl)，登載於同一圖版的圖 11—15.這些標本顯然也是屬於 *Cl. shensiensis* 的。

18. 淸澗縣老鴉關

層位：延長層下部

Neocalamites sp.

王水同志採集的標本。

19. 延川縣延水關

層位：延長層下部

Danaeopsis fecunda Halle

王水同志採集的標本。

20. 葭縣大會坪

層位：延長層下部

Danaeopsis fecunda Halle
未鑑定的裸羽片化石 (Undetermined Sterile Pinnae)

係王水同志採集的標本。*Danaeopsis fecunda* 的裸羽片，保存異常佳美，最好的一塊標本登載於本書圖版 XXIX 圖 1, 1a, 1b.

21. 葭縣峪口

層位：延長層下部

Neocalamites sp.

王水同志採集的標本。

22. 銅川縣高崖底北河溝中

層位：延長層底部

Equisetites? sp. (Cf. *E. rogersi* Schimper)

李春昱同志所採集的標本。

地點 23, 24, 25, 26, 27 是屬於山西省的（俱位在山西及陝西兩省的邊界上）。大部分標本都是王水同志採集的，其層位都是屬於延長層下部。*Danaeopsis* 有保存僅佳者。保存甚佳的 *Equisetites brevidentatus* 新種係賈福海及高存禮兩同志所採集的。王水同志採集的延長層下部 *Neocalamites* 標本甚多，樹幹有寬至 15 厘米以上者，但俱不能作正確的鑑定故在正文內未曾描述。茲一律暫定爲 *Neocalamites* spp.。

23. 山西臨縣馬家灣

Neocalamites sp.
Danaeopsis fecunda Halle

24. 山西臨縣第八堡

Equisetites brevidentatus Sze 新種
Danaeopsis fecunda Halle

25. 山西興縣李家凹

Equisetites sp. (Strobili of *Equisetites*)
Neocalamites sp.
Danaeopsis fecunda Halle
?Sphenobaiera furcata (Heer) Florin

這一個地點所發現的 *?Sphenobaiera furcata* 的標本，有炭質薄膜保存於其上，因此可用'浸解方法'研究其氣孔及表皮的構造。這是延長層所發現的化石標本中僅有的一塊可以研究表皮構造的標本。

26. 山西石樓縣轉角鎮

Neocalamites sp.

27. 山西中陽縣（或離石縣）仙芝河口

Neocalamites sp.

28. 山西永和縣烏門

Danaeopsis fecunda Halle

地點 29、30、32、33、34、35、36 的標本都是石油總局送來研究的。其層位尚不明白。

29. 陝西鱗遊縣北馬坊

Danaeopsis fecunda Halle

30. 陝西耀縣房兒上

Equisetites sarrani Zeiller 新種
Danaeopsis fecunda Halle

31. 陝西耀縣瀟馬河南（李春昱同志採集的標本）

Danaeopsis fecunda Halle

32. 陝西淳化縣坪底刺坪裏

Danaeopsis fecunda Halle

33. 陝西延安縣（詳細地點不明）

Cladophlebis paralobifolia Sze 新種
Thinnfeldia major Raciborsk

34. 陝西綏德縣義合鎮

Equisetites sarrani Zeiller

35. 陝西延長縣周家灣

Sphenopteris? chowkiawanensis Sze 新種
Taeniocladopsis rhizomoides Sze 新屬,新種

36. 陝西黃龍縣(詳細地點不明)

Sphenobaiera crassinervis Sze 新種
昆蟲的翼部化石(本書圖版 LV, 圖 6, 6a)

本書所研究的材料發現於各個不同地點,分佈於各個不同的縣份,並不是採集於一個地點的一個地層剖面的,因此較詳細的分出各個不同的化石層位如層位 1(Bed 1),層位 2 (Bed 2),層位 3 (Bed 3)…… 現在還不可能。但就我們目前所知道的 36 個地點而言,多數地點其層位屬於延長的上部、中部或下部已大致明白。各種化石的地層上的分佈即直的分佈大致如下表:

延長層上部的種屬:

Thallites sp.
Equisetites deltodon Sze 新種
Equisetites acanthodon Sze 新種
E. sarrani Zeiller
E. sp. (strobili of *Equisetites*)
Neocalamites carrerei (Zeiller) Halle
N. carcinoides Harris
N. rugosus Sze 新種
N. brevifolius Sze 新種
N. sp.
N.? sp.
Cladophlebis shensiensis P'an
Cl. szeiana P'an
Cl. cfr. *gigantea* Ôishi
Cl. raciborskii Zeiller
Cl. grabauiana P'an
Cl. kaoiana Sze 新種
Cl. graciles Sze 新種
Cl. ichunensis Sze 新種
Cl. stenophylla Sze 新種
Cl. suniana Sze 新種
Cl. sp. a.
Cl. sp. b.
Phlebopteris? linearifolia Sze 新種
Danaeopsis fecunda Halle
D.? sp.
Bernoullia zeilleri P'an
Thinnfeldia rhomboidalis Ettingshausen
Th. major Raciborski
?*Th. nordenskiöldi* Nath.
Th. rigida Sze 新種
Th. alethopteroides Sze 新種
Th. laxusa Sze 新種
Ctenopteris sarrani Zeiller
?*Protoblechnum hughesi* (Feistm.) Halle (?新種)
Sphenozamites changi Sze 新種
Sinozamites leeiana Sze 新屬,新種

Drepanozamites? p'ani Sze. 新種
Ginkgoites chowi Sze 新種
G. sp.
Glossophyllum? shensiense Sze 新種
Psygmophyllum? sp.
Sagenopteris spatulata Sze 新種
S. sp.
Swedenborgia cryptomerioides Nathorst
?Stenorachis (*?Ixostrobus*) *konianus* Ôishi & Huzioka
Carpolithus spp.
Conites sp.
Radicites sp.
Problematicum a.
Problematicum b.
Problematicum c. (*Muscites?* sp.)

延長層中部的種屬：

Neocalamites carcinoides Harris
Cladophlebis shensiensis P'an
Cl. szeiana P'an
Cl. cf. *gigantea* Ôishi
Bernoullia zeilleri P'an
Glossophyllum? shensiense Sze 新種
Conites sp.

延長層下部的種屬：

Equisetites brevidentatus Sze 新種
Equisetites? sp. (cf. *E. rogersi* Schimper)
Equisetites sp. (strobili of *Equisetites*)
Neocalamites spp.
Cladophlebis shensiensis P'an
Danaeopsis fecunda Halle
未鑑定的裸羽片化石 (Undetermined Sterinle Pinnae)
Ginkgoites magnifolia (Fontaine)
?Sphenobaiera furcata (Heer) Florin
?Protoblechnum hughesi (Feistm.) Halle (?新種)
Conites sp.

延長層的層位不明的種：

Equisetites sthenodon Sze 新種
Cladophlebis paralobifolia Sze 新種
Thinnfeldia major Raciborski
Sphenopteris? chowkiawanensis Sze 新種
Sphenobaiera crassinervis Sze 新種
Taeniocladopsis rhizomoides Sze 新屬,新種

根據上表我們知道分佈於延長層的底部直至頂部的最顯著和最重要的是 *Cladophlebis shensiensis* P'an 及 *Danaeopsis fecunda* Halle 兩種化石。*Cl. shensiensis* 一種在延長層的下部，似不甚豐盛，迄今僅有兩個地點證明其存在即綏德縣的高家庵及橋上。*D. fecunda* 則在延長層的下部亦甚爲繁殖，因在多數地點發現其化石甚多。在本書第 67 頁中本書作者曾經指出 *Danaeopsis* 的化石，可能是不止一種的。但僅以裸羽片的體積及形態而論，至少在目前是不便分爲很多不同的種的。因爲如果現在我們將當前的 *Danaeopsis* 的裸羽片材料創立很多不同的新種，那末將來所採集的多數標本，將不易完全決定其屬於何種的。因爲斯行

健和李星學在 1951 年曾經報道在甘肅的延長層中已經發現一塊 *Danaeopsis* 的實羽片化石是和瑞典 Scania 瑞底克期的 *Danaeopsis fecunda* Halle 的實羽片是完完全全相同的，因此我們相信陝西及甘肅延長層所發現的裸羽片化石都是屬於這一個種的。支持這個意見的是陝北的所有標本其葉脈的型式也和這個種是相一致的，而和另一個著名的種卽歐洲上三叠紀下部至中部的 *Danaeopsis marantacea* Heer (參看 Gothan & Weyland 教科書，1954，第 114 頁插圖 92) 是不相同的。根據潘鍾祥最近的報道 (1954，第 211 頁) 這一個種在陝北可直達瓦窰堡煤系的下部地層中。和 *D. fecunda* 相同，*?Protoblechnum hughesi* (Feistm.) Halle 一種標本也是延長層的下部直至頂部的，並且這些標本也可發現於瓦窰堡系的下部的 (P'an, 1936，第 24 頁)。至於最顯著的事實是：延長層中幾乎沒有一個化石層位沒有含着豐富的 *Neocalamites* 的。根據王水同志所採集的標本，我們知道 *Neocalamites* 在延長層底部是豐盛無比的。根據西北大學地質系同志及石油總局同志的報告，我們知道 *Neocalamites* 的標本，就是在直接位於延長層之下的石千峯系，也發現很多，並且其直的分佈也是很廣的。石千峯系的標本很可能是屬於 *Calamites* 的 (參看斯行健 1952，第 11 頁及第 16 頁 Sze 1952，第 17 頁及第 22 頁)。此外如 *Equisetites* 的一種子囊穗化石，也分佈於延長層的下部及上部。根據 *Danaeopsis* 的直的分佈狀況我們相信 *Bernoullia* 將來也很可能在延長層的下部找到的。因為 *Bernoullia* 的直的分佈狀況也和 *Danaeopsis* 完全相同，曾在歐洲的上三叠紀下部及中部發現其化石 (參看 Hirmer 1927，第 592 頁)，而 *Bernoullia zeillieri* P'an 一種在東亞除分佈於延長層外也可以直達較高的地層如越南東京的瑞底克期至里阿斯期地層 (Zeiller, 1903，第 34 頁圖版 I 圖14—16；P'an, 1936，第 26 頁) 的。到目前為止在延長層下部除 *Cl. shensiensis* 外還沒有發現過其他 *Cladophlebis* 的各種的化石。

就目前所得的知識而論，分佈於自延長層的中部直至上部的化石為下列各種：

Neocalamites carcinoides Harris
Cladophlebis shensiensis P'an
Cladophlebis szeiana P'an
Cladophlebis cf. *gigantea* Ôishi
Bernoullia zeilleri P'an
Glossophyllum? shensiense Sze 新種

根據上表我們知道發現於延長層中部的化石幾乎都是延長層上部地層中最豐富的種屬。當然這些化石發現於中部並沒有像上部那樣的繁盛；但我們也可以相信在未來不斷的採集工作中，目前限於上部的其他各種化石也或多或少地可以發現於中部甚至下部的。延長植物羣中發現標本最多的種，顯然是 *Cladophlebis shensiensis*, *Danaeopsis fecunda*, *Bernoullia zeilleri* 及 *Glossophyllum? shensiense*. 其餘比較發現標本很多的有下列各種 *Cladophlebis szeiana*, *Cladophlebis raciborskii*, *Neocalamites carcinoides* 以及其他 *Cladophlebis* 的各新種，*Thinnfeldia* 的各新種……等等。任何一個較大的地區所發現的化石標本，如果它們是發現於這一個大地區的很多不同的地點的同一個地層中的，那末，我們可以根據每一個種的分佈的地點的多少，推斷關於這一個植物羣的各種化石以何種為最豐盛，何種次之，何種又次之的次序。根據這一個觀點推斷出來的結論，雖然不能作為最後的定論，但多少還是可靠的。從這一個觀點得出延長植物羣的各種的豐盛上面的次序大致如下表：(甘肅省的發現地點也計算在內)：

1.	*Danaeopsis fecunda*	15個地點
2.	*Cladophlebis shensiensis*	10個地點
3.	*Glossophyllum? shensiense*	6個地點
4.	*Cladophlebis szeiana*	6個地點
5.	*Bernoullia zeilleri*	5個地點
6.	*?Protoblechnum hughesi* (?n. sp.)	4個地點

應該指出的是：最後的一種卽 *?Pr. hughesi* (?n. sp.) 其分佈的地點雖多，但每一地點所發現的化石還是很稀少的。而另外一方面如下列各種卽 *Sphenozamites changi*, *Neocalamites carcinoides* 以及 *Thinnfeldia* 的各種並且 *Cladophlebis* 的各新種其分佈的地點雖不多，但在某一個或某兩個地點中却是異常豐盛的。

中生代植物一般是直的分佈很長的，因此不容易作為劃分比較狹義的"層帶" (Zone) 的標準化石的，但

延長層植物羣的最顯著的和最豐盛的植物爲 *Bernoullia, Danaeopsis* 及 *Glossophyllum?* 三屬，因此作者暫定延長植物羣爲 *Danaeopsis-Bernoullia* 植物羣。和 *Bernoullia zeilleri* 一樣，*Glossophyllum? shensiense* 也曾發現於越南東京瑞底克期至里阿斯期地層中。根據植物羣在地層上的發生次序，以 *Danaeopsis-Bernoullia* 爲主的延長植物羣是較老於以 *Dictyophyllum-Clathropteris* 爲主的東京植物羣是不成問題的。很可能的延長層的頂部是大致相當於越南的東京煤系及湘贛一帶的安源煤系的底部的。

（三）延長植物羣的對比及其地質時代

在上面的兩個題目中，作者已經指出：根據延長植物羣的組成份子的植物學上的性質，並且根據延長植物羣的每一個種屬的地層上的直的分佈情況，這一個植物羣是和東亞及世界各處的所謂瑞底克期至里阿斯期以及中侏羅紀的植物羣是完全不相同的。作者又曾指出這一個植物羣是以 *Danaeopsis* 及 *Bernoullia* 爲主的，根據植物羣在地層上的發生次序，顯然是較老於以 *Dictyophyllum-Clathropteris* 爲主的越南東京植物羣及華南的安源植物羣。本書作者完全同意潘鍾祥 1936 年的意見，這一個植物羣決不能够老於 Keuper 卽上三叠紀，也決不能够新於瑞底克期（Rhaetic）卽上三叠紀的末期。因此這一個植物羣的地質時代，我們祇能暫定爲考依波–瑞底克（Keuper-Rhaetic），卽上三叠紀初期至末期。至於將延長層再詳細劃分爲上三叠紀下部、中部及上部（卽 Unterer, Mittelerer 及 Oberer Keuper），根據本書結論第二個題目所宣佈的一個延長植物羣種屬的直的分佈表，在目前還不可能；因爲延長植物羣的最重要和最突出的分子如 *Cladophlebis shensiensis, Bernoullia zeilleri, Danaeopsis fecunda, Glossophyllum? shensiense, ?Protoblechnum hughesi*……等差不多都是從延長層的底部直達頂部的。*Bernoullia* 及 *Glossophyllum?* 雖在延長層下部尙未能够證明其存在，但這是因爲作者目前所研究的材料太少之故。到今天爲止，在延長層的下部地層中，採集者在每一個地點僅僅找到一兩種化石，並未曾詳細地加以採集。卽在延長層中部地層中，採集者也並沒有徹底地加以搜求。因此延長植物羣確實的直的分佈情況尙待他日詳細採集的結果。因此將延長層劃分上三叠紀的下部、中部及上部，也必須待之異日。

就目前所得的知識而論，延長植物羣是大致相當於奥國的 Lunzer Keuper 及瑞士西北部的 Basler Keuper 的。這兩個植物羣是屬於標準的上三叠紀中部（卽 Mittlerer Keuper）的。這兩個植物羣也是都以 *Danaeopsis, Bernoullia* 及 *Glossophyllum* 爲主的，雖然以"種"名而論和我們的是不相同的，雖然如歐洲上三叠紀中部的特殊植物 *Pterophyllum jaegeri* 及其他各種在延長層中尙未曾找到過。支持這個意見的還有其他證據，卽我們的 *Cladophlebis shensiensis* Pan 是和 Basel 的 *Cl. rütimeyeri* Heer（Leuthardt[100] 1904，第 34 頁，圖版 15，圖 1,2）是非常接近的。根據小羽片的形態及脈的型式，兩者幾乎完全相同。僅有的區別是在 *Cl. shensiensis* 的小羽片的形態根據當前的材料是變異很大的。Basel 的標本，其小羽片的形態變異較少。很可能的，將來這兩個種是可以合成爲一種的。另外在我們的材料中還找到了一塊標本，頗似瑞士西北部 Basel 植物羣中的 *Sphenobaiera furcata*（Heer）Florin。這一個種最初經 Heer[58]（1865）定爲 *Sclerophyllina furcata*，後又經 Heer[61]（1877）改其屬名爲 *Baiera*，1936 年又經 Florin 改爲 *Sphenobaiera*，1943 年 Kräusel[81] 又描述同樣的標本於 Basel，並詳細地研究其表皮及小氣孔的構造，知其確屬於 *Sphenobaiera* 的類型的。我們的標本僅有一塊並且保存得不够理想，根據葉的寬度及其分叉狀態，大致和 Leuthardt[99] 的化石（1903，第 7 頁；圖版 2 圖 1—4；圖版 4，圖 1）及 Kräusel 的標本（1943，第 80 頁，插圖 9—10；第 81 頁）是可以比較的。最有意義的是我們的葉部化石的表皮構造也或多或少地和 Basel 的標本相同的。此外如我們的 *Ginkgoites chowi* sp. nov. 其葉的體積及脈的粗度又極似奥國 Lunz 的 *Ginkgoites lunzensis*（Stur）Florin（參看 Kräusel，1943，第 72 頁，圖版 1 圖 1—8；圖版 II 圖 1—8；圖版 III、圖 1—5 插圖 6,7）。很可能的如將來在我們的地點中，發現保存較全的化石，我們的新種，葉的前部也會分裂成 8 個至 9 個裂片，並且裂片的前端是作截形的（參看 Kräusel、1943，第 75 頁，插圖 7）。此外可以指出的是我們的 *Cladophlebis szeiana* 也很接近於 Basel 的 *Merianopteris angusta* 的（Heer、1877，第 69 頁，圖版 24，圖 7—12 etc，Leuthardt 1904，第 32 頁，圖版 18，圖 1,1a）。這一個種後又被 Krasser[83]（1909，第 108 頁）敍述於 Lunz。Krasser 改其名爲

Asterotheca meriani (Brongn.) Stur, 並且將北美維基尼亞州的中部上三叠紀的 Asterocarpus virginiensis Fontaine 同屬於一個"異名表"(Synonym)之下。地質學家現在都已完全承認歐洲的 Basler Keuper 及 Lunzer Keuper 是和北美的維基尼亞州的所謂 Virginia-Keuper 大致是屬於同一地質時代的,三者是都屬於"中部上三叠紀"(Mittlerer Keuper)的。剛才已經提及,北美的 *Asterocarpus virginiensis* 和歐洲的 *Asterotheca meriani* (=*Merianopteris angusta*),根據 Krasser 是同種的,因此我們的 *Cl. szeiana* 也和北美 Virginia-Keuper 的 *Asterocarpus virginiensis* 是可以比較的。根據潘鍾祥 1936 的意見,我們的種是更接近於 *Asterocarpus virginiensis* var. *obtusilobus* (Fontaine, 1883, 第 45 頁,圖版 XXI, 圖 3,4; 圖版 XXIV, 圖 3—5; 圖版 XXV, 圖 1)。本文作者的意見,我們的種不但是"裸羽片"和北美的種相接近,其"實羽片"也大致和北美的種是相似的。*Cl. szeiana* 也接近於北美的 *Asterocarpus platyrachis* Fontaine (Fontaine[30], 1883, 46 頁, 圖版 49, 圖 2)。這一個種根據 Krasser (1909, 第 108 頁),也是和歐洲的 *Merianopteris angusta* Heer 是同種的,也應該定名爲 *Asterotheca meriani* (Brongn.) Stur 的。此外如我們的 *Cladophlebis graciles* 也和北美的 *Cladophlebis microphylla* Fontaine (1883, 第 51 頁,圖版 XXVII, 圖 2,2a) 很相近似的;並且和同一地點的 *Cl. pseudowhitbiensis* Fontaine (1883, 第 52 頁, 圖版 XXVII, 圖 4) 也可以比較的。此外值得提出的是,我們的 *Sphenozamites changi* Sze 新種根據葉的體積也和北美的 *Sphenozamites rogersianus* Fontaine (1883, 第 80 頁,圖版 43, 圖 1; 圖版 44, 圖 1,2; 圖版 45, 圖 1,2) 相同,雖然葉的形態是不甚相似的,並且北美的種葉脈之間還有橫紋的。不過 *Sphenozamites* 的葉的體積的巨大如此的標本,除北美的 Virginia-Keuper 外,迄今也僅僅發現於陝北的延長層中。另外我們的 *Equisetites?* sp. (cf. *E. rogersi* Schimper),根據葉鞘的齒的形態也和北美的 *E. rogersi* (Fontaine 1883 圖版 II, 圖 1—3) 是相同的。潘鍾祥從前的意見 (1936, 第 25 頁),延長層的 *Danaeopsis* 是和一部分北美的 *Pseudodanaeopsis* 是相同的。不過北美的 *Pseudodanaeopsis* 根據 Lundblad[102] (1950, 第 17 頁) 是和歐洲的 *Danaeopsis* 是完全不相同的植物。很可能的,北美的種根本不是蕨類植物(參看 Sze & Lee[178], 1951, 第 88 頁)。另外值得注意的是延長層的 *Sphenobaiera crassinervis* 新種,也大致可以和北美 *Virginia*-Keuper 的 *Sphenobaiera multifida* (Fontaine) Florin (Fontaine, 1883, 第 87 頁,圖版 46; 圖版 47, 圖 1) 相比較的。

據上所述我們知道延長植物羣的最相接近的植物羣是'上三叠紀中部'歐洲的所謂 Lunzer Keuper, Basler Keuper 以及北美的 Virginia-Keuper 各植物羣,因此其地層時代也大致可以對比的。支持這個意見的是延長層的許多 *Equisetites* 新種如 *E. sthenodon* 及 *E. deltodon*……等根據樹幹的體積以及葉鞘的齒的形態,也非常接近德國南部及瑞士北部的'上三叠紀中部'(Schilfsandstein 層) 的標準化石 *Equisetites platyodon* Brongniart (Ferntzen[34], 1933, 第 37 頁; Leuthardt[100], 1904, 圖版 XXI, 圖 1,2) 的。體積巨大的歐洲種如 *E. arenaceous* Jäjar 爲歐洲上三叠紀下部至中部 (Lettenkohle 及 Schilfsandstein) 最繁盛的植物,也多少可以和延長層中巨大的 *Equisetites* 相比較的。但延長層的地層時代根據地層上的次序以及其他證據,我們暫時不能完全決定其屬於'上三叠紀中部'的。上面已經提及這一個植物羣,現在我們祇能暫定爲考依波-瑞底克 (Keuper-Rhaetic) 亦卽上三叠紀的下部至頂部的。在陝北及甘肅一帶直覆於延長層之上的煤系地層現在我們已經確實證明是屬於里阿斯期(卽下侏羅紀)的。因此延長層的頂部是屬於瑞底克期 (Rhaetic) 是沒有問題的。至於延長層的底部是否在上三叠紀的中部開始的或是否在上三叠紀的下部已經開始,我們暫不能作最後的決定。因爲延長層是直覆於石千峯系之上的。而石千峯系的時代,地質學家意見是迄未能取得一致。多數地質學家主張石千峯系是屬於二叠三叠紀 (Permo-Triassic) 的。若干古植物學家則主張石千峯系是屬於上二叠紀的。據最近在宜君區的估計,延長層的總厚達 1175 米左右,因此我們最好暫定延長層的下部其時代是相當於上三叠紀的初期的。至於延長層的下部決不可能屬於中三叠紀 (Middle Triassic) 的問題,在這裏無須多說,因爲所有植物學上的證據都完全和這一個意見相衝突的。

除上述世界最著名的三個'上三叠紀中部'植物羣以外,和延長植物羣最相接近的,並且幾乎是完全相同的植物羣是蘇聯古植物學家 **Брик**, 1952 所發表的哈薩克斯坦西部的伊列克河中流盆地的兩個地層的植物羣。這兩個植物羣 **Брик** 也是定爲上三叠紀的。化石的組成分子如下表:

較底的一層名 Курашасаиская 統厚 250—300 米所含化石如下:

Danaeopsis marantacea (Presl) Heer
Danaeopsis emarginata Brick
Danaeopsis bipinnata Brick
Danaeopsis angustipinnata Brick
Bernoullia aktiubensis Brick
Todites roesserti Zeiller
Polypodites cladophleboides Brick
Cladophlebis simplicinervis Brick
Cladophlebis tripinnata Tur-Ket ex Ms.
Equisetites arenaceus (Jaeger) Schenk
Lepidopteris ottonis (Goepp.) Schimper
Callipteridium remotum Brick
Aipteris nerviconfluens Brick
Thinnfeldia sp.
Taeniopteris angustifolia Schenk
Sphenozamites surakaicus Prynada ex Ms.
Yuccites spathulatus Prynada ex Ms.
Yuccites uralensis Prynada ex Ms.
Araucarites convexus Brick
Sagenopteris ilekensis Brick
Ixostrobus sp. cf. *I. groenlandicus* Harris
Swedenborgia cryptomerioides Nathorst

較高的一層名 Курайлинская 統厚 40—45 米。這個地層地質學家定爲上三叠紀到下侏羅紀的過渡層。Брик 認爲這一個地層也應該是屬於上三叠紀的。

Xylomites zamitae Goepp.
Danaeopsis hughesi Feistm.
Bernoullia aktiubensis Brick
Todites roesserti Zeiller
Diplozites kazachstanicus Brick
Cladophlebis szeiana P'an
Cladophlebis aktiubensis Tur.-Ket. ex Ms.
Rhacophyllum pachyrhachis (Schenk) Schimper
Lepidopteris ottonis (Goepp.) Schimper
Taeniopteris ensis (Oldh.) Zeiller
Yuccites uralensis Prynada

根據上面的兩個表,我們知道哈薩克斯坦的上三叠紀植物羣也以 *Danaeopsis*, *Bernoullia* 及 *Glossophyllum* (即 Брик 的 *Yuccites*) 爲主的,並且也有 *Cladophlebis szeiana* 及 *Cladophlebis shensiensis* (這一個種即 Брик 的 *T. roesserti*) *?Protoblechnum hughesi* (Брик 定爲 *Danaeopsis hughesi*) 及 *Swedenborgia cryptomerioides* 以及 *Sagenopteris*, *Thinnfeldia*, *Equisetites*, *Sphenozamites* 以及 *Ixostrobus* 等等。因此我們覺得哈薩克斯坦植物羣是和我們的延長植物羣完全可以對比的。應該特別指出的是 Брик 的鑑定多少是倘有問題的。上面已經提及她的 *Todites roesserti* 是完全等於我們的 *Cl. shensiensis* 的,根據她所發表的圖影 (1952[9], 圖版 VII, 圖 1—7, 圖 106) 這一個哈薩克斯坦的種,根據小羽片的變異狀態及葉脈的型式,的確是和 *Cl. shensiensis* 完全相同的。又如她的兩種 *Yuccites* (1952, 圖版 XV) 又顯然就是 *Glossophyllum? shensiense*。她的毫無保留地所鑑定的 *Danaeopsis hughesi* 標本 (1952, 圖版 IV, 圖 1—6) 也是不能鑑定的。這些保存不全的標本,在目前我們至多祇能定爲 *?Protoblechnum hughesi* (Feistm.) Halle (?新種),本書第 41 頁曾明白地指出,印度的種是和 *Danaeopsis* 絲毫沒有關係的。此外 Брик[9] 所定的許多 *Danaeopsis* 各個新種也完全是根據葉的體積的變異的。在本書第 67 頁上作者曾經指出,延長層的 *Danaeopsis* 葉的體積也變異頗大,但沒有理由將它定爲各個不同的種名的。並且 Брик 的 *Danaeopsis emarginata* (1952, 圖版 I, 圖 1—5) 很

可能的就是我們的 *Danaeopsis fecunda* 的。她的 *D. marantacea*（1952，圖版 I 圖 6）也可能是屬於此種的。最有意思的是 **Брик** 的 *Danaeopsis bipinnata* 及 *Danaeopsis angustipinnata*（1952，圖版 II，圖 3，4；圖版 III，圖 1—11）根據羽片的體積及形態，尤其是根據葉脈的型式和我們的 *Bernoullia Zeilleri* 的裸羽片是完全相同的。這些化石無疑地祇能定為 *B. zeilleri* 的。支持這個意見是在哈薩克還有 *Bernoullia* 的實羽片化石（Брик，1952，圖版 V，圖 9—11）。至於 **Брик** 所定的 *Bernoullia aktiubensis* 的裸羽片化石（1952，圖版 V，圖 1—7）是不能鑑定的碎片，可能根本和 *Bernoullia* 是沒有關係的。此外 **Брик** 所鑑定的 *Callipteridium* 和 *Lepidopteris* 都是不甚可靠的。*Thinnfeldia* 和 *Swedenborgia* 也都是很小的碎片，這些標本似乎至少須加一個問號於屬名之前。她的 *Sphenozamites surakaicus*（1952，圖版 XIV，圖 8）也多少有些像我們的 *Psygmophyllum?* sp. 她的有一塊定為 *Equisetites arenaceous*（1952，圖版 XI，圖 5）的標本又好像是屬於 *Neocalamites* 的。這一塊標本，樹幹表面的直肋至為顯明和 *Neocalamites* 是完全相同的。另外值得特別提出的是哈薩克也有一標本（**Брик**，1952，圖版 IX，圖 4）定為 *Cl. aktjubensis* 是和我們的 *Cladophlebis ichuanensis* 新種是相接近的。

據上所述我們知道 **Брик** 所研究的哈薩克斯坦西部的上三叠紀植物羣是和我們的延長植物羣是完全同時的，最有意義的事實是在哈薩克斯坦西部假整合地覆在上三叠紀植物羣之上的煤系地層（卽 Дженишке 統厚 100 米）含有一個植物羣也是以 *Coniopteris hymenophylloides*, *Cladophlebis* sp. ex. gr. *C. denticulata*, *Cl. whitbyensis*, *Cl. lobifolia*, *Phoenicopsis speciosa*, *Pityophyllum nordenskiöldi*……等化石為主的。這一個植物羣 **Брик** 定為中侏羅紀。根據本書作者的意見，這一個植物羣也應該定為 *Coniopteris-Phonicopsis* 植物羣，其時代也應該定為下侏羅紀至中侏羅紀（Liassic-Dogger）的。並且完全和陝北的瓦窰堡煤系及其上的衣食村煤系是同時的。也完全和晉北的大同煤系及其上的雲崗統以及北京附近的門頭溝煤系（窰坡統及龍門統）是同時的。為供國內地質學家參考方便起見，作者特將此植物羣抄錄於下：

Gleichenites sphenopteroides sp. n.
Coniopteris hymenophylloides (Brongn.) Sew.
C. porcina Brick ex Ms
C. sp. cf. *C. Fursenkoi* Pryn.
Dictyophyllum sp.
Cladophlebis haiburnensis (L. et H.) Brongn.
Cl. whitbiensis Brongn. var. *punctata* Brick
Cl. sp. ex gr. *C. denticulata* (Brongn.) Font.
Cladophlebis lobifolia (Phill.) Brongn
Equisetites ferganensis Sew. sensu lato
E. hallei Thomas
Ptilophyllum cutchense Morris
Nilssonia vittaeformis Pryn.
N. compta (Phillips) Bronn
Phoenicopsis speciosa Heer
Ginkgoites sp.
Feildenia sp.
Pagiophyllum peregrinum (L. et H.)
P. setosum (Phillips)
Pityophyllum angustifolium (Nath.) Möller
Podozamites sp.
Conites sp. a.
Conites sp. b.

應該提出的是：我們知道哈薩克的侏羅紀植物羣中根據上表，並沒有含 *Ruffordia* 及 *Onychiopsis* 等化石，因此這一個植物羣是不可能較中侏羅紀為年輕的。

Daugherty[21] 在 1941 年所發表的北美亞利桑那州的上三叠紀植物羣其組成分子比較特殊。因為這一植

物羣含有 *Coniopteris* (*C. plumosa* D.) 等化石。此外尚有 *Clathropteris* 及 *Dadoxylon* 式的木化石。這一個北美上三叠紀植物羣和延長植物相似的植物為 *Equisetites, Neocalamites, Cladophlebis, Danaeopsis* (Daugherty 錯誤地定為 *Ctenis arizonicus D.*), *Phlebopteris* (Daugherty 定為 *Laccopteris*), *Sphenopteris* 及 *Podozamites* 等化石，Daugherty 所描述的 *Equisetites bradyi* (1941, 第61頁,圖版12圖4,5) 根據葉鞘和齒的形態和我們的 *E. sarrani* 完全是沒有區別的。他的 *Cladophlebis microphylla* (1941, 圖版4, 圖3) 也可和我們的 *Cl. graciles* 相比較的,他的 *Laccopteris smithii* 也和我們的 *Phlebopteris linearifolia* 是相接近的,他的 *Sphenopteris arizonicus* 也或多或少和我們的 *Sphenopteris* sp. 相似。此外 Arizona 的 *Yuccites poleonsis* D. (1941, pl. 13, fig. 1) 應該就是 *Neocalamites*。此外最令人注意的是 Daugherty 所鑑定的 *Ctenis neuropteroides* (1941, 圖版14, 圖2) 根本不是 *Ctenis*, 這塊標本的葉的形態是 *Danaeopsis* 及 *Taeniopteris* 的形態,其兩側邊根本沒有分裂而作裂片的形態。中脈十分顯著,側脈也和 *Danaeopsis* 完全相同僅在葉邊微微地互相接合而成為網脈。根據本書作者的意見,這一塊標本和我們的 *Danaeopsis fecunda* Halle 是可以比較的,應該暫定為 *Danaeopsis?* sp.。此外 Daugherty 的 *Podozamites arizonicus* D. (1941, 圖版14, 圖2) 也根本不是一個新種; 根據葉的標準的劍形的形態及其體積,這些標本是標準的 *P. lanceolatus* (*L.* & H.)。上面已經提及亞利桑那州的上三叠紀植物羣含有 *Coniopteris* 甚為特殊。但這些標本是否眞為 *Coniopteris* 也是頗有問題的。Daugherty 自己也曾指出 (1941, 第55頁) 他的"*Coniopteris plumosa* (1941, 圖版9, 圖3,5) 的裸羽片,極似中國二叠紀的 *Sphenopteris nystroemii* Halle 的",因此我們覺得亞利桑那州的化石是和侏羅紀中部及下部的最普通的 *C. hymenophylloides* Brongn., 是完全不同的植物。 Daugherty 自己又曾指出 (1941, 第55頁):他的"實羽片化石又頗似 *C. hymenophylloides* 的,而根據他所發表的圖影 (1941, 圖版9, 圖4) 我們實在不能表示肯定的意見。不過亞利桑那州的植物羣是屬於'上三叠紀' (Upper Triassic) 的,大概是沒有問題的。這個植物羣也含有北美維基尼亞州'上三叠紀中部'的標準化石如 *Lonchopteris virginiensis* Fontaine (Daugherty, 1941, 第49頁,圖版5, 圖4,5; 圖版6, 圖1,2) 以及其他化石。 Seward[154] (1910 第332頁) 相信 *L. virginensis* 是三叠紀的紫萁科(卽薇科)的一份子,他並且指出:這種化石具有古生代 *Lonchopteris* 的葉脈, 但應該是創立一個新的屬名的。 不過到了今天尚無人為此中生代化石創一個新的屬名。Daugherty 也因此暫時保留 Fontaine 所原定的屬名。這一種 *Lonchopteris* 式的化石除發現於北美的維基尼亞州及亞利桑那州上三叠紀外,也曾經發現於瑞士西北部的上三叠紀中部的 Basel 植物羣中, Leuthardt[100] (1904, pl. XVIII figs. 2,2a), 定為 ***Pecopteris* (*Lonchopteris*) *reticulata*.**

南非洲的 Molteno 層的植物羣 (Du Toit[23], 1927, Vol. XXII, Pt. 2; 1939 p. 317) 是和延長植物羣不甚完全相同的,雖然這個植物羣的時代也被定為上三叠紀或瑞底克期的 ("Upper Triassic or Rhaetic" 參看 Reed[135], 1921, 第99頁)。Molteno 植物羣和延長植物羣完全相同的分子是 *Neocalamites carrerei* Zeiller 及 *Ginkgoites magnifolia* (Fontaine) 兩種。其他和我們的或多或少相接近,並且可以比較的是 *Cl.* (*Todites*) *roesserti* 及 *Cl.* (*Todites*) *goeppertiana*, 這兩種都接近於我們的 *Cl. shensiensis*。又如 *Cl. nebbensis* 是接近於我們的 *Cl. ichuanensis* 的。此外如 *Stenopteris elongata* 似也可以和我們暫定為 ?*Sphenobaiera furcata* 的標本大致可以比較的。 和延長植物羣一樣, Molteno 層也有4—5種 *Thinnfeldia*, 但這些種可能都是屬於 Gothan 教授所創的屬名 *Dicroidium* 的。

Harris 所研究的格陵蘭東部的 Scoresby Sound 植物羣,和延長植物羣完全相同的種屬有下列數種 *Equisetites sarrani, Neocalamites carcinoides, Swedenborgia cryptomerioides* ·····等。 很奇怪的,這些化石在格陵蘭東部都是發現於較高的層位中的。*N. carcinoides, E. sarrani* 都是完全限於 Harris 的 *Thaumatopteris*-Zone 亦卽限於下侏羅紀(卽里阿斯期)的。 *Sw. cryptomerioides* 也多半是限於 *Thaumatopteris* Zone 的,這一個種也發現於 *Lepidopteris* Zone (瑞底克期卽上三叠紀頂部) 至 *Thaumatopteris*-Zone 的過渡層中。此外格陵蘭東部和延長層植物可以比較的種屬是 *Neocalamites hoerensis, Todites goeppertianus, Drepanozamites nilssoni*, 這三種化石除 *T. goeppertianus* 發現自 *Lepidopteris* Zone 至 *Thaumatopteris* Zone 以外,其餘兩種都是僅發現於 *Lepidopteris* Zone 的。*N. hoerensis* 和東亞的 *N. carrerei* 幾乎是完全沒有區別的。 *T. goeppertianus* 和我們的 *Cladophlebis* (*Todites*) *shensiensis* 也是非常接近的。 *D. nilssoni* 和我們的 *D.? p'ani*

是不甚相同的,因爲在後者或多或少地是顯出一條中脈的。另外在格陵蘭東部也有很多的 *Podozamites*, 大部分是發現於 *Lepidopteris*-Zone 的。和延長層的 *Podozamites* 相似,這些化石都是屬於 *P. lanceolatus* 的類型的。格陵蘭東部也有 *Sagenopteris*, 是在 *Thaumatopteris*-Zone 發現的。格陵蘭東部的 *Stenopteris* 也好像和我們的 *? Sphenobaiera furcata* 的標本是可以比較的。應該指出的是:在格陵蘭東部的 Scoresby Sound 植物羣,根據 Harris[56] (1937, 第 31 頁),幾乎是完全沒有 *Thinnfeldia* 的化石的,僅有的一種定名爲 *Thinnfeldia* sp. (Harris, 1937, 第 31 頁插圖 1) 是發現於 Lepidopteris Zone 的。據上所述,我們覺得延長植物羣的時代是不能完全和 Scoresby Sound 植物羣相對比的。以地層時代而論,我們至多可以說延長層的頂部是可能大致相當於格陵蘭東部的 *Lepidopteris*-Zone 卽普通所謂瑞底克期的。

斯行健 1949 年所發表的“鄂西香溪煤系植物羣”結論第 48 頁曾經指出瑞典地質學家 Troedsson[185] 曾於 1930 年及 1934 年詳細地校正了前人的所定的地層層位。他曾經將瑞典的瑞底克期及里阿斯期的分界線自原定的第 8 層及第 9 層之間降低至第 4 層至第 5 層之間,於是 Palsjö, Stabbarp, Halsinborg 等處的植物化石前人所視爲標準的瑞底克期者,大部分知其確屬於里阿斯期。這個意見爲 Harris 所贊同,他曾明白的指出(1937, 第 87 頁)“如果 Troedsson 的硏究結果能較早公佈於世,則全世界其他各處的植物羣,前人所認爲屬於瑞底克期者,大部分將改爲里阿斯期”。但至今日在瑞典方面,仍舊確實地屬瑞底克期的植物和延長植物羣完全相同的種屬有 *Danaeopsis fecunda* (發現於 Scania) 及 *Thinnfeldia major* (發現於 Bjuf 的 α 層至 1 層以及 Bjuf 的第 3 層,以及 Skromberga 的第 2 層,俱確屬於瑞底克期。

在瑞典方面也尙有和延長層完全相同的植物,但發現於較高的層位卽里阿斯期 (參考 Harris, 1937 表 2 及表 3) 如 *Neocalamites carcinoides* (發現於 Scania) 及 *Thinnfeldia nordenskioldi* (發現於 Palsjö) 以及 *Swedenborgia cryptomerioides* (發現於 Hör 及 Palsjö) 等,此外瑞典方面和延長層化石可以互相比較的種屬,也和格陵蘭大致相同如 *Neocalamites hoerensis, Todites goeppertianus, Drepanozamites nilssonia*……以及 *Sagenopteris, Phlebopteris, Stenopteris* 及 *Podozamites* 等等。最令人特別注意的事實是: *Danaeopsis fecunda* 的“實羽片”亦卽保存孢子囊的化石,除 Scania 外,亦在甘肅的延長層中發現 (Sze & Lee, 1951, 第 85—91 頁,圖版 I, 圖 5—9)。中國的化石和瑞典的化石是完全相一致的,也就是因爲這個發現,我們相信,延長層的所有裸羽片都是屬於這一個種的。和 *Bernoullia zeilleri* 一樣, *D. fecunda* 是延長層中最豐富的化石,並且是無疑地發現於自延長層的底部直至頂部的,因此這一個種是延長層的代表植物,雖然根據最近的發現這一個種在陝北一帶似乎也可以發現於較高的瓦窰堡煤系中 (P'an[128] 1954, *p.* 211)。

自 1903 年 Zeiller[201] 發表其著作“越南的東京植物羣”以後,東京植物羣直至今日爲亞洲最著名的“瑞底克期”的植物羣。正如筆者[166,172] (1931, 第 70—73 頁, 1949, 第 50—51 頁) 所指出: Zeiller 定東京植物羣爲瑞底克期,顯然是受 Nathorst 及 Schenk 的影響;因爲他當時是將東京化石與 Nathorst 所發表的瑞典各處如 Palsjö, Helsinborg, Höganäs, Stabbarp 等處的所謂瑞底克期植物羣,並且和 Schenk 所發表的德國 Franken 的所謂瑞底克期植物羣相比較的。上面已經提及瑞典的 Palsjö, Helsingborg ……等處的地層,已於 1930 年及 1934 年爲瑞典地質學家 Troedsson 所校正,其時代是確屬於里阿斯期的。而德國的 Franken 植物羣的時代, Schenk 自己在當時也是非常猶豫的,他一方面定其時代爲瑞底克期而在論文中却說道:“和三疊紀植物羣的關係是很微的”……“所以應該將瑞底克期的地層當做屬於里阿斯期來看待,而根據化石的重要特徵瑞底克期地層也應該當做里阿斯期建造 (Liasbildung) 的最初期來看待”。我們從這些句子的口氣來看,知道就是 Schenk 自己也有將他所硏究的 Franken 植物羣與其定爲瑞底克期還不如定爲里阿斯期的爲合理。Gothan 在 1914 年曾將 Franken 的植物羣及其地層各方面加以詳細討論,最後完全決定 Franken 植物羣是屬於里阿斯期的。此意見也爲 Harris 所完全贊同 (1937, 第 81 頁, “I am in complete agreement with Gothan's conclusion”)。Harris 同時特別指出: “Schenk 討論他的重要‘邊界層’ (Grenzschichten) 植物羣的時代很爲詳盡,他最後決定其時代屬於瑞底克期,雖然他這樣做,並沒有很大的保證;而直至最近,全世界學者都認爲他的化石是標準的瑞底克期植物羣,不再問其證據的是否可靠了!” 自從 Zeiller 在 1903 年的著作發表以後全世界學者對於東京植物羣的時代議論紛紜,意見迄未一致。Krysthofovich[86] (1921, No. 22) 認爲其時代是屬於下侏羅紀的。Gothan 和本書作者 (Sze 1931, 第 70 頁) 認爲“在東京植物羣中眞實地說並沒

有含一個瑞底克期的分子，而是與里阿斯期相衝突的"。 Halle* 似乎相信東京植物羣是屬於瑞底克期的。Harris（1937，第 96—97 頁）認爲東京植物羣的眞正瑞底克期分子僅有兩種即 *Nilssoniopteris jourdyi* 及 *Pterophyllum schenki* 而含有眞正的里阿斯期分子却有四種，即 *Todites goeppertiana*, *Woodwardites microlobus*, *Equisetites sarrani* 及 *Marattiopsis* sp. nov.（*M. hoerensis* of Zeiller）。他並且指出：*Marattiopsis* 一屬植物在歐洲從來未曾在里阿斯期以前的地層中找到過的。 Harris 最後的結論是"東京植物羣含有歐洲的 *Lepidopteris*-Zone 以及 *Thaumatopteris*-Zone 兩個時期的各分子的混合"。Harris 雖然沒有肯定地說明東京植物羣的確實時代，但是他是傾向於這一個植物羣是瑞底克期直至里阿斯期的意見的，因爲他同時指出："這個植物羣是在很多不同的地點中採得的；而據我所知，這些地點彼此的眞實的地層狀況，還沒有弄明白；有些一定的地點却含有瑞底克期的斧足類化石（Deprat[22]，1914）"。關於東京植物羣 Jongmans 教授[71,72]在 1937 認爲其時代應該是瑞底克期至里阿斯期的（1937a，第 336 頁；1937b，第 359 頁）。這個意見，本書作者是完全同意的。作者曾經明白地指出："根據植物羣在地層上的發生的先後次序來講，以 *Dictyophyllum-Clathropteris* 爲主的東京植物羣以及中國南方的安源植物羣都應該屬於瑞底克期至里阿斯期的。其時代是比較以 *Danaeopsis-Bernoullia* 爲主的延長植物羣是要新些。" 最可惜的是在中國北方直覆於 *Danaeopsis-Bernoullia* 植物羣之上的地層所含有的化石，是屬於 *Coniopteris-Phoenicopsis* 爲主的植物羣的，而後者根據植物羣的發生次序是屬於里阿斯期至中侏羅紀的。在中國北方直至今日還沒有找到 *Dictyophyllum-Clathropteris* 爲主的東京及安源植物羣，但 *Danaeopsis-Bernoullia* 植物羣比 *Dictyophyllum-Clathropteris* 植物羣爲老是沒有問題的。可能 *Danaeopsis-Bernoullia* 植物羣的頂部地層是大致相當於 *Dictyophyllum-Clathropteris* 植物羣的底部的。最重要的事實是延長層中也含有東京植物羣的重要分子，如下列幾種：*Equisetites sarrani*, *Neocalamites carrerei*, *Cladophlebis raciborskii*, *Bernoullia zeilleri*, *Ctenopteris sarrani*……等。很可能的東京的 *Noeggerathiopsis hislopi* 也是和延長層的 *Glossophyllum*? *shensiense* 是完全同種的。這一種化石在雲南也發現於和東京的相當的地層中，（Sze[172]，1949，第 52 頁）。根據 Seward 和 Sahni（Sahni[140]，1936，1c）這一種化石應該定名爲 *Peloudea zeilleri* Seward 而是和恭華那植物羣的種是完全沒有關係的。 Kräusel[81] 在其 1943 年曾經指出這一個東京種也很可能是屬於 *Glossophyllum* 的。還有東京的 *Cladophlebis roesserti* Presl 無論根據裸羽片及實羽片化石也完全可能是和延長層的 *Cl. shensiensis* 是相同的。在作者的當前的材料中 *Cl. shensiensis* 的裸羽片的形態及體積是變異很大的，那末東京的 *Cl. roesserti* 也可能是屬於 *Cl. shensiensis* 的類型當中的。Harris 將東京的 *Cl. roesserti* 放在格陵蘭的 *Cl. goeppertianus*（Münster）Krasser 同一個"異名表"之內，他並且指出：（1931，第 35 頁）Zeiller 將越南東京的化石定名爲 *Cl. roesserti* Presl 而 Presl 的"種型化石"（Type-specimens）是一塊不能鑑定的碎片，而 *Cl. roesserti* 的這個學名也爲 Schenk 及其他作者所應用，他們的化石是和 *Cl. goeppertianus* 是完全不相同的"。上面討論格陵蘭和延長植物羣的關係時，作者曾經指出延長層的 *Cl. shensiensis* 是和 *Cl. goeppertianus* 是很相接近的。此外在東京植物羣中也有 *Podozamites distans* Presl，而這一個種也顯然和延長層的 *Podozamites lanceolatus* 是很相接近的。根據筆者（1931，第 16 頁，第 27 頁）的意見 *P. distans* 和 *P. lanceolatus* 應該是同種的。據上所述，我們知道延長植物羣和越南東京植物羣完全相同的分子有 8 種之多，這也是一件令人不能忽視的事實，這一個事實，似也可以或多或少地支持 *Danaeopsis-Bernoullia* 植物羣的上部的地質時代是相當於 *Dictyophyllum-Clathropteris* 植物羣的下部的意見的。

在日本方面，以 *Dictyophyllum-Clathropteris* 爲主的所謂成羽植物羣（Nariwa-Flora）自大石 1932 年的重要論文（Ôishi[118]，1932b）發表以後，聞名於世。1938 年，大石及藤岡[122]再發表一篇補充的論文（A supplement）。這一個植物羣，大石定爲瑞底克期。Harris（1937，第 95 頁）指出："日本的植物羣和越南東京的植物羣是很少相同的"，在同一篇論文的 96 頁，他又說道："沒有理由可以猜想日本的和越南東京的植物羣的地質時代是有很大的差別的；這兩個植物羣的區別不過僅僅是表示着'植物區域'（Floral province）的不同

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* 應該指出的是：Halle 的意見（Halle 1927 b, p. 21）是在 1930 年以前發表的，當時他將東京化石和瑞典的 Palsjo，Stabbary……等處的化石相比較的。當時瑞典地質學家 Troedsson 的工作尚未發表。自從 Troedsson 1934 年的工作發表以後，Halle 的意見當亦有所改變，因爲 Palsjo……等處的地層現在公認屬於下侏羅紀了。

而已”，日本植物羣的定爲瑞底克期，也和東京植物羣一樣，Harris 是表示懷疑的態度的。他正式地說明（1937，第94頁）“日本的植物羣是屬於瑞底克期至里阿斯期的面相（Rhaeto-Liassic Aspect）的”。同時他還曾說明：“造成日本植物羣的各‘種’之內，祇有極少的‘種’是和歐洲三叠紀的種相同的，而這些極少數和歐洲三叠紀相同的各種是比較和 *Lepidopteris*-Zone（卽瑞底克期）的種是相同的；比較地更多的‘種’和歐洲的 *Thaumatopteris*-Zone（卽里阿斯期亦卽是下侏羅紀）的種相同的，而若干種竟至更和歐州的更新的地質時代的種是相同的，尤其是和 Lower Oolites 期（卽中侏羅紀的下部）的種是相同的”。所謂中侏羅紀的化石，Harris 指的是大石所鑑定的 *Podozamites lanceolatus, Cladophlebis haibarnensis, Cl. denticulata, Todites williamsoni* 等化石。Harris 更指出：“日本植物羣好像有至少半打可靠的‘種’或‘屬’是歐洲 *Lepidopteris* Zone 的種如 *Neocalamites hoerensis, Hausmannia crenata, Ptilozamites, Cycardocarpidium swabi, Baiera paucipartita, Pterophyllum schenki*, 等。在這6種之中”祇有 *Cycadocarpidium* 是發現在成羽植物羣的。日本植物羣的和歐洲的 *Thaumatopteris* Zone（卽下侏羅紀）相同的種却比較地更多：如 *Marattiopsis muensteri, Thaumatopteris brauniana, Dictyophyllum nilssoni, D. muensteri, Todites princeps, Nilssonia acuminata, N. muensteri, B. taeniata, B. muensteriana* 以及 *Campylophyllum hormanni*……等種，而所有這些種都是發現於成羽植物羣的”。Harris 更加以伸說道：“我們所得到的證據在日本方面不足以表示有分別層帶的可能性；但同時似乎也有些可能的指示：比方說，成羽區的有些地點（如同 Ôishi 的地點 No. I）好像是表示着 *Lepidopteris* Zone 植物羣的成分爲多，而其他的各地點（No. 49）以屬於 *Thaumatopteris* Zone 植物羣的成分爲較多”。Harris 更着重地指示（1937，第94頁）：“矢部及大石[196]（1929）和大石[116,118]（1931，1932b）在中國及日本所描述的惟一的老於瑞底克期的種是 *Pterophyllum jaegeri*；但這標本非常破碎，……我看是屬於里阿斯期最底部的 *P. subaequala* 的”。自 Harris 1937 年的論文發表以後，大石[120]又於1938年發表一篇論文定名爲“日本的兩個相當於格陵蘭東部的 *Lepidopteris* 及 *Thaumatopteris* 層帶”。他在這篇論文中決定了成羽區的成羽系（Nariwa Series）是屬於瑞底克期至里阿斯期（卽自上三叠紀的頂部直至下侏羅紀）的。他指出了成羽系的某些層位是很富於植物化石的。他更指出了成羽區的主要化石地點有30個，而在這30個地點中至少有一半以上的地點含着歐洲的 *Lepidopteris* 及 *Thaumatopteris* 的種屬。他進一步指出：下列地點是屬於歐洲的 *Lepidopteris* Zone 卽瑞底克期的卽他論文所指的 No. I 及 Loc. 45，48，55，63 等。下列地點含着歐洲 *Lepidopteris* Zone 很相接近的種屬如 Loc. 16，21，50，62 等。下列地點含着歐洲的 *Thaumatopteris* Zone 如 Loc. 44，49，64，66，87，91 等。還有下列地點含着 *Lepidopteris* Zone 至 *Thaumatopteris* Zone 的過渡層中的化石如 Loc. 65，68 69 等。關於每一地點的植物化石，我們在這裏不再敍述。Ôishi 最後完全決定日本的成羽植物羣完全是可和格陵蘭東部 Scoresby Sound 相對比的。那就是說日本的成羽植物羣也可以分爲上三叠紀末期及下侏羅紀兩個層帶的。應該特別指出的是 Ôishi 的意見並不爲 Gothan 教授所贊同。Gothan（1937—1938，第388頁）這樣說：“自從經過這一個研究（Gothan 指的是 Harris 的格陵蘭東部的工作）以後，瑞底克期及里阿斯期兩個植物羣的區別，再次地爲人所注意了，這個問題 Gothan[37] 在1914年爲德國的 Franken 植物羣同樣意義地處理過的。現在大石（1938）在日本也試作同樣地分爲兩個層帶的處理。但他的事實是站立在一個很微弱的脚上的，而尤其是在日本，根本沒有找到過 *Lepidopteris ottonis*，這一個種是歐洲及格陵蘭的瑞底克期標準化石。大石所敍述的其他種屬，根本不能作爲分兩個層帶的證據。最近在德國方面也有些地質學家將 Franken 的里阿斯期植物羣又重新地放到瑞底克期去，這顯然是不對的。”上面的一段話可以看出 Gothan 的意見是始終和他從前的意見一樣，卽東亞一帶的中生代植物羣如越南東京，中國萍鄉（卽安源煤系）以及日本的成羽植物羣都屬於里阿斯期，根本沒有瑞底克期的分子在內。Gothan 的意見也似和 Harris 1937 年的意見無甚出入，Harris 這樣說（1937，第96—97頁）“除出東京以外（上面已經提及，Harris 相信東京的 *Lepidopteris* Zone 化石祇有兩種）在中國方面，確實無疑地的瑞底克期面相的分子也非常少的，僅有 *Lepidopteris ottonis* 及 *Cycardocarpidium erdmanni* 等……”。Harris 顯然也認爲中國南方的安源煤系，也不是完全瑞底克期的，因爲在這一帶也沒有找到過確實無疑的瑞底克期化石。不管怎樣說，大石在1938年將日本的成羽植物羣定爲瑞底克期至里阿斯期的意見和本文作者最近的意見是完全相一致的。本文作者在這一篇的結論中肯定地決定了越南東京、中國萍鄉及醴陵（安源煤系）至粵北的艮口直至

雲南的一平浪及日本的成羽植物羣都是以 *Dictyophyllum-Clathropteris* 爲主的。這一個植物羣卽 *Dictyophyllum-Clathropteris* Flora 根據發生的次序顯然是要較以 *Danaeopsis-Bernoullia* 爲主的延長植物羣的地質時代爲新,其時代是應該暫定爲瑞底克-里阿斯 (Rhaeto-Liassic) 的。應該特別指出的是延長植物羣中,也含有日本成羽植物羣的 *Thaumatopteris* Zone (Ôishi 1938, 第 79 頁) 完全相同的分子如下列各種: *Cladophlebis gigantea, Cl. raciborskii, Neocalamites carrerei, Swedenborgia cryptomerioides* 及 *?Stenorachis* (*Ixostrobus?*) *konianus, Podozamites lanceolatus* ……等。而這些相同的化石,都是屬於延長層上部的。而本書所一再提及 *Danaeopteris-Bernoullia* Flora 的上部可能相當於 *Dictyophyllum-Clathropteris* Flora 的下部的意見,更得到了一個重要的證據。

筆者在 1949 年所發表的鄂西香溪植物羣其組成分子比較特殊,因爲這一個植物羣含有越南東京植物羣的重要分子有 10 種之多,如 *Equisetites sarrani, Neocalamites carrerei, Marattiopsis muensteri, Dictyophyllum nathorsti, Clathropteris meniscioides, Pterophyllum inconstans, Pt. tiezei, Pt. nathorsti, Cycadolepis corrugata* ……等,同時也含有中國北方的 *Coniopteris hymenophylloides* Brongn. 及 *Cladophlebis whitbyensis, Phoenicopsis speciosa*……等化石。因此這一個植物羣無疑地是屬於里阿斯期 (卽下侏羅紀) 的。斯行健和李星學 1952 年所描述的四川侏羅紀植物羣,其層位也顯然是和鄂西的香溪植物羣完全可以對比的。在四川方面更找到一個極稀見的格陵蘭東部的下侏羅紀的 *Scoresbya dentata* Harris。應該注意的是:香溪植物羣中也有和延長植物羣完全相同的分子如 *Equisetites sarrani, Neocalamites carrerei, Ginkgoites magnifolia, Podozamites lanceolatus* 及 *Swedenborgia cryptomerioides* 以及 *Cladophlebis raciborskii* (這一種發現於四川的香溪系) 等種。此外在鄂西方面也有 *Sphenozamites* sp.。最有興趣的是這些種除 *G. magnifolia* 外,都是發現於延長層的上部的。

總結的說,以 *Danaeopsis-Bernoullia* 爲主的延長植物羣,其地質時代是大致相當於歐洲及北美的'上三叠紀中部'亦卽大致相當於奥國的 Lunzer Keuper, 瑞士的 Basler-Keuper 及北美的 Virginia-Keuper 等。延長層的沉積時期,可能自上三叠紀的下部已經開始,而直至瑞底克期。根據南非的 Molteno 層厚達 2,000 米以上,其時代仍可能屬於瑞底克期 (Reed[135], 1921, 第 98 頁) 的事實而論,則延長層的時代,全部屬於瑞底克期,也不是完全不可能的。雖然 *Lepidopteris ottonis* (Goeppert) 尚未找到,但延長層亦含有其他重要的瑞底克期化石如 *Danaeopsis fecunda* Halle ……等,並且還含有很多較瑞底克期爲新的分子在內。此種較新的分子可以舉出的有下列各種如: *Neocalamites carcinoides, N. carrerei, Equisetites sarrani, Cladophlebis raciborskii, Cl. gigantea, Th. nordenskioldi, Th. rhomboidis, Th. major, Swedenborgia cryptomerioides, Podozamites lanceolatus*……等。*N. carrerei* 及 *N. carcinoides* 兩種俱被潘鍾祥描述於陝北的瓦窰堡煤系中。*N. carcinoides* 在瑞典及格林蘭東部都是限於下侏羅紀的 *Thaumatopteris* Zone 的 (Harris, 1937 表 1 及表 3)。*N. carrerei* 在東亞的瑞底克期而尤其是里阿斯期是分佈很廣的,部分地點甚至可能到了中侏羅紀(參看本書第 10 頁的異名表)。這一個種最初發現於越南東京植物羣。後又被記載於日本的成羽植物羣及鄂西的香溪煤系及其他地點的下侏羅紀植物羣。應該特别指出的是 *N. carrerei* 根據大石 1938 年論文的第 78 及 79 頁的敍述,在成羽植物羣中不僅發現瑞底克期也曾發現於下侏羅紀中。*E. sarrani* 及 *Cl. raciborskii* 俱發現於越南的東京植物羣,但 *E. sarrani* 在格陵蘭東部僅發現於下侏羅紀,在中國方面此種也曾被記載於鄂西的香溪煤系及陝北的瓦窰堡系。*Cl. raciborskii* 曾發現日本的成羽植物羣。根據大石 (1938, 第 79 頁), 這一個種也是發現於成羽區的 *Thaumatopteris* Zone 卽是屬於下侏羅紀的。此種亦被描述於朝鮮的下侏羅紀,亦被記載於四川的下侏羅紀 (Sze & Lee[179], 1952 第 23 頁)。這一個種在東亞的侏羅紀地層中似分佈很廣 (參看第 20 頁異名表), Thomas 在 Kamenka 所描述的 *Cl. kamenkensis* 似亦屬於此種(參看本書第 20.21 頁)。最近李星學同志又敍述此種於大同煤田的雲崗統,其時代是屬於中侏羅紀的。*Cl. gigantea* 根據 Ôishi 1938 第 79 頁在日本也是僅發現於日本成羽區的下侏羅紀的。*Th. nordenskioldi* 也曾被潘鍾祥描述於延長層上部及瓦窰堡系下部,此種在歐洲是發現於瑞典的瑞底克期及奥匈 (Austria-Hungaria) 的下侏羅紀底部的。*Th. rhomboidalis* 曾被斯行健敍述於福建長汀的下侏羅紀。這是一個瑞底克期至下侏羅紀的著名的種,曾被記載於歐洲及南非的下侏羅紀及瑞底克期。*Th. major* 除發現於波蘭 Galizien 的侏羅紀以外,還發現於瑞典

Schonen 的瑞底克期。 *Sw. cryptomerioides* 在中國曾被記載於鄂西的香溪煤系及日本成羽區的下侏羅紀及瑞底克期至下侏羅紀的過波層 (Ôishi, 1938, 第79頁) 中。 這一個種在格陵蘭東部及瑞典的層位亦甚高，都是發現於 *Thaumatoperis* Zone (卽下侏羅紀) 的 (Harris[56], 1937, 表2及表3)。至於 *Podozamites lanceolatus* 更是全世界侏羅紀最普通的一個種，也不必詳述了。此外如 *Bernoullia zeilleri* 及 *Glossophyllum? shensiense* 也曾發現於越南東京的瑞底克期至里阿斯期植物羣中，而 *Danaeopsis fecunda* 一種最近又被載於陝北瓦窰堡系中。據上所述，我們知道：幾乎在延長層所含的所有舊種中，都是比較上三叠紀中部爲高，而在新種方面其最相接近的舊種也多半是和瑞底克期並且比瑞底克期爲高的(參看本書每一個新種的討論，此處不擬詳述)。 有些舊種甚至可以到了中侏羅紀的，如 *Cl. raciborskii* 及 *Podozamites lanceolatus*……等。 化石上的極大部分的證據，似乎都在直指着延長層的全部地層都是屬於瑞底克期的。 不過在本書結論的許多篇專題中，作者曾再三地說明，延長層中的最繁盛最豐富的爲 *Danaeopsis* 及 *Bernoullia* 以及 *Glossophyllum?*，而這三屬植物都是歐洲'上三叠紀中部'的最多並且最具特徵的化石，並且 *Danaeopsis* 及 *Bernoullia* 也都可發現於歐洲的'上三叠紀下部'地層中。除這三屬植物之外，延長層中的最豐富的化石是 *Cl. shensiensis* 而和這一個延長層中最豐富的種最相接近的是瑞士西北部 Basel 的中部上三叠紀，所謂 Basler Keuper 的 *Cl. rütimeyeri* Heer.，並且這一個種卽 *Cl. shensiensis* 的相同的實羽片化石，也發現於北美的'上三叠紀中部'卽所謂 Virginia-Keuper 中。Fontaine[30] 定此種實羽片化石爲 *Acrostichides linneaefolius* (1883, pl. IX, figs. 1, 1a)。此外又如 *Cl. szeiana* 其最接近的爲北美及歐洲'上三叠中部'的 *Asterotheca* meriani (Brongn.) Stur (等於 *Asterocarpus virginiensis* Fontaine 又等於 *Merianopteris angusta*)，並且在延長層中的許多體積很大的 *Equisetites* 新種，都非常接近於歐洲的下部至上部上三叠紀體積很大的 *Equisetites* 各種。 根據上述事實，換一句話說，卽根據植物羣在地層上的發生次序，延長植物羣是無疑地要比東京、安源以及成羽植物羣是要較老的。作者因此決定暫定延長植物羣的地質時代爲上三叠紀下部至頂部 (Keuper-Rhaetic) 或上三叠紀頂部卽瑞底克期。 應該注意的是延長層和直覆在其上瓦窰堡煤系，據最近所知含有完全相同的化石，如 *Equisetites sarrani, Neocalamites carrerei, N. carcinoides, Danaeopsis fecunda, Thinnfeldia nordenskioldi* 以及 *?Protoblechnum hughesi* 等。不過這些種除 *D. fecunda* 外，都可以發現於比瑞底克期還要新的侏羅紀地層中 (上面已經提及) 的。 因此我們不能完全和潘鍾祥最近的意見 (1954, 第209—213頁) 相同，將陝北的下侏羅紀的瓦窰堡煤系，下移而至於所謂"延長系"的上部中。 根據李星學，瓦窰堡煤系也含有 *Coniopteris hymenophylloides* 化石，這一個事實，也更說明了瓦窰堡系是決不能定爲瑞底克期的。 在結論的第IV個專題中，作者將再討論這一問題。

講到這裏所餘剩下的問題，是直接位在延長層下面的石千峯系的時代問題。 石千峯系也是在華北分佈很廣的地質建造，它是紅色、紫色或綠色，乾燥而甚少生物遺跡的地層，厚度約700—750米。 這一個乾燥沉積層的地質時代，地質學家的意見，也迄未曾取得一致。筆者 (1952, 第15頁, Sze, 1952 第20頁) 認爲其時代當屬於古生代末期，多數地質學家似仍相信這一個地質建造其時代應該屬於古生代至中生代過渡層亦卽所謂屬於二叠三叠紀 (Permo-Triassic) 的。惟無論怎樣講，乾燥環境中所沉積的石千峯系決不可能和富於植物化石的延長層，其沉積時期是直接連接着而沒有任何的間斷的。如果石千峯系是屬於上二叠紀的，那末在中國北方尙缺乏"下三叠紀"及"中三叠紀"的沉積層；如果石千峯系是屬於二叠三叠紀的，那末，中國北方也還缺少'中三叠紀'的沉積層。因爲如果石千峯系屬於二叠三叠紀的理由是對的話，那末，這一個建造其厚度僅750米也至多僅能到達至於下三叠紀。支持這個意見的是：歐洲的下三叠紀卽 Buntsandstein 層，也是和上二叠紀一樣，都是從乾燥環境中所沉積的。究竟這兩個關於石千峯系的地質時代的意見，那一個是比較正確的呢。作者覺得尙須待地質學家將來更多的努力，獲得更多的證據以證明之。豈特中國北方而已，東亞中生代的所有陸相建造的時代及其分層，尙須待地質學家及古生物學家的不斷的、勇敢的、堅韌的努力以解決之。

(四) 陝北中生代陸相地層時代的討論

陝西北部的中生代地層，潘鍾祥在1936年曾劃分爲下列五個建造：

石千峯系　大部分爲紅色長石砂岩及頁岩，其厚度在 750 至 1,000 米左右。其時代潘同志在 1936 年定爲二叠三叠紀，1954 年同意斯行健的意見改爲上二叠紀。

延長層　大部分爲灰色砂岩、砂質頁岩及頁岩的互層，砂岩常成交錯層狀，含石油並含斧足類、魚類及植物化石，後者至爲豐富。其厚度潘同志定爲 1,000 米，但據最近在銅川至宜君區的估計，延長層的厚度（不包括瓦窰堡系）至少在 1,175 米左右。其時代潘同志定爲上三叠紀。本書作者完全同意此一意見。

瓦窰堡煤系　大部分爲灰色砂岩（亦常成交錯層狀）及灰色或黑色頁岩的互層。含石油，其下部含煤層及油頁岩，其厚度約爲 800 米，其時代潘同志 1936 年定爲下侏羅紀，1954 年改爲上三叠紀頂部至下侏羅紀。此意見李星學最近表示不能同意（1955，第 41 頁）。本書作者支持李同志的意見，下面將討論及之。

安定層　下部爲紅色砂岩頁岩，上部爲薄層泥質石灰岩，含魚化石 *Pholidophorus*，其厚度不到 100 米，其時代潘同志定爲上侏羅紀，李同志定爲中侏羅紀的上部。本書作者認爲兩者都甚可能。

保安系　下部爲塊狀交錯層紅砂岩，中夾頁岩；上部爲紅色砂岩及頁岩中夾綠色砂岩及頁岩。全層厚約 2000 米。化石未曾發現。根據潘鍾祥，陝北的保安系大致可以和四川盆地中的四川系相對比，其時代屬於白堊紀。

茲先論延長層的時代。延長層植物羣的地質時代，上面已經詳細地討論，是屬於所謂考依波–瑞底克（Keuper-Rhaetic）的。此一植物羣在東亞僅發現於陝西北部及甘肅的東部及西部，東亞其他各處迄至今日尙未發現相同的地層及其植物羣。根據植物化石的證據，此一植物羣顯然和奧國的所謂 Lunzer Keuper，瑞士西北部的所謂 Basler Keuper 以及北美維基尼亞州東部的所謂 Virginia-Keuper 各植物羣是可以比較的。上述三個植物羣都確實地證明是屬於上三叠紀的中部的，卽所謂屬於 Middle Keuper 的。延長層植物羣雖然和上述三植物羣較相接近，但其地層的沉積時代可能在上三叠紀初期卽 Keuper 紀的初期（Lower Keuper），已經開始而直至上三叠紀的末期的瑞底克期（Rhaetic＝Uppermost Keuper）。延長層厚度在銅川、宜君地區約爲 1,200 米左右，而在其底部地層中亦發現了 *Danaeopsis* 及 *Neocalamites* 等化石，則延長層的沉積時期在 Keuper 紀初期卽已開始，當亦甚爲可信，並且 *Danaeopsis* 一屬植物羣雖多發現於中部上三叠紀的，在德國 Wurzburg 區的下部上三叠紀亦卽謂 Lettenkohlensandstein 期中，亦頗有發現（Gothan[42]，1954，第 113 頁）。這一事實更足以支持延長層的底部是屬於上三叠紀的初期的。

瓦窰堡系的地質時代：直覆於延長層之上的煤系地層在陝北名瓦窰堡煤系，在甘肅東部及西部名華亭煤系（卽安口窰煤系），此煤系地層在陝北厚約 800 米，其下部爲灰色砂岩頁岩，以及黑色頁岩及煤層；中部爲灰白色塊狀砂岩；上部爲灰色砂岩頁岩及黑色頁岩。瓦窰堡煤系的植物化石，經潘鍾祥 1936 年所宣佈者爲下列七種：

Neocalamites cf. *carrerei* (Zeiller)
Neocalamites cf. *carcinoides* Harris
Equisetites cf. *sarrani* Zeiller
Coniopteris hymenophylloides Brongn.
Baiera cf. *lindleyana* (Schimper)
"*Danaeopsis*" *hughesi* Feistm.
Thinnfeldia nordenskioldi Nathorst

又根據潘鍾祥的意見（1936，p. 37 及中文節要系四頁），"斯行健，1933 年所描述的陝北府谷縣盤灣的化石，顯係出於此系之下部。"府谷縣的植物化石如下表：

Sphenopteris diamensis (Seward) Sze
Coniopteris hymenophylloides Brongn.
Coniopteris sp.
Cladophlebis (*Eboracia*) *lobifolia* (Phill.)
Cladophlebis cf. *arguta* (L. & H.) Halle
Cladophlebis sp.
Podozamites lanceolatus (L. & H.) Braun
Elatocladus manchuricus (Yok.) Yabe

Ctenis sp.
Nilssonia sp.

根據上述兩個表的植物化石，瓦窰堡煤系顯然是屬於中國北方中生代煤層最常見的 *Coniopteris-Phoenicopsis* 植物羣的範圍以內的。其地層時代確實地是屬於下侏羅紀至中侏羅紀（Liassic-Dogger）的，並且確實地是可以和北京附近的門頭溝煤系及山西北部的大同煤系對比的。

最有意義的發現是王尙文同志於 1950 年在延安地區的延安砂岩之下瓦窰堡煤系之上發現一個大的假整合。王同志將此大的假整合以下的地層，名爲延長系包括瓦窰堡煤系在內；並且把大的假整合以上的地層名爲延安系。最近數年來，石油管理總局的陳賁同志在宜君地區的瓦窰堡煤系的上部地層中也找到一個假整合，因此將瓦窰堡煤系的上部地層，定爲衣食村煤系，而將在此假整合以下的瓦窰堡系的下部地層定爲瓦窰堡系。李德生、馬繼祥[96]支持這個意見（1953，第 32—34 頁）。李、馬兩同志同時指出："所謂衣食村煤系是和延安系是位在同一層位的"。也有人把延安系和安定層之間厚約130米的岩層另分爲一系，名爲直羅系。上部爲砂岩頁岩互層，下部爲白色石英砂岩，底部爲礫狀，頂部爲油頁岩 。直羅系和位其下的延安系及位其上的安定層均爲假整合接觸。對於直羅系的劃出，潘同志却認爲是不必要的。潘同志在其 1954 年論文中因爲 *Coniopteris hymenophylloides* 一種，在瓦窰堡含煤系的下部含煤層中未曾見過，決定將瓦窰堡系下部劃歸於延長系"中，並且列一表如下：

<table>
<tr><th>潘鍾祥分層（1936 年）</th><th colspan="2">石油局分層（1950 年）</th><th colspan="2">潘鍾祥分層（1954 年）</th><th>時　代</th><th>厚 度（米）</th></tr>
<tr><td>安　定　層</td><td colspan="2">安　定　系</td><td colspan="2">安　定　層</td><td>上侏羅紀</td><td>50</td></tr>
<tr><td rowspan="3">瓦窰堡煤系</td><td colspan="2">直羅系（厚 130 米）</td><td colspan="2" rowspan="2">延安系</td><td rowspan="2">下侏羅紀</td><td rowspan="2">470</td></tr>
<tr><td>延安系</td><td>衣食村煤系（宜君區）</td></tr>
<tr><td colspan="2" rowspan="2">延長系</td><td rowspan="2">延長系</td><td>瓦窰堡含煤層</td><td rowspan="2">上三叠紀</td><td rowspan="2">1400</td></tr>
<tr><td>延長層</td><td>延長層</td></tr>
<tr><td>石千峯系</td><td colspan="2">石千峯系</td><td colspan="2">石千峯系</td><td>二叠紀</td><td>1080</td></tr>
</table>

應該提出的是潘同志[127]在 1936 年提及本書作者所研究陝北府谷縣的含 *Coniopteris* 植物羣時；則謂此植物羣"顯係出於此系（卽瓦窰堡系）的下部"的（1936，中文節要，第四頁）。1954 年發表的論文第 213 頁中提到此植物羣時，則改爲"其層位不大確知，惟觀其種屬，諒屬於延安系（按卽原來的瓦窰堡系的上部）是無問題的"。一個"顯"字和一個"諒"字，似乎都是隨便說的。李星學同志在其最近的論文中，却認爲潘同志的意見，還有權商的必要。他舉出下面三個理由：(1) 按照中國北方侏羅紀的煤系沉積及其所含的植物羣來看，陝北的瓦窰堡煤系的上部地層卽現在所謂衣食村煤系（其層位等於延安系）其層位很可能是和晉北的大同煤系以上的地層卽現在所謂雲崗統及北京附近的門頭溝煤系的上部卽現在所謂龍門統以及大青山的石拐煤系上部卽現在所謂召溝統相當的，而以屬於中侏羅紀爲宜。瓦窰堡煤系一個名詞仍應保留，此煤系的層位相當於普通一般地質學家定爲下侏羅紀的地層相當，如大同煤系及門頭溝煤系的下部所謂窰坡統以及石拐煤系下部所謂五當溝統等。(2) 潘同志將瓦窰堡煤系歸併於"延長系"所舉出的惟一重要的證據是 *Danaeopsis fecunda* Halle 一種也曾發現於瓦窰堡系中。這一個證據是不够充分地證明瓦窰堡是可以歸併於"延長系"的，卽屬於上三叠紀的上部的。因爲這一個種迄至今日僅發現於瑞典及中國的少數地點，它在陝北發現於較上三叠紀上部爲高的地層中，也不是完全不可能的。(3) 潘同志所舉出另一個的反面的證據（Negative evidence）是 *Coniopteris hymenophylloides*（Brongn.）一種從來未曾在瓦窰堡系下部找到過，這一個種是發現在延安系（等於衣食村煤系）中的 。李同志對於這一個意見，也不完全表示同意 。李同志曾在何春蓀等

1945 年採自宜君地區的瓦窰堡煤系近底部的標本中，證明有 *Coniopteris hymenophylloides* 的存在。同樣的事實，也曾發現於甘肅東部的華亭煤系（其層位完全相當於陝北的瓦窰堡系）的下部地層中。李同志將陝北的侏羅紀沉積與華北及其鄰近地區的相當地層作一個對比表如下：

地區 地層時代	北京西山	山西大同	內蒙大青山	陝西北部	甘肅東部	甘肅中部
上侏羅紀至第四紀	髫髻山系 （上侏羅紀或下白堊紀）	渾源統 （上白堊紀?）	礫石層黃土 （第四紀）	宜君礫岩 （白堊紀）	六盤山系 （下白堊紀）	甘肅系 （第三紀）
中侏羅紀地層	? 九龍山系 龍門統　門頭溝煤系	雲崗統 上部 ? 中部 下部	大青山系 ? 長漢溝系 石拐煤系　召溝統	安定層 直羅系 衣食村煤系	崆峒山系 華亭煤系 上部	鐵冶溝紅色岩層 和尚舖煤系
下侏羅紀地層	? 窯坡統	大同煤系	? 五當溝統	瓦窰堡煤系	下部	阿干鎮煤系

李星學同志[95]將陝北的衣食村煤系、晉北的雲崗統、北京附近門頭溝煤系的上部所謂龍門統、大青山一帶石拐煤系的上部所謂召溝統以及甘肅中部的和尚舖煤系，都歸於中部侏羅紀，其意見可能是正確的。不過這樣的劃分，完全是根據岩石的性質及其底部的一個假整合的存在的。令人遺憾的是缺少足够化石上面的證據。地質學家的劃分地層建造，一向是以化石上面的證據作爲根據的，因此，如果沒有化石方面的證據，劃分地層時代，總是非常勉強的。並且李同志最近發表一篇論文"大同煤田的雲崗統及其植物化石"（1955，第 35—38 頁）所列舉的幾種化石和位在其下的大同煤系的化石是完全相同的。筆者[166] 1931 年的"中國里阿斯期植物化石"一書發表以後，先後接到蘇聯及日本古植物學家 Krysthofovich 及 Ôishi（大石）兩教授來信謂 *Coniopteris hymenophylloides* Brongn. 是英國 Yorkshire 的"中部侏羅紀"標準化石。西伯利亞東部以及日本含有 *Coniopteris* 的地層，其層位似較里阿斯期爲高，很可能的西伯利亞東部（即阿穆爾省等處）及日本含有 *Coniopteris* 等化石的地層是屬於"中侏羅紀"的。Krysthofovich 及 Ôishi 兩教授的意見顯然是指中國北方的門頭溝煤系、大同煤系及瓦窰堡煤系……等甚至山東的坊子煤系以及鄂西的香溪煤系都有屬於"中侏羅紀"的可能的。本書作者直至今日仍和 Gothan 教授的意見相同即 *Coniopteris hymenophylloides* 雖然是 Yorkshire 的"中侏羅紀"標準化石，而這一個種在東亞尤其是在中國可能在'下侏羅紀'已經產生而直延至"中侏羅紀"。古生物學家對於某一個地區的一個或兩個標準化石的意義不應該完全用舊的眼光來判斷，而應該用辯證法的觀點來討論，那就是說：決定一個新的地區的地層時代，不應該過分重視某一地區的所產生的一個或兩個標準化石而應該用多數的證據來決定之。同樣地情形如 *Onychiopsis* 及 *Ruffordia* 也是如此，兩者都是英國下白堊紀初期（即 Wealden 期）的最重要標準化石；但這兩屬植物在朝鮮發現於"上侏羅紀"的洛東江層（Rakuto Bed），而在日本則發現於上侏羅紀的手取系（Tetori Series）直至下白堊紀初期的 Ryôseki Series（Ôishi[121]，1940，168 頁；231—232 頁；240—241 頁），在中國則發現於中部至上部侏羅紀的鷄西煤系（松花江下游鷄西，鶴岡、阜新一帶）及下白堊紀初期的板頭系（福建的永安）。筆者直至今日，仍同意 Gothan 教授的意見、仍信東亞的中生代的造煤時期可能是在瑞底克期開始，經過下侏羅紀，有幾處或直至中侏羅紀及上侏羅紀。因此本書作者利用此一機會表示同意李星學同志的意見，將陝北的衣食村煤系、晉北大同煤田的雲崗統、大青山一統的召溝統、北京附近門頭溝煤系的上部所謂龍門統以及甘肅東部的和尚舖煤系都暫歸於'中侏羅紀'。至於狹義的陝北瓦窰堡煤系、狹義的大同煤系、狹義的門頭溝煤系、狹義的石拐子煤系以及甘肅東部的阿干鎮煤系，都應該仍歸於下侏羅紀，雖然這些陸相建造也仍含有 *Coniopteris*……等化石。是否山東的坊子煤系及鄂西的香溪煤系其上部地層也可歸於中侏羅紀呢？在未找出足够其他證據

以前，本書作者暫不作肯定的決定，但仍然傾向於將坊子煤系及香溪煤系全部歸於下侏羅紀的意見的。這兩個煤系建造也都含有 *Coniopteris hymenophylloides* 化石，而在坊子煤系中產生更爲豐富。坊子煤系除含有豐富的 *Coniopteris* 外，其餘的化石，也幾乎全和門頭溝煤系及大同煤系相同。至於鄂西的香溪煤系，除含有 *Coniopteris hymenophylloides* 以外，還含有很多的越南東京植物羣中的重要分子如：*Equisetites sarrani* Zeiller, *Neocalamites carrerei* Zeiller, *Dictyophyllum nathorsti* Zeiller, *Clathropteris meniscioides* Brongn., *Pterophyllum inconstans* Braun, *Pterophyllum tiezei* Zeiller, *Pterophyllum portali* Zeiller, *Pterophyllum nathorsti* Schenk, *Cycadolepis corrugata* Zeiller ……等等。最前的兩種也曾發現於標準的上三疊紀延長層植物羣中，同時鄂西香溪煤系也含有德國、瑞典及格陵蘭東部下侏羅紀植物羣（即 Harris 的 *Thaumatopteris*-Zone）中的重要分子如：*Equisetites sarrani*, *Marattiopsis münsteri*, *Dictyophyllum nilssoni*, *Clathropteris meniscioides*, *Sphenopteris modesta*, *Ginkgoites* cf. *hermelini*, *Czekanowskia* sp., ?*Ctenoppteris* sp., *Swedenborgia cryptomerioides* ……等等。最後的一種，也發現於延長層植物羣中。而四川方面香溪煤系中更發現了格陵蘭東部'下侏羅紀'的重要化石如 *Scoresby dentata* Harris (Sze & Lee[179], 1952 第1頁及15頁)。因此至少就香溪煤系的時代而論，是無法定爲中侏羅紀的。因此我們也至少可以證明 *Coniopteris hymenophylloides* 一個種，雖然是 Yorkshire 的中侏羅紀標準化石，在中國方面，也可以在下侏羅紀地層中找到的。而陝北的狹義的瓦窰堡煤系（即原來的瓦窰堡系的下部），也決不能因爲根據未曾找到 *Coniopteris* 的事實（根據李星學同志 *Coniopteris* 是找到過的，上面已經提及）而完全將其歸於上三疊紀頂部，其理由亦至爲明顯。因爲在陝北的瓦窰堡系中，如果眞的沒有產生 *Coniopteris* 我們也祇能以當時的'植物地理學'上的關係來解釋之（參看潘鍾祥[128], 1954, 第214頁），因爲一個種的分佈，本來是可以和別的種的分佈不相同的。一種在某一個區域特別繁盛的植物在另一個地區本來是可以特別貧乏的，甚至可以沒有的。同樣的話也可以應用於討論中國南方的安源煤系直至越南的東京煤系。我們也決不能僅僅根據這些煤系的沒有發現過 *Coniopteris* 化石的事實，而認爲其層位應該較老於中國北方的含有 *Coniopteris* 的煤系地層。中國南方的安源煤系及越南的東京煤系及日本的成羽系其植物羣都是以 *Dictyophyllum-Clathropteris* 爲主的。一般的講，全世界的中生代地層中，*Dictyophyllum-Clathropteris* 植物羣是比以 *Coniopteris-Phoenicopsis* 爲主的 *Coniopteris-Phoeniopsis* 植物羣其地層上的發生較早，因爲 *Dictyophyllum-Clathropteris* 兩屬及其他此植物羣中的若干植物，也曾發現於歐洲的中部上三疊紀地層中的，如 Lunzer-Keuper, Basler Keuper, Virginia-Keuper……等（參看 Ôishi & Yamasita[124], 1936）。同時越南的東京植物羣、雲南的一平浪植物羣以及日本的成羽植物羣，其層位較老，尙有動物方面的證據作爲根據，在下面的第五個專題中將再提及。因此本書作者利用此一機會特別指出：作者對於中國南方的安源煤系（包括一平浪及良口等煤系）及越南的東京煤系，日本的成羽系，其層位似較中國北方的門頭溝煤系及大同煤系爲老的意見，是可以完全同意的。不過這一個問題，並不是因爲安源煤系及東京煤系以及日本的成羽系的，並未曾找到過 *Coniopteris* 化石的事實來決定的。對於東亞尤其是中國各陸相地層及其植物羣的地質時代的詳細的討論，不是當前的這一個題目所允許的。作者對此問題以及其和動物羣的關係及和造山運動的關係，擬在中國中生代植物圖鑑中更詳細地討論之。

中國北方的侏羅紀煤系最常見最重要的化石是 *Coniopteris*, *Ginkgoites*, *Baiera*, *Phoenicopsis*, *Czekanowskia* 等。同時這些植物的直的分佈即在地層上的分佈也是很長的。本文作者擬暫定中國北方侏羅紀下部至中部爲 *Coniopteris-Phoenicopsis* 植物羣，這一個植物羣在東亞應該是從下侏羅紀開始而直至中侏羅紀的。下面將再提及。

（五） 根據植物羣的進化觀點劃分中國中生代的陸相建造

地質學上所謂的 Palaeozoic, Mesozoic, Cainozoic, 都是最大的劃分單位，這些名詞嚴格的講，應該譯爲動物世界的古生代、中生代及新生代。根據植物的進化觀點來看，這些名詞並不完全適合的；因爲植物世界的古生代是從前寒武紀到下二疊紀，中生代是從上二疊紀到下白堊紀，新生代是從上白堊紀到現代。因此德國高騰（Gothan）教授爲植物世界的古生代、中生代、新生代另創新的名詞，即 Palaeophytic, Mesophytic, Cainophytic。這些名詞自創立後，並沒有被很多的古生物學家和地質學家所採納。

地質學上最小的分層單位爲"層帶"(Zone)。根據動物化石，歐洲的下侏羅紀、中侏羅紀及上侏羅紀，都可分爲很多層帶，如 *Harpoceras concavum* 層帶，*Lytoceras jurense* 層帶等等。英國哈立斯 (Harris) 教授將格陵蘭東部、德國及瑞典的上三叠紀末期，卽瑞底克期 (Rhaetis) 根據植物化石定名 *Lepidopteris* 層帶，而將下侏羅紀，卽里阿斯期 (Liassic) 定爲 *Thaumatopteris* 層帶。在這裏我們可以看出，根據動物化石，歐洲的下侏羅紀可以劃分爲很多層帶，而根據植物化石僅能够分爲一個層帶。換言之，根據植物化石所定的層帶是要比動物化石所定的層帶，在地層上，亦卽在時間上要長得多。

中國大陸自三叠紀尤其是自侏羅紀肇始以後，卽無很大的海浸，因此缺乏海生動物的證據，地層時代的鑑定全靠植物化石，而植物化石在地層上的直的分佈是要比動物化石長得多，因此利用植物化石鑑定時代困難較大。也就爲這個緣故，中國中生代各陸相地層的正確時代的鑑定，地質學家意見迄今未能完全取得一致。作者認爲鑑定中國中生代各陸相地層，利用較大的分層單位是非常便當而有用的。比"層帶"較大的分層單位爲"系"(Series)。當作一種暫時的方案，作者提出下列一個表，這一個表是完全根據植物羣的進化觀點，用較大的分層單位來劃分中國中生代的陸相地層的。

植物羣	地層建造	地質時代
Ruffordia-Onychiopsis 系	上部：板頭系及其相當的地層 (北京附近的坨里及大灰廠一帶)	下白堊紀初期 (Wealden)
	下部：鷄西煤系及其相當地層 (鷄西、鶴岡、阜新一帶)	中部至上部侏羅紀 (Dogger-Malm)
Coniopteris-Phoenicopsis 系	門頭溝煤系及其相當地層 (相當於大同煤系及瓦窰堡煤系)	下部至中部侏羅紀 (Liassic-Dogger)
Dictyophyllum-Clathroptheris 系	安源煤系及其相當地層 (相當於艮口、一平浪及東京煤系；鄂西的香溪系，確屬於下侏羅紀)	上三叠紀頂部至下部侏羅紀 (Rhaetic-Liassic)
Danaeopsis-Bernoullia 系	延長層 (陝西北部、甘肅東部、西部)	上三叠紀下部至頂部 (Keuper-Rhaetic)

上面這個表完全是以植物羣在地層上的發生的先後次序，作爲根據的。譬如 *Danaeopsis-Bernoullia* 植物羣，其在地層上的發生，似較 *Dictyophyllum-Clathropteris* 植物羣爲老。因爲 *Danaeopsis* 及 *Bernoullia* 爲歐洲的中部上三叠紀最繁盛的化石，歐洲的 Basler Keuper 及 Lunzer Keuper 兩植物羣卽以此兩屬植物爲主。而 *Danaeopsis** 一屬，在歐洲的下部上三叠紀也已經發生，譬如德國 Wurzburg 及其他地點 (屬於 Lettenkohlengrouppe 期卽屬於下部上三叠紀卽 Unterer Keuper) 卽含有很多的 *Danaeopsis* 化石 (Kayser[76]，教科書 1923，第 469 頁；及 Gothan & Weyland，1954 第 113 頁)。此屬植物也曾發現於北美的'中部上三叠紀'中 (Hirmer[63]，1927，第 595 頁)。而 *Bernoullis* 一屬，也和 *Danaeopsis* 一樣曾發現於德國 Franken 的'下部上三叠紀'的 Lettenkohle 層中 (Frentzen[33]，1926，B，13；Hirmer[63]，1927，第 592 頁)。至於 *Dictyophyllum-Clathropteris* 植物羣亦較 *Coniopteris-Phoenicopsis* 植物羣爲老，在上面的一個專題中已曾提過。因爲 *Coniopteris-Phoenicopsis* 植物羣中的多數植物是由下侏羅紀至中侏羅紀的，而 *Coniopteris* 更是英國 Yorkshire '中侏羅紀'的標準化石。至於 *Ruffordia-Onychiopsis* 植物羣比較爲最新，亦有重要的證據。*Ruffordia* 及 *Onychiopsis* 爲歐洲下白堊紀初期卽 Wealden 期的標準化石，而在東亞如日本及朝鮮都發生於上侏羅紀至下白堊紀初期的。這一個植物羣中的其他植物，也足以證明這一個意見。

Danaeopsis-Bernoullia 系最重要的標準植物是 *Danaeopsis fecunda*, *Bernoullia zeilleri*, *Glossophyllum? shensiense*, *Cladephlebis shensiensis*, *Cl. szeiana* ……等，所有上述各種，俱和歐洲及北美的上三叠紀中部植物羣的重要分子有親緣關係，尤其是和瑞士西北部的 Basler-Keuper 奥國的 Lunzer-Keuper 北美的 Virginia-Keuper 各植物羣。根據植物化石，這一個植物羣卽延長植物羣，大致相當於歐洲及北美的上三叠紀中部，茲

* *Danaeopsis* 也發現於德國 Württemberg 的'中部上三叠紀'地層中 (Kayser[76]，1923，第 473 頁)。

暫定其時代屬於上三叠紀的初期至末期 (Keuper-Rhaetic)，當無問題。

Dictyophyllum-Clathropteris 系的最標準的化石是熱帶及半熱帶的蕨類,而尤以雙翅蕨科 (Dipteridaceae) 及觀音座蓮科 (Marattiaceae) 爲主,最重要的屬爲 *Dictyophyllum, Clathropteris* 及 *Marattiopsis* 等。裸子植物亦甚多,如 *Pityophyllum, Otozamites, Pterophyllum, Nilssonia, Ctenis* 等,所有上述植物俱和瑞典、德國及格陵蘭東部的所謂 *Lepidopteris* 層帶 (上三叠紀末期) 及 *Thaumatopteris* 層帶 (下侏羅紀) 各植物羣的重要分子完全符合,其地質時代當亦完全可以對比。中國南方的湘贛一帶的安源煤系,粵北的艮口煤系,廣西的西灣煤系,雲南的一平浪煤系直至越南的東京煤系俱屬於這一個植物系統之內,其地質時代俱應暫定爲上三叠紀末至下侏羅紀,至於鄂西及四川的香溪煤系其地質時代,應屬於下侏羅紀。

Coniopteris-Phoenicopsis 系的最具特徵的化石爲 *Coniopteris, Phoenicopsis, Czekanowskia, Ginkgoites, Baiera, Cladophlebis whitbyensis, Cl. denticulata* 以及其他化石,這些化石大半是於英國約克夏 (Yorkshire) 一帶的中侏羅紀植物羣的重要分子。北京附近的門頭溝煤系、晉北的大同煤系、陝北的瓦窰堡煤系、甘肅的華亭煤系、內蒙大青山的石拐煤系俱屬於這一個植物系統之內,其時代應屬於下侏羅紀至中侏羅紀。李星學最近在“古生物學報”的論文 (Lee[95], 1955, 第 39—42 頁) 指出:北京附近的門頭溝煤系的下部屬於下侏羅紀,其上部地層所謂龍門統應屬於中侏羅紀;在陝北方面,原來的瓦窰堡煤系的下部屬於下侏羅紀,而其上部 (即現在所謂衣食村煤系) 應該屬於中侏羅紀; 在內蒙大青山一帶,石拐煤系的大部分確屬於下侏羅紀,而位在其上的召溝統則屬於中侏羅紀; 在甘肅方面,華亭煤系的上部屬於中侏羅紀,下部屬於下侏羅紀。 作者對於李星學的意見完全表示同意。

Ruffordia-Onychiopsis 系,迄至目前爲止是我們所知道的中國中生代最高植物化石層。這一個植物系可分爲上下兩部 。 上部名爲板頭系,其地層出露於福建永安附近,其最重要的化石爲 *Ruffordia, Onychiopsis, Cladophlebis browniana, Cl. dunkeri, Ptilophyllum boreale, Otozamites klipsteinii* 以及松杉科化石如 *Brachyphyllum obesum, Sphenolepidium elegans, Pagiophyllum gracile* 等。除植物化石以外,板頭系還含有魚化石,和 *Lycoptera sinensis* 頗相近似。板頭系的植物化石確實相當於歐洲的 Wealden 及北美的 Older Potomac 植物羣,其時代確屬於下白堊紀初期 。 和板頭系大致相同的植物化石亦發現於北京附近的坨里及大灰廠一帶,其地層時代亦應完全相當。山東的萊陽層亦含大致相同的松杉科化石及魚化石,其時代亦屬於下白堊紀初期,萊陽層的層位應完全可以和板頭系相對比。

Ruffordia-Onychiopsis 系的下部地層出現於北滿松花江下游的鷄西、鶴岡及阜新一帶,作者擬定其地層爲鷄西煤系,其時代應該屬於上侏羅紀或屬於中部至上部侏羅紀。鷄西煤系亦含有 *Ruffordia* 及 *Onychiopsis* 等化石,並含有松杉科化石 *Elatocladus manchuricus* 以及很多其他化石如 *Cladophlebis, Baiera, Podozamites* 等,這些化石又大致接近於下部至中部侏羅紀的植物化石,應該特別指出的是: *Ruffordia* 及 *Onychiopsis* 兩屬蕨類化石是歐洲下白堊紀初期的標準化石,而在中國除發現於板頭系外,亦發現於上侏羅紀的鷄西煤系; 在日本及朝鮮,這兩屬植物除發現於上白堊紀初期外,亦發現於上侏羅紀地層中。

在日本方面,大石 (Ôishi) 教授也曾經根據植物羣的進化觀點,用比較層帶還要大的分層單位系來劃分日本的中生代陸相地層。大石 (Ôishi) 提出下列三個系:

III *Angiosperm* 系 (上部白堊紀)

II *Onychiopsis* 系 (上侏羅紀至下白堊紀)

I *Dictyophyllum* 系 (上三叠紀至中侏羅紀)

在這裏我們可以看出在日本方面還沒有發現延長層及其植物羣,因此也沒有 *Danaeopsis-Bernoullia* 系。另外一方面在中國方面的上白堊紀地層,也還沒有找出被子植物系 (Angiosperm Series)。即根據“大標本”,中國的上白堊紀迄今還沒有發現被子植物化石;雖然根據花粉化石,中國的上白堊紀也可能有被子植物系的存在。

中國中生代植物的時代,筆者曾於前著中[166,168]再三討論及之 (1931、pp. 66—73, 1933b, p. 59), 1949 年發表的鄂西香溪煤系植物一書中討論更爲詳盡。直至今日中國地質學家及古生物學家對於中國中生代各陸相建造及各植物羣的地質時代尚未完全取得一致 。 地質學家及古生物學家對於北京附近的門頭溝煤系、

晉北的大同煤系、陝北的瓦窰堡煤系及鄂西的香溪煤系的時代的屬於侏羅紀下部的意見比較相近。對於中國南部及西南部如江西、湖南邊境的安源煤系、粵北的艮口煤系直至越南的東京植物羣的地質時代的決定，意見比較紛紜，因爲這一帶的煤系地層牽涉到瑞底克期（卽上三叠紀上部）及里阿斯期（卽下侏羅紀）的劃分問題。瑞底克期*和里阿斯期的確實地劃分界線的不易決定，不特中國如此，全世界幾乎莫不如此。作者在前著中亦早有提及，譬如瑞典的若干地點的植物羣經納脫斯特（Nathorst）研究以後，地質學家一向認爲標準的瑞底克期，自從 1930 年及 1934 年特洛德孫[185,186]（Troedsson）的重新劃分地層以後，知其大部分確實屬於里阿斯期。又譬如德國的弗朗根地層及植物羣經欣克[145]（Schenk）1867 年研究以後，地質學家亦一向認爲是標準的瑞底克期。1914 年高騰（Gothan）教授[37]加以校正，始知弗朗根（Franken）植物全部或大部確屬於里阿斯期。而根據高騰（Gothan）1937—38 年發表的論文第 388 頁，弗朗根的里阿斯植物羣又有德國若干地質學家重新定爲瑞底克期，這一個意見高騰認爲是不對的。"Neuerdings behanden einige Geologen die fränkischen Lias-Pflanzen wieder als "rhätisch", aber wohl zu unrecht."

和江西萍鄉、湖南醴陵的安源植物羣大致相似的越南的東京植物羣，蔡耶[201]（Zeiller）在 1903 年定爲瑞底克期，其意見顯然是受納脫斯特（Nathorst）及欣克（Schenk）的影響。弗羅馬歇（Fromaget）則謂其煤系地層應該屬於那立克期（Noric），因爲彼在直覆於煤系之上的地層中，找到了那立克期的動物化石。柯金·勃朗（Coggin Brown）表示同樣的意見，因爲他在 1938 年在雲南發現和東京相似的植物羣與煤層，並且在此煤層之下的一個地層中，發現若干那立克期的動物化石。柯金·勃朗（Coggin Brown）認爲雲南及東京的煤系及植物羣都應該屬於那立克期的上部的。在日本方面，和越南東京及中國安源煤系大致相同的成羽植物羣（Nariwa Flora），大石（Ôishi）亦定爲瑞底克期，但小林貞一[78]（Kobayashi, 1938 第 76—82 頁）則謂成羽植物羣實位於那立克期的 *Pseudomonotis*（*Entomonotis*）*chotica* 動物化石層之下，日本的成羽植物羣也應該是屬於那立克期，甚至可能是屬於那立克期以前的，卽所謂屬於 Carno-Noric 期的。這一個意見，大石[121]（Ôishi, 1940, 第 155 頁）未曾表示同意，他認爲日本的 *Pseudomonotis* 層，是確實地位在成羽植物羣層位之下的。大石（Ôishi）又於 1938 年另作一文將日本的成羽植物羣分成爲上下兩部，完全和瑞典、德國及格陵蘭相對比，其上部屬於 *Thaumatopteris* 層帶卽下侏羅紀，其下部屬於 *Lepidopteris* 層帶卽上三叠紀的末期。

據上所述，我們知道上三叠紀至下侏羅紀之間的煤系地層及其植物羣的正確時代的決定，全世界地質學家及古生物學家意見都未取得一致。作者及高騰（Gothan）教授1931年的意見，謂中國南部的安源煤系及越南的東京植物羣也可能大部分是屬於里阿斯期的（Sze, 1931, 第 66—73 頁）；本書作者又在 1949 年發表的鄂西香溪煤系植物化石一書的結論中（1949, 第 41—71 頁），根據重要的造山運動的證據，或多或少地支持 1931 年的意見，認爲越南東京及我國西南部的植物羣與其定爲上三叠紀末，總不若定爲下侏羅紀較近事實，同時本書作者又曾再三地明白指出：東亞的中生代造煤時期，似肇始於上三叠紀的末期，經下侏羅紀而至中侏羅紀，而其主要造煤時期，則屬於下侏羅紀。根據現在一般中國地質學家的意見，似已都認爲中國北方以植物化石 *Coniopteris* 及 *Phoenicopsis*** 爲主的門頭溝煤系（相當於晉北的大同煤系及陝北的瓦窰堡煤系）其時代屬於下侏羅紀至中侏羅紀或無問題。比較成問題的是：中國長江以南湘贛邊境的安源煤系（相當於粵北的艮口煤系、雲南的一平浪煤系），但一般地質學家的意見，亦已多傾向於將此煤系定爲上三叠紀的瑞底克期至下侏羅紀。安源煤系根據植物化石實以 *Dictyophyllum* 及 *Clathropteris* 爲主，這個煤系根據植物化石或多或少地和中國北方的 *Coniopteris-Phoenicopsis* 植物羣不甚相同，暫定其時代爲瑞底克期至里阿斯期，本文作者完全表示同意。潘鍾祥同志最近的意見（1954, 第215頁）謂安源煤系在萍鄉一帶可分爲上煤系及下煤系，上煤系屬於里阿斯期，下煤系則屬於瑞底克期，作者亦多少可以表示同意。可惜的是此上下兩煤系雖有一造山運動，所謂山灣運動作爲間隔，其植物化石是大致相同的；卽根據植物化石的證據，安源煤系實無法分

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* 瑞底克期法國地質學教科書中，也叫做亞里阿斯期（Infra-Leas）。瑞底克期和里阿斯期界線的難分，我們可以從德國地質學家 von Ammon 致 Gothan 的信看出來，他這樣說："依照我個人的經驗而講，我很抱歉不能多告訴你，除出下面的事實以外，那就是說：就是按照岩石的性質，我們也常常不能知道瑞底克期和里阿斯期的界線是在何處，就是在我們所已經知道的許多標準地層剖面，也常常使我們對於這個問題無所適從。

** *Phoenicopsis* 一個屬名，已經 Florin 分成數屬，但沒有知道表皮及小氣孔構造的標本，一個籠統屬名（Sammelgattung）*Phoenicopsis* 還是可以用的（Gothan, 1954, 教科書，第 320 頁）。

成上下兩部分的。

本書所發表的延長層及其植物羣,上面已經提及僅發現於陝西北部及甘肅東部及西部,東亞其他各處迄今未曾發現,因此東亞的中生代陸相地層及其植物化石,頗難和延長層及其植物羣相對比。上面也已經提及:延長層的時代可暫定爲上三叠紀的下部至頂部;又延長植物羣根據植物化石,實以 *Danaeopsis* 及 *Bernoullia* 爲主,因此延長層的層位大致相當於歐洲的上三叠紀的中部,卽大致相當於奧國的 Lunzer Keuper, 瑞士西北部的 Basler Keuper 以及北美的 Virginia-Keuper, 而歐洲的 Lunzer Keuper 及 Basler Keuper, 其地層及其植物羣確實較古於德國弗朗根 (Franken) 及瑞典的 Palsjo, Stabbarp, Hälsingberg 等處的所謂瑞底克至里阿斯期地層及其植物羣,這是爲歐洲的所有的地質學家所公認的。據此則延長層及其植物羣較微古於中國南部的安源煤系及越南的東京煤系及其植物羣,也不是完全不可能的。或者延長層的頂部似可以和安源煤系的下部相對比。不過最成問題的是:安源煤系下部和延長層上部的植物化石却是完全不相同的,完全相對比,當有相當的困難。這一個困難(卽在上三叠紀末期中國北方和南方植物完全不同的事實)除以當時的植物地理學的關係不同來解釋外,找不出另外可以解釋的理論。總而言之,作者暫定延長層屬於 *Danaeopsis-Bernoullia* 植物羣的範圍以內,暫定安源煤系(等於艮口、一平浪及東京煤系)是屬於 *Dictyophyllum-Clathropteris* 植物羣範圍以內,並以植物羣的發生次序,暫定前者較古於後者,當可得到國內所有的地質學家及古生物學家的承認的。

北滿松花江下游的鷄西、鶴岡及阜新一帶的侏羅紀煤系的時代及其所含的植物羣,已經何錫麟同志(1953, 第144—148頁)討論,其時代似較新於門頭溝煤系,很可能是屬於中侏羅紀至上侏羅紀的。根據何錫麟所宣佈的植物化石及根據作者身邊尚未研究的化石材料(喩德淵、張文堂諸同志所採集),此一植物羣顯然以 *Ruffordia* 及 *Onychiopsis* 爲主,而屬於 *Ruffordia-Onychiopsis* 植物羣的範圍的。福建的板頭系 (Sze[171], 1945 第45—59頁) 及北京附近大灰廠及坨里一帶的地層 (P'an[126], 1933, 第533—538頁),亦屬於此植物羣的範圍以內,但其時代是的確屬於下白堊紀初期。山東萊陽層亦確屬於下白堊紀初期。

上面所宣佈的是一個根據植物進化觀點來劃分中國中生代陸相地層的表。本書作者相信,這樣的劃分或可得中國地質學家的承認的。至於每一植物羣所包含的其他個別重要植物的詳細討論以及中國中生代各陸相地層的較詳細的討論,不在本文"延長層植物羣"一個題目之內所允許的,本書作者預備將來在"中國中生代植物圖鑑"中詳細討論這些問題。

(六) 延長層植物羣是否有恭華那植物羣的親緣關係

延長植物羣是否含有恭華那植物羣及盎格蘭植物羣的分子在內,換言之卽延長植物羣是否與後二者有親緣關係,自潘同志1936年的論文發表以後,一向爲地質學家及古生物學家所注意。在本書的緒論中已經提及,蘇聯地質學耆宿奧勃魯契夫院士於1893—1894在陝北綏德縣城附近延長層中所採集的化石,經當時的奧國古植物學家克拉梭氏研究,認爲有一種化石有"下部 *Glossopteris*——面相"卽下部恭華那系面相(二叠紀),另一種化石屬於"中部恭華那系"(三叠紀)。前一種克拉梭氏定爲 Cordaitaceenblätter (?*Noeggerathiopsis hislopi* (Bunb.) Feistm。後一種則定爲 *Danaeopsis hughesi* Feistm. 這兩種都是恭華那植物羣中重要分子。自從克拉梭1900年的論文發表以後,雖有若干古植物學者加以討論(如 Gothan 1915, 第270頁; Halle 1927, 第138頁; Sze 1931, 第7頁; Sze 1933, 第77頁),但一般地質學家或多或少地還相信在陝西北部一帶的古生代末期或中生代的地層中,有恭華那植物羣的重要分子的混入。自從潘鍾祥同志1936年的論文發表以後,我們知道奧勃魯契夫院士所採集克拉梭研究的化石,實係採自中生代上三叠紀的延長層中。潘同志除描述上述的兩種以外,還描述一種 ?*Schizoneura gondwanensis* Feistm. 潘同志在其論著的結論中有一專題"延長植物羣與印度的恭華那植物羣的親緣"("Relation to the Indian Gondwana Flora" 1936, 第38—39頁)。潘同志認爲他所鑑定的 ?*Schizoneura gondwanensis* 及 ?*Noeggerathiopsis hislopi* 雖然和恭華那古大陸的化石相似,其鑑定的正確性似尙有問題,而他所鑑定的"*Danaeopsis*" *hughesi* 是沒有疑問的,他這樣說:"陝西北部的"*Danaeopsis*" *hughesi* (作者按潘同志指的是克拉梭的標本) 雖然曾經 Halle 教授指出是有屬於 *Pto-*

toblechnum wongii 的可能的;但我們在陝北一帶所採集多量的同樣的材料,却證明了克拉梭所描述的"*Danaeopsis*" *hughesi* 好像眞實地和印度的種相同種的程度較甚於 *Protoblechnum wongii*。"於是潘同志接着說道:"根據上面所述的關於陝北盆地中有恭華那植物羣種屬存在的證據,這是確實的在下部二叠紀以後的時間中,大羽羊齒植物羣的地區和印度的恭華那古大陸有暫時的銜接,讓恭華那植物羣向北遷移。自從蘇聯北部的上部二叠紀地層中發現了 *Glossopteris* 植物羣以後,一般的意見逐漸地增長,卽南北兩大陸在當時必定有過使陸地植物可以互相遷移後分佈的方法。Zalessky 博士曾經指出:在當時舊地中海(本書作者按此舊地中海是指當時的 Tethys Sea)必定已經有過地頸及地峽(isthmus)之類或者是一羣密集的半島(A dense archipelags)橫亙着;他並且說,可能有過一個盎格蘭-恭華那古大陸(Angara-Gondwana continent)的存在,但是盎格蘭及恭華那的銜接的側邊的伸展情形的論據還是不够的。Sahni 教授[139]說過:(1926, 第 240 頁)'就我們現在所已知道的地方,但很可能的,恭華那植物羣的向北遷移,還有另外的經過中國的大道。'假使我們的恭華那種的鑑定是靠得住的,那末,盎格蘭-恭華那古大陸的曾經存在於下部二叠紀後的時間中的意見,得到了另外的證據,並且恭華那植物羣的向北遷移應該是經過中國的。但是我們的 *Schizoneura gondwanensis* 及 *Noeggerathiopsis* 的鑑定還不無疑問,因此對於這一個重要意見的宣佈,還沒到成熟的地步。最近 Fritel 博士[35](1925, 第 335 頁)指出了山西一帶的二叠三叠紀地層中的恭華那植物分子重要發現的事實;但因爲缺乏化石的圖影及其詳細的描述,我們對於他的初步決定的表,不能加以任何的結論。因此我們在未得到更多的材料以前,對於這個問題現時尙不能完全加以決定"。

根據上面的敍述,我們覺得潘同志雖然在結論的最末段中特別指出:"對於這個問題,現時尙不能完全加以決定",但是他傾向於延長植物羣是有恭華那植物羣分子的混入的。在本書緒論第 2 頁中,筆者曾經指出:延長植物羣和恭華那植物羣的親緣關係,實不甚明顯。並且在第 3 頁中作者又曾經指出,潘同志的 *Schizoneura gondwanensis* Feistm. 可能是 *Neocalamites* 的一種保存狀況,又他的 ?*Noeggerathiopsis hislopi* Bunburg 卽本書中所描述的 *Glossophyllum? shensiense* 新種,這一個種根據最近的知識頗接近於歐洲'上三叠紀中部'的 *Glossophyllum florini* Kräusel(參看本書第 49 頁),這一個種是屬於銀杏植物的,和恭華那植物羣中的 *Noeggerathiopsis hislopi* 可能是毫無關係的。潘同志自己認爲沒有疑問的恭華那分子是他的"*Danaeopsis*" *hughesi* Feistm. 碎片化石,其正確的鑑定,完全不可能的。雖然作者將這些碎片加一問號於屬名及種名之前定爲印度種,卽現在所謂 ?*Protoblechnum hughesi* (Feistm.) Halle(?新種)但作者同時認爲正如本書第 41 頁中所指出的,將這些碎片,毫無保留地定爲印度的種其理由是不够堅強的。上面也已經提及(本書第 41 頁),徐仁同志亦認爲潘的鑑定是頗有問題的,卽延長的化石不可能是屬於印度的。講到這裏,應該特別指出 Halle 教授(1927, 第 138 頁)對於克拉梭的標本的意見,他這樣說:"Krasser (1900, 圖版 2, 圖 4)所描述的陝北的被定爲 *Danaeopsis hughesi* 的標本,曾經造成了中國北部有恭華那植物羣分子的許多猜想,但這塊標本的保存狀況太破碎了,是不能够作正確的鑑定的。這一塊標本眞的好像有些像印度的種的,但它和印度種及 *Protoblechnum wongii* 不同,因爲其羽片基部在中脈的上面的邊(distal side of the midrib)是作寬的擴開的形態。這一塊標本可能是這一個屬名(作者按卽 *Protoblechnum*, 根據 Halle 這一個屬名等於印度的所謂"*Danaeopsis*";根據 Halle 印度的種和中國的 *Pr. wongii* 是應該放在同一屬名卽 *Protoblechnum* 之下的)之下的另一個種(作者按 Halle 是在指陝北的標本是屬於 *Protoblechnum* 的另一個在 *Pr. wongii* 及 *Pr. hughesi* 兩種之外的新種的),也很可能是屬於另外一個屬名下的種的"。雖然潘所研究的若干塊標本較 Krasser 的標本保存較全,本書作者認爲 Halle 1927 年對於 Krasser 的標本所指出的意見,也完全可以適用於潘的標本的。

據上所述,我們知道陝北延長植物羣的和恭華那植物羣的親緣關係,至少就目前所得的證據而論,是異常微弱的。但這並不是說,中國的中生代地層在未來的不斷的調査和採集工作中,完全不可能找出恭華那分子;作者並且相信在未來的採集工作中,中國中生代地層尤其是在延長層中是可能找出恭華那分子的。

講到這裏,應該指出自 Zeiller[201], 1903 年的著作發表以後,一般地質學家似已都相信越南東京及中國雲南的瑞底克期至里阿斯期中,含有恭華那植物羣的重要分子如 *Glossopteris* 及 *Noeggerathiopsis* 等。Gothan 教授[39](1921, 第 448 頁)認爲東京和雲南的兩處植物是古生代恭華那古大陸的植物絕滅後,逃往越南

及雲南的一種孑遺植物。 Jongmans[71,72] 1937 年發表的兩篇論文，都提到了這個問題（1937a，第 336 頁；1937b 第 359 頁）。他在第一篇論文中說道：“在這裏所顯出的猜想，就是 Zeiller 所描述的越南東京的瑞底克期至里阿斯期地層中的所謂 *Glossopteris* 植物羣，可是假使人們將 Zeiller 的化石圖影看一看，並且將這些圖影和 Zalessky 所發表的盎格蘭植物羣及 White 所發表的北美 Hermit 植物羣中的圖影比較一下，人們就立刻覺得東京的標本，很好的是可以和 *Gangamopteriopsis*※ 以及相同的許多植物相比較的。很可能的 Zeiller 也是受別人的影響，因爲在當時一般學者都傾向於一種想法，卽在這一帶地區應該可以找到 *Glossopteris* 植物羣的。我們如將 Zeiller 的原來標本再研究視察一下，方才可以將這裏問題弄清楚。假使東京的標本眞的是 *Glossopteris*，那末，在這裏和我的推斷相衝突了。令人注意的是 Zeiller 僅僅發現了這些葉，而這些葉是可以和盎格蘭及 Hermit 植物羣中的若干化石相比較的，並且在東京地區，更多的恭華那分子的證據是沒有的”。Jongmans 在第二篇文章中（1937b 第 359 頁）再着重地指出：“僅有的一個證據，證明在較後的時代中，在華夏植物羣之上覆蓋着恭華那植物羣，是 Zeiller 的東京的 *Glossopteris* 化石。可是作者在另一篇（在同一卷書中）關於討論‘同時和地層’的論文中，曾經指出過的，就是東京的瑞底克期至里阿斯期的所謂 ‘*Glossopteris*’ 化石是僅僅根據若干葉部化石的。而這些葉部化石 Zeiller 定爲 *Glossopteris* 的，但這些葉部化石很可以和 White※ 及 Zalessky 所發表的 Hermit 頁岩層及盎格蘭植物羣中的化石相比較的，比方說 Zalessky 所創的屬名 *Gangamopteriopsis*”。

本文作者利用這一機會特別指出：作者完全同意 Jongmans 的說法，卽東京的 *Glossopteris* 化石是不可靠的。關於東京的 *Noeggerathiopsis* 化石也有不少學者如 Seward 和 Sahni 表示過意見，認爲係 *Pelourdea* 的一個新種。Kräusel[81] 在 1943 年發表的重要論文第 62 頁中曾經指出：“Krasser 曾將 Lunz 的標本和越南東京的三叠紀的葉部化石相比較，這些葉化石 Zeiller（應該是不對的 ‘wohl zu unrecht!’）是定爲 *Noeggerathiopsis hislopi* 的”。 Kräusel 又在第 72 頁中說道：“*Glossophyllum* 現在僅限於 Lunz，但同時代的植物可能在中生代分佈甚廣，不過將這些化石詳細地加以討論是沒有價值的，如果我們沒有知道這些葉化石的解剖方面的知識以前。……”。“Krasser 將 Lunz 的標本和東京的化石互相比較是完全對的；因爲就所有我所知道的化石，以外表的形態而論，東京的化石是的確和我們的 *Glossophyllum* 相接近的。這些標本（指東京的化石）似乎是不可以毫無保留地定爲那個學名（指 *N. hislopi*）的。印度恭華那層的化石（指眞正的 *N. hislopi*），根據葉脈及解剖方面的構造是和 *Glossophyllum* 很不相同的，可能根本不是銀杏植物（Seward & Sahni 1920 4, pl. 1）。很可能的東京的葉部和印度的化石是根本沒有關係的。但東京的化石是否是眞正的 *Glossophyllum* 呢？我們尙須等待着將來的證明。”

本書作者也完全和 Kräusel 的意見相同，卽越南東京的和陝北延長植物羣的化石都不是恭華那植物羣的重要種 *N. hislopi* 而都有屬於奥國 Lunz 一帶的‘中部上三叠紀’的 *Glossophyllum* 的可能的。講到這裏，應該特別指出：和東京完全相同的化石也發現於雲南（Sze 1949，第 52 頁）。Seward 和 Sahni 定其名爲 *Pelourdea zeilleri* 兩位學者也認爲越南和雲南的化石是和恭華那植物羣重要分子 *N. hislopi* 是沒有關係的（參考本書第 51 頁）。在越南東京，Zeiller 還描述了一塊定名爲 *Danaeopsis* cf. *hughesi* Feistm.（1903，第 57 頁圖版 IX，圖 1）的標本，本文作者相信，這一塊標本可能是 *Taeniopteris* 的碎片是和 Zeiller 在同一圖版所表示的 *T.* cf. *macclellandi* O. & M. 很相近似的。最後應該提及，在中國雲南的中生代地層中，日本學者橫山又次郎（Yokoyama）在 1906 年（1906 第 15 頁圖版 5 圖 2）也描述過一塊定名爲 *Glossopteris* 的化石，這塊化石根據斯行健（Sze 1931 第 7 頁的脚註）的意見也是一塊完全不能鑑定的不清楚的標本。

據上所述，我們應該可以明白卽在中生代地層中，越南東京及中國雲南一帶的恭華那分子是根本不可靠的。

最後應該特別再提出的是：奥勃魯契夫院士在 1893—1894 年在四川所採集的曾被克拉倰（Krasser 1900 第 146 頁圖版 3，圖 1—3a）定爲 *Schizoneura* 的一塊標本，也是不可靠的。這塊標本後來被改爲 *Schizoneura krasseri* Seward（*Grabau*[43]，中國地質史，第 1 卷，第 407 頁）。Seward 的論文我們無法找到，但這些標本是

※ 斯行健按 Jongmans 似乎並沒有仔細看 White 的論文，北美的 Hermit 頁岩並未曾含有 *Gangamopteriopsis*.

根本不能鑑定的，可能是屬於 *Neocalamites* 的。關於這一點斯行健在1931年已經指出過了（Sze, 1931, 第7頁）。還有在葛利普的中國地質史第2卷第326頁上表示着一塊發現於前遼寧省侏羅紀的被定爲 *Schizoneura hoerensis* 的化石。這塊標本，根據說明，也是橫山又次郎所鑑定的。但根據圖影，這一塊化石也是 *Neocalamites* 而是和恭華那植物羣中的屬名 *Schizoneura* 是沒有關係的。這一個種卽 *Schizoneura hoerensis* Schimper 最先是發現於瑞典的瑞底克期的 Hoer 砂岩層的。Halle 教授在1908年已經將其改屬於他的新屬名 *Neocalamites* 了。斯行健（Sze, 1931, 第5—9頁，圖版3，圖1：圖版4，圖1）在1931年所描述的江西萍鄉煤田的瑞底克期至下侏羅紀的 *Macroglossopteris leeiana* 根據 Florin 及 Harris 是屬於 Nathorst 1878年所創的 *Anthrophyopsis* 的。這兩個屬名的關係，斯行健1931年的論文，亦曾有詳細的討論，認爲其關係是不明白的。作者同時指出 Nathorst* 所研究的很多標本是非常破碎的，並且可能是代表不止一個屬名的。雖然 Nathorst 的 *Anthrophyopsis* 和我們的 *Macroglossopteris* 是否同屬的問題還不能作最後的決定的，本文作者認爲斯行健和 Gothan 教授1931年的意見（Sze 1931, 第7頁）卽我們的江西的 *Macroglossopteris* 也可以看爲恭華那植物羣的一種中生代的孑遺的猜想是應該在取消之例的。因爲 *Macroglossopteris* 是一個新屬名是不必要連想到是和 *Glossopteris* 有關係的。同樣的例子，不勝枚舉。比方說 *Macrotaeniopteris* 和 *Taeniopteris* 是毫無關係的；*Protoblechnum* 和 *Blechnum* 是毫無關係的。因此我們明白不但是陝北的延長植物羣和恭華那植物羣的親緣關係是非常薄弱的，東亞中生代地層中被疑爲恭華那分子的化石也都是不可靠的。根據這些事實，我們似乎也可以不必隨便猜想，恭華那植物羣北遷的道路是否經過中國的問題了。

（七）陝北延長層的厚度及其岩石性質

陝北延長層的厚度根據潘鍾祥1936年的估計爲1000米，已如上述。最近數年來石油管理總局諸地質同志在銅川的馬杓溝及高崖底至宜君的四郎廟一帶曾經詳細地加以調查，同時配合打鑽的結果，估計其厚度約爲1175米左右，並且詳細地加以分層，自延長層的底部至頂部共分爲170層（不包括瓦窰堡煤系）。作者特將延長層自底部至頂部的岩石性質敍述之於下，地層的柱狀剖面則附於書末。應該特別指出的是本書所描述的四郎廟炭河溝的化石是在延長層的頂部的第168層中所找到的，本書所描述的杏樹坪七母橋化石是在延長層的頂部的166層中所找到的。又本書所描述的銅川縣高崖底北河溝中的化石是在延長層的底部第18層中所發現的。

延長層是以假整合的關係直覆於石千峯系之上的，延長層自底部向上直至頂部的岩石性質根據石油總局地質同志調查的記錄如下表（數目字1, 2, 3, 4……的次序，是從底部數起的）：

1.	砂岩：上部黃綠色，下部土黃色，頂部灰綠色，全層均爲中粒，十字層含長石。	11.20米
2.	泥砂岩夾砂岩：泥砂岩，棕紅色，砂岩只一層紫紅色，細粒，薄層，雲母質。	5.65米
3.	砂質頁岩：灰綠色，醬紫色間夾。	1.10米
4.	砂岩：灰綠色灰色，細粒，雲母質，顆粒，由下而上漸細，雲母漸增，含有大卵石。	8.00米
5.	泥砂岩：淺灰色，雲母岩，薄層中夾同色較鬆的頁狀砂岩及頁狀泥砂岩。	1.10米
6.	砂質頁岩：黃綠色，灰黃綠色紫色，淺灰色中夾頁狀砂岩及透鏡狀砂岩。	6.40米
7.	上部泥砂岩：淺灰，灰色夾砂質頁岩；下部砂岩：紫灰色細粒，薄層狀頁岩。	6.05米
8.	頁岩及砂質頁岩：黃綠色，灰綠色，夾紙片狀炭質頁岩，含植物化石。	3.60米
9.	泥砂岩：淺灰紫色，灰綠色，下部夾灰綠色頁岩。	2.20米
10.	上部爲頁狀砂岩：黃綠色，雲母質，薄板狀；下部爲頁岩與砂質頁岩：灰、綠、紫。	4.50米
11.	泥砂岩：棕紅色，灰藍色灰綠色，黃綠色，雲母質，上部夾砂質頁岩。	3.65米
12.	砂質岩與泥砂岩之互層：前者爲紫紅色，黃綠色夾油頁岩。	8.50米
13.	砂岩：黃綠灰綠色，細粒及中細粒，長石質，上部夾泥岩之薄層。	6.70米
14.	砂岩：灰綠色，灰藍色，細粒，長石質，十字層狀，上層夾礫岩一二層。	13.90米

* Nathorst 所鑑定的 *Anthrophyopsis* 的標本中，一部分無疑地是屬於 *Ctenis* 的，一部分無疑地是屬於 *Sagenopteris* 的，已有不少學者如 Gothan 和 Seward 等指出過了。

15. 砂質頁岩：灰藍色，黃綠色，灰綠色中夾薄層油頁岩，頂部爲一層砂岩。 4.35 米
16. 泥砂岩：黃綠色含鈣質結核，頂部有一層油頁岩，厚約 10 公分。 3.75 米
17. 砂岩：黃綠色，細粒十字層狀，下部富含蘆木化石夾礫岩一層，厚 10 厘米。 9.55 米
18. 泥砂岩：黃綠色，紫灰色頂部爲砂質頁岩，呈灰綠色，中產植物化石。 3.35 米
19. 砂岩：黃綠色，細粒，薄層狀，雲母質。 5.65 米
20. 泥砂岩：黃綠色，上部砂質減少漸變爲砂質頁岩，頂部夾一層黃綠砂岩。 9.75 米
21. 砂岩：灰黃綠色，灰綠色，黃綠色，十字層狀。 5.30 米
22. 泥砂岩：灰綠色，雲母質，薄層狀，於上部具十字層及波紋。 2.25 米
23. 砂岩：灰色，灰黃綠色，細粒，薄層狀及頁狀，底部爲砂質頁岩，中夾泥砂岩。 11.70 米
24. 泥砂岩、夾頁質砂岩及頁岩：灰色，灰綠色，深灰色，灰黃綠色，上部夾油頁岩。 10.90 米
25. 泥砂岩：灰色，緻密石英質，十字層狀，風化後，形狀甚不規則。 1.90 米
26. 砂質頁岩及頁岩夾泥砂岩：前者呈灰綠及灰黃綠色，更夾一層灰黑色泥灰岩。 2.30 米
27. 砂岩、砂質頁岩：砂岩：爲灰綠色，細粒；砂質頁岩：呈黃綠色。 7.00 米
28. 上部砂岩：黃灰綠色，細粒，堅硬，下部砂質頁岩：黃綠色夾雜藍灰色。 2.60 米
29. 砂岩：灰綠色，深灰色，細粒，中部夾油頁岩，岩性變化大。 10.15 米
30. 砂岩：上部綠灰色，細粒，中下部藍灰色，細粒，夾黃綠色，砂質頁岩二層。 6.30 米
31. 砂岩、砂質頁岩互層：砂岩灰綠色，石英質，砂質頁岩，藍灰色，黃綠色。 2.25 米
32. 砂岩：灰綠色，中細粒，厚十字層狀，含長石、雲母，頂、底各夾一層砂質頁岩。 9.20 米
33. 泥砂岩、夾砂質頁岩：前者呈淺灰色、藍灰色，薄層狀與厚狀，後者淺灰、灰黃綠。 2.80 米
34. 頁岩夾砂岩：頁岩：黃綠色，灰黑色；砂岩：爲黃綠色，雲母質。 3.25 米
35. 砂岩：淺灰色，雲母質，石英質，凸鏡狀。 2.30 米
36. 砂岩：灰色灰綠色，長石質，十字層狀，底部夾 40 厘米的砂質頁岩與油頁岩。 1.75 米
37. 礫岩：礫岩爲灰黃綠色，頁岩，膠結物爲泥砂質者。 0.80 米
38. 頁岩：深灰綠色，下部呈頁狀，上部呈扁平的橢圓狀皆甚堅硬。 1.10 米
39. 砂岩夾泥砂岩：砂岩爲淺黃綠灰色，細粒；泥砂岩：爲綠灰色，頁狀。 5.40 米
40. 砂質頁岩：灰色及灰黑色，下部呈頁狀，岩性不規則，呈凸鏡狀。 1.25 米
41. 砂岩夾頁岩：砂岩：黃綠及淺藍綠色，雲母質，薄層狀；頁岩爲黃綠色，厚 50 厘米。 5.30 米
42. 泥砂岩與砂質頁岩的互層：泥砂岩：雲母質，堅硬；砂質頁岩：爲灰色藍灰色。 9.60 米
43. 泥砂岩：深灰綠色，薄層狀，較緻密，上部近於砂質頁岩。 3.15 米
44. 砂岩：上、下部爲綠色，粉紅色混雜，中部主要爲棕黃色，長石質，十字層，上部爲含水層。 7.65 米
45. 砂岩與泥砂岩互層：砂岩：藍灰綠色，細粒，薄層；泥砂岩：黃綠色，各有三層。 1.30 米
46. 上、中部爲砂質頁岩：藍灰色，夾同色薄砂岩；下部爲砂岩；深灰色，細粒，板狀。 3.30 米
47. 砂岩：砂質頁岩；均呈灰色至深灰色，砂岩爲厚層狀。 3.70 米
48. 砂岩：灰綠色，厚層狀，長石質，中夾砂質頁岩一薄層，長石含量下部較少。 6.25 米
49. 砂質頁岩夾砂岩：前者深灰色，板狀；後者同色，薄層石英質，頂上部夾黑頁岩。 2.70 米
50. 砂岩：灰至灰綠色，厚層狀，中夾黑頁岩，下部砂岩的岩性變化大。 2.00 米
51. 砂岩與砂質頁岩之夾層：上部灰綠色，下部灰色及藍灰色。 4.75 米
52. 砂岩：灰綠色，長石質，厚十字層狀，風化顯著之處見有長石構成的斑點。 4.10 米
53. 砂質頁岩：藍灰綠色，底部夾黑色紙狀頁岩的薄層。 1.70 米
54. 砂岩夾砂質頁岩：砂岩：灰綠色，細粒，厚層狀，砂質頁岩爲同色，薄層。 1.40 米
55. 砂質頁岩：暗綠灰色。 6.00 米
56. 砂岩：上、中部灰綠色，下部灰色，含微量長石。 5.30 米
57. 砂岩：藍灰色，細硬者與黃綠灰色長石質者的互層，上部夾薄層砂質頁岩。 3.10 米
58. 泥砂岩：黃綠色，灰綠色，含雲母，頂部有 80 厘米的黃綠灰色砂質頁岩。 3.15 米
59. 砂岩：棕黃色，長石質堅硬，厚層狀，中粒，長石多呈粉紅色。 1.75 米
60. 礫岩：灰綠色，礫石爲砂質頁岩及頁岩，呈不規則的多邊形，呈凸鏡狀。 1.20 米
61. 砂岩：棕黃色，中粒，長石質，厚層狀，表面刻有小佛像。 17.00 米

62. 泥砂岩砂質頁岩互層：泥砂岩：藍灰色，黃色，黃綠色，薄層狀；砂質頁岩：深灰色。 4.85 米
63. 泥砂岩與砂質頁岩的互層：泥砂岩：灰綠色，薄層狀，砂質頁岩：灰綠，黃綠夾油頁岩。 2.60 米
64. 砂岩：薄層，雲母質，甚緻密，風化後呈頁狀。 0.80 米
65. 泥砂岩砂質頁岩互層：泥砂岩：灰色灰綠色，較堅硬；砂質頁岩：灰綠，黃綠。 8.15 米
66. 砂岩：灰綠色，黃綠色，中細粒，石英質，厚層狀。 1.50 米
67. 泥砂岩夾砂質頁岩：泥砂岩：灰，灰綠，黃綠等色，砂質頁岩爲灰色，夾油頁岩。 7.55 米
68. 砂岩夾泥砂岩：全層均呈棕黃色，砂岩爲厚層狀長石質，頂部有油頁岩。 18.00 米
69. 砂岩：黃綠色，厚層狀長石質，風化後有黃色斑點出現。 3.40 米
70. 砂岩夾砂質頁岩：砂岩：灰色，灰綠色細粒，頂上部一層產化石，砂頁岩有二層。 6.60 米
71. 細砂岩砂質頁岩的夾層，全層呈黃綠灰色。 6.50 米
72. 砂岩：灰綠色，長石質，塊狀。 10.70 米
73. 頁岩與砂岩互層：前者綠灰色，後者淺綠色，雲母質，有波痕。 12.90 米
74. 砂岩：黃綠色，塊狀，厚十字層。 15.00 米
75. 上部砂岩及泥砂岩：前者淺綠色，中粒，後者呈藍灰或綠色；下部砂岩：同色。 5.40 米
76. 角頁岩與砂岩之互層：角頁岩：藍灰色，淡灰色，砂岩呈灰黑或藍灰色，極細粒堅硬，底部有灰綠色砂質頁岩厚 12 米。 6.45 米
77. 砂岩：綠色白灰色，黃綠色，中粒或細粒，塊狀含雲母，但頂部極少，上部夾灰色頁岩及砂質頁岩，產化石，中夾煤綫一層，中產植物化石。 21.20 米
78. 砂岩與砂質頁岩泥砂岩互層：均爲綠色，泥砂岩極堅硬，有結核，無鈣質。 3.00 米
79. 砂岩夾砂質頁岩：砂岩：淺綠色，黃綠色，中粒及細粒，含鈣質，雲母，有波痕薄層狀或塊狀者，砂質頁岩爲黃綠色或者灰綠色夾薄層砂岩。 13.00 米
80. 砂岩泥砂岩的互層：均爲綠黃色，砂岩爲細粒，厚層狀，泥砂岩中含植物化石。 3.70 米
81. 砂岩：淺綠色，下部爲黃綠色，細粒，薄層，上部夾同色泥砂岩，下部夾一層黃頁岩。 9.93 米
82. 砂岩與頁岩的互層：砂岩爲淺綠色或黃綠色，中粒，厚層狀，鈣質頁岩呈灰色。 4.00 米
83. 砂岩：淺綠色或黃綠色，中粒，層狀或頁狀，含雲母鈣質。 7.25 米
84. 砂岩與泥砂岩的互層：砂岩：綠色，中粒，雲母質，泥砂岩：灰綠色，夾二層砂質頁岩。 7.30 米
85. 頁岩夾泥砂岩及砂岩：頁岩爲暗綠色，鈣質，下部具介壳狀斷口，後二者呈綠色。 9.65 米
86. 頁岩夾砂岩：頁岩呈淺綠色，有時爲砂質頁岩，砂岩共三層，頂部一層呈黃綠色，鈣質堅硬，底部一層爲淺綠色，暗綠色，厚層狀。 17.73 米
87. 上部爲塊狀頁岩及泥砂岩，灰至藍灰色，有扁豆狀結核，底部爲藍灰，黑色頁岩，富含化石，下部爲砂岩夾砂質頁岩，砂岩爲鈣質，厚 1.2 米。 3.80 米
88. 砂岩淺綠色，細粒，薄層狀者及頁狀者，下部富雲母堅硬夾極薄頁岩。 8.40 米
89. 砂岩與頁岩的互層：前者呈綠黃色，淺綠色，薄層狀或頁狀，後者同色或灰色。 6.13 米
90. 泥砂岩砂質頁岩及頁岩的互層：泥砂岩：淺綠色，後者呈灰綠色。 6.40 米
91. 砂岩：細粒，塊狀，雲母質，鈣質，上部較疎鬆，下部較堅硬。 2.70 米
92. 頁岩與砂質頁岩夾泥砂岩：均呈淺綠色或暗綠色，砂岩爲細粒薄層，間或含鈣質，共四層，厚 1—1.5 米，中夾泥砂岩。 14.00 米
93. 砂質頁岩及頁岩：淺綠色。 3.80 米
94. 砂岩：厚層狀，雲母質，中部層面發育極佳，底部較細具波痕。 5.80 米
95. 頁岩：綠黃色，淺綠色，鈣質，夾一層堅硬細砂岩，厚 20 厘米。 5.40 米
96. 砂岩與泥砂岩：淺綠色，前者爲薄層，雲母質，底部有淺棕黃色砂岩。 2.90 米
97. 頁岩：暗灰色，鈣質，新鮮面具介壳狀斷口，風化後成紙片狀。 2.80 米
98. 砂岩夾頁岩：均爲淺綠色，砂岩爲細粒，下部一層爲厚層狀共二層，頁岩亦二層。 12.35 米
99. 砂岩：棕色，金黃色，細粒，雲母質至上部，漸變爲頁狀砂岩，具波痕。 7.00 米
100. 頁岩夾砂岩：頁岩，淺綠色，砂岩，暗綠色中粒及細粒，具波痕。 11.05 米
101. 砂岩，白灰色，灰色或白灰色，細粒。 2.70 米
102. 耐火土，白色，細膩，略含砂質。 0.60 米

103. 砂岩：黃灰，金黃等色，中或細粒，不含鈣質，上部富雲母。 15.30 米
104. 油頁岩：黑色，夾紫黑色，薄砂岩數層，呈扁豆狀（黑頁岩層）。 23.70 米
105. 頁岩夾砂岩：頁岩爲灰黑色，黑色砂岩爲灰白色，細粒。 15.00 米
106. 砂岩與頁岩的互層：砂岩爲白灰色，細粒，雲母質，頁岩爲黑色，紙片狀。 3.90 米
107. 砂岩夾頁岩：砂岩灰色，棕黃色，細粒，頁岩，黑色，灰黑色。 8.50 米
108. 砂岩：灰色，細粒。 2.50 米
109. 砂岩夾頁岩：砂岩：爲灰白色灰黃色，細粒，頁岩：灰黑色。 16.50 米
110. 本層主要爲砂岩：色暗綠，淡褐，灰綠，細粒，頂部爲黑頁岩及砂質頁岩，產化石。 2.60 米
111. 砂岩與頁岩及砂質頁岩的互層：前者爲灰色，綠黃，細粒，後者爲黑色灰色（油砂）。 4.50米
112. 上部砂岩：淺綠色，暗綠色，灰色，下部爲同色，頁岩與砂質頁岩之薄層。 6.40 米
113. 砂岩：淺棕黃色，綠黃色，淺綠色，細粒，塊狀，無鈣質反應。 1.70 米
114. 砂岩與頁岩的互層：砂岩爲綠黃色，淺綠色，頁岩爲黑色，暗綠色，棕黃色。 7.00 米
115. 砂質頁岩與砂岩的互層：砂岩：白灰色，細粒薄層，砂質頁岩，黑灰色。 19.10 米
116. 砂岩夾砂質頁岩：砂岩爲淺棕黃色至黃色，中粒塊狀，富鈣質含雲母，頂部多黑色雜質及大片雲母，砂質頁岩呈白灰色。 4.00 米
117. 砂岩：白灰色，鈣質疏鬆。 3.00 米
118. 砂岩與砂質頁岩及頁岩的互層：砂岩爲綠黃，金黃，中粒，頁狀，後者灰色。 10.00 米
119. 頁岩及砂質頁岩與砂岩的互層：前者爲灰色，砂岩呈白灰色，細粒雲母質。 10.00 米
120. 砂岩：黃色，暗綠色，中或細粒，塊狀，鈣質，夾薄黑頁岩。 6.50 米
121. 頁岩：灰黑色，淺棕黃色，黃色，黑色，下部夾淺綠色，薄層鈣質雲母砂岩。 3.00 米
122. 頁岩：黃色，灰色，暗綠色等，中部及頂部各夾薄層雲母砂岩，呈綠黃色，淡褐色。 8.00 米
123. 砂岩：淺棕黃色，鈣質，砂粒含長石，鈣質顆粒及棕色碎片多，常夾砂質頁岩。 2.00 米
124. 頁岩：淺綠色，灰色，棕色，金黃色等，有時爲紙片狀，上部含扁豆狀砂岩。 4.50 米
125. 砂岩夾砂質頁岩與頁岩：砂岩：淺棕黃色，細粒，雲母質，後者呈淺棕黃等。 5.00 米
126. 砂質頁岩與頁岩夾砂岩及泥砂岩：前二者呈金黃，灰，茶黃色，後二者灰色。 11.00 米
127. 砂岩：黃綠色，中粒，雲母質，疎鬆，含鈣質及鐵質結核。 2.00 米
128. 砂岩與頁岩之互層：砂岩：灰色含雲母，後者黑色。 3.60 米
129. 砂岩：白灰至淺綠色，中或細粒，雲母質，塊狀，中夾金黃色頁岩，底部夾泥砂岩。 7.00 米
130. 頁岩：淺綠色。 3.90 米
131. 砂岩：杏黃色，中粒，塊狀，雲母質，含斜長石及大片白雲母，風化後呈黃砂。 7.90 米
132. 頁岩：綠黃色，黃棕色，金黃色，淺藍灰色紙片狀。 8.50 米
133. 砂岩：白灰色，淺綠色，雲母質，塊狀。 4.50 米
134. 砂質頁岩、頁岩：綠黃色，白灰色，灰色，頁岩呈紙片狀。 3.40 米
135. 砂岩：黃綠色，塊狀，含鈣質，雲母及鐵質圈，中夾一層砂質頁岩。 5.00 米
136. 砂岩：淺綠色，中粒雲母質，鈣質，中夾灰色頁岩的碎片。 9.70 米
137. 頁岩及砂質頁岩：綠黃色，雲母質，夾一層頁狀砂岩。 4.30 米
138. 泥灰岩與頁岩的夾層：灰色，底部夾一層砂岩，極堅硬。 3.20 米
139. 頁岩：灰色，棕色，黃色，棕黃色等，間有紙片狀者，上部有一層含鐵結核。 22.00 米
140. 砂岩：淺綠色，板狀，細粒，雲母質。 6.50 米
141. 砂質頁岩及頁岩夾砂岩：砂質頁岩及頁岩，爲暗綠色，淺綠色，灰色，棕灰色，砂岩爲灰色，薄層，下部夾一層鈣質頁岩。 17.50 米
142. 上部砂岩：暗綠色，細或中粒，下部爲泥砂岩與砂質頁岩的互層。 3.50 米
143. 頁岩：綠黃色。 5.00 米
144. 砂質頁岩及頁岩：綠黃色，淺綠色，上部夾頁狀砂岩，下部夾扁豆狀砂岩。 15.00 米
145. 砂岩：暗綠色，淺綠色，雲母質，頁狀者及鈣質者，上部夾灰色鈣質頁岩。 2.00 米
146. 頁狀砂岩與砂質頁岩及頁岩的互層：砂岩爲綠黃色，後二者呈綠黃色灰色。 13.30 米
147. 砂質頁岩及頁狀砂岩：淺綠色，間夾紙狀頁岩及泥灰岩，岩性變化大。 10.55 米

148.	砂岩：淺綠色，細粒，雲母質，層面極佳，下部多孔，含鈣質。	1.65 米
149.	泥砂岩：黃綠色，層面極佳。	3.30 米
150.	砂質頁岩與頁狀砂岩，泥砂岩及泥灰岩的互層：均呈黃綠色。	5.90 米
151.	砂岩：黃綠色，淺綠色，雲母質，層狀者及紙片狀者。	6.00 米
152.	砂岩夾砂質頁岩：砂岩：淺綠色，雲母質，頁狀及波紋狀者，後者同色。	17.50 米
153.	本層的岩性自上而下爲砂岩：綠黃色，細粒，富雲母，砂質頁岩：同色，含鈣質及雲母，頁狀砂岩與雲母細砂岩；砂岩：淺綠色，雲母質，細粒，層狀。	10.80 米
154.	頁岩及頁狀砂岩，砂質頁岩：淺綠色，砂岩有波痕，岩性有變化，砂頁岩可互變。	15.00 米
155.	上部砂質頁岩薄砂岩：鈣質塊狀頁岩的互層，淺綠色。下部砂岩：淺綠色，細粒，薄層狀，含泥質，堅硬。	5.50 米
156.	砂質頁岩與頁狀砂岩的互層：砂質頁岩：暗綠色，淺綠色，有時爲頁岩呈灰白色，砂岩色變同，間夾薄層塊狀鈣質頁岩。	34.30 米
157.	砂岩：淺綠色，中粒及細粒，雲母質，夾泥砂岩一層。	10.20 米
158.	砂岩與砂質頁岩的互層：均呈淺綠色，含鈣質，砂岩爲中粒，具波痕，雲母質。	5.00 米
159.	砂質頁岩及頁岩與砂岩的互層：前二者爲黃綠色，雲母質，砂岩爲凸鏡狀。	12.00 米
160.	砂岩：上部：灰，灰綠及草綠，細粒或中粒，厚層狀鈣質，夾砂質頁岩。中部：呈黃綠色，細粒少具波痕，雲母質，下部夾砂質頁岩，呈灰綠色。	19.60 米
161.	頁岩：淺藍灰色，泛黃色，紙狀。	2.50 米
162.	砂岩：上、中部淺綠，黃灰，細粒，薄層，下部爲灰白色，細粒，厚層狀，底部富雲母。	8.80 米
163.	頁岩：淺藍灰色，泛黃色，塊狀與紙狀者之互層。	3.40 米
164.	砂岩：淺灰綠色，細粒，塊狀，底部有十字層，含黑、白雲母，夾鈣質頁岩。	4.20 米
165.	砂岩夾頁岩：砂岩：淺灰綠色及藍灰色，中粒及細粒，雲母質，層狀，頁岩：有時爲砂質頁岩，呈灰至黑色，紙片狀，富化石碎片。	11.50 米
166.	頁岩與砂岩的互層：頁岩：淺灰綠色，灰綠色，灰色，黑色，中部一層植物化石，砂岩：淺灰綠色，淺黃灰色，中粒或細粒，塊狀富含雲母。	8.50 米
167.	砂岩：淺灰綠色，中粒，雲母質，上部具波紋，中夾二薄層砂質頁岩。	9.50 米
168.	砂岩與頁岩的互層：砂岩：絹雲母質，細粒；頁岩：棕色或灰色，中含植物化石。	4.50 米
169.	砂岩：灰綠色，細粒，層狀，具波痕，有時夾頁岩之薄層。	8.00 米
170.	砂岩：淺綠色，中粒或細粒，厚十字層狀，富鈣質，含炭質碎片及灰頁岩碎片。	8.80 米

以假整合的關係，直覆於延長層之上的地質建造爲瓦窰堡煤系及其上的衣食村煤系，其時代屬於下侏羅紀至中侏羅紀（Liassic-Dogger）含 *Coniopteris-Phoenicopsis* 植物羣，作者當另作一文敍述之。在本書結論的第二個專題中，作者曾經分別敍述延長植物羣在每一個地點的組成狀況及每一種化石的地層上的直的分佈。迄至今日爲止，我們所已經知道的延長植物羣的發現地點，至少已有 36 個之多，分佈於各縣（一部分地點是位在晉陝邊境的）。迄至今日爲止，我們所已經知道的地層剖面，以銅川縣的馬杓溝及高崖底至宜君縣的四郎廟一帶爲最完全，這不能不歸功於石油總局的領導人張俊同志及諸地質同志，尤其是張更、陳賁、湯任先及其他各位同志數年來的努力。可惜的是，筆者在這一個詳細地層剖面所採集的化石材料，所得研究的是僅僅限於延長層頂部的兩個層位（如 168 層及 166 層），其他各層位的化石並未曾見到。而根據這一個詳細剖面，我們知道第 8 層、第 17 層及第 18 層（作者僅有機會研究一種卽 *Equisetites?* sp.（cf. *E. rogersi* Schimp. 係李春昱同志所採集），第 77 層及第 80 層，俱含有植物化石，而第 70 層及第 87 層、第 110 層亦俱含有化石（未曾註明是植物化石）。可能在其他的各層位中，尚可找到含有植物化石的地層。作者深信將來如能根據這一個詳細地層剖面，搜求延長層自底部直至頂部各層位的化石必可得延長植物羣各分子的直的分佈的整個面貌。在本書第 79 頁中已經提及，延長層下部及底部出露的地點如綏德縣的高家庵及橋上，清澗縣的老鴉關，延川縣的延水關，葭縣的大會坪及峪口以及山西臨縣的馬家灣及第八堡，興縣的李家門，石樓縣的轉角鎮，中陽縣的仙芝河口以及永和縣的烏門第處，尚含有豐富的，並且保存完善的 *Danaeopsis*, *Neocalamites*, *Equisetites*, 以及 *Ginkgoites magnifolia*, *Cladophlebis shensiensis*, ? *Protoblechnum hughesi*, ? *Sphenobaiera furcata* 等

化石,這些地點更應繼續地詳細加以搜求。作者深信將來在這些地點詳細地搜求化石的結果,必有異常驚人的發現。又延長層中部地層出露的地點如清澗縣附近,延長縣的懷林坪及石家溝以及綏德縣的沙灘坪以及其他層位不明的地點尤其是延長縣的周家灣以及黃龍縣(詳細地點不明)等處,將來亦應特別加以注意,詳細地搜求化石。我們知道延長縣周家灣的 *Taeniocladopsis rhizomoides* 及 *Sphenopteris? Chowkiawanensis* 及黃龍縣的 *Sphenobaiera crassinervis* 及昆虫的翼部化石(本書圖版 LV, 圖6, 6a)都是異常特別的化石。

本書所研究的材料,應該是可以稱爲十分豐富的,但作者深信,這一部分材料僅僅不過是延長層植物羣眞正存在的化石的一小部分而已!根據當前的研究結果,我們已經得到我們的上三叠紀植物羣的許多意想不到的豐富的知識,這一點我們應該再一次地感謝石油管理總局負責人及諸地質同志以及 1951 年之冬陪伴作者一同旅行的關佐蜀及湯任先兩同志。根據當前的豐富材料,我們知道延長植物羣將來尙可發現更多的植物學上、地質學上以及古地理學上具有重要意義及價值的標本的希望。本書作者深切地企待着這些重要發現的來到,爲延長層植物羣作第二册及第三册中國古生物誌。詳細地研究植物化石應該對於開發這一個在中國北部及西北部的分佈很廣的中生代的含油沉積層是具有相當的重要意義的:而開發這一個含油沉積層的工作現在已經由石油管理總局及中央地質部繼續進行中。本書作者深切地感到榮幸能够得到允許參加一部分的工作。

表 1　銅川十里鋪至宜君四郎廟柱狀剖面圖

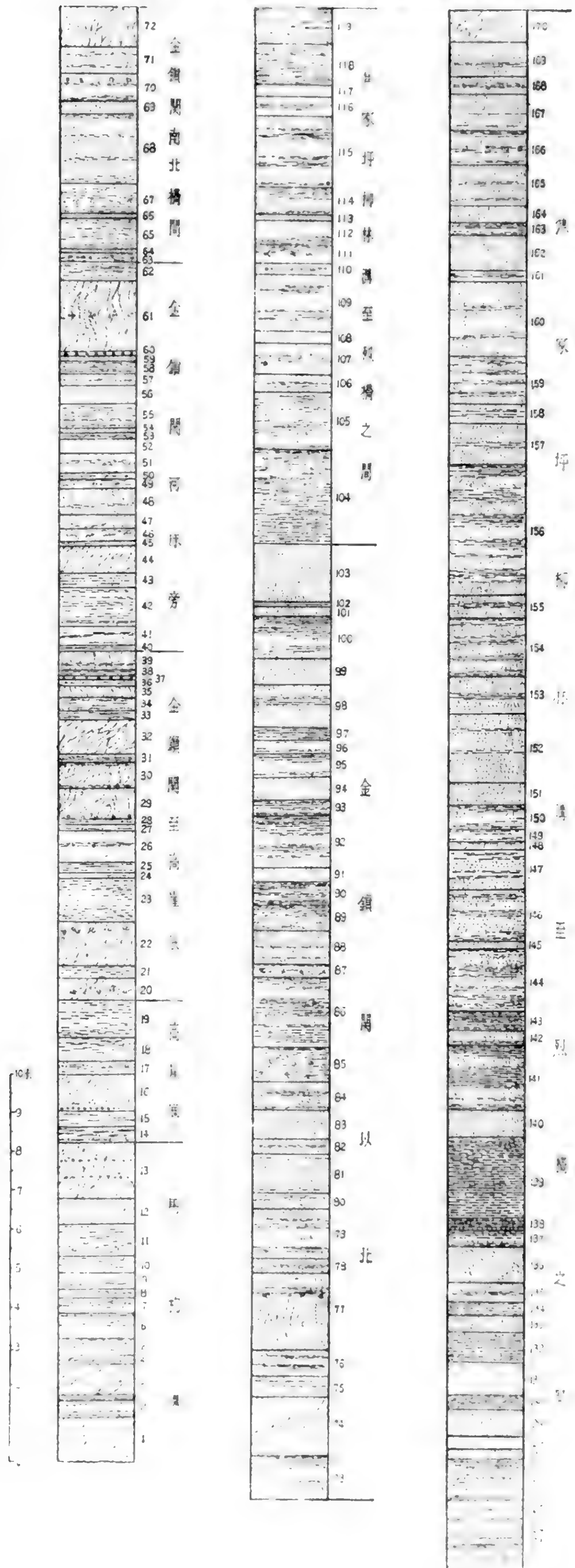

表2　延長植物羣種屬産地分佈表

層位 / 地点 / 種	延長層上部												延長層中部					延長層下部														延長層層位不明							
	陝西 宜君四郎廟炭河溝	陝西 宜君杏樹坪七母橋	陝西 宜君焦家坪	陝西 延長七里村	陝西 延長城南	陝西 延長城西棗口村	陝西 延長烟霧溝	陝西 延長禹家村溝	陝西 綏德棗家坪	陝西 綏德城東北12-15里	甘肅 華亭劍沟河	甘肅 武威南營兒	陝西 清澗縣城附近	陝西 清澗王家塬	陝西 延長倹林坪	陝西 延長石家河	陝西 綏德沙灘坪	陝西 葭縣大會坪	陝西 葭縣峪口	陝西 清澗老鴉関	陝西 綏德橋上	陝西 綏德高家庵	陝西 延川延水関	陝西 銅川高崖底北河沟	山西 臨縣馬家湾	山西 臨縣第八堡	山西 永和烏門	山西 興縣孪家凹	山西 石樓轉角鎮	山西 中陽仙之河口	甘肅 華亭硯河口	陝西 黄龍縣(詳細地点不明)	陝西 耀縣肅馬河	陝西 耀縣房兒上	陝西 延安縣(詳細地点不明)	陝西 綏德北馬坊	陝西 淳化坪底劇坪裏	陝西 綏德義合鎮	陝西 延長周家湾
1. *Thallites* sp	+																																						
2. *Equesitites sarrani* Zeiller				+																																		+	
3. *E. sthenodon* sp. nov.																																		+					
4. *E. brevidentatus* sp. nov.																										+													
5. *E. acanthodon* sp. nov.	+																																						
6. *E. deltodon* sp. nov.			+																																				
7. *E.* sp. (Strobili of *Equisetites*)				+																								+											
8. *E.* sp. (cf. *E. rogersi* Schimper)																								+															
9. *Neocalamites carrerei* (Zeiller) Halle	+																																						
10. *N. carcinoides* Harris	+			+																																			
11. *N. brevifolius* sp. nov.				+																																			
12. *N. rugosus* sp. nov.	+							+																															
13. *N.* sp.						+																																	
14. *N.*? sp.	+																																						
15. *N.* spp (文内未描述)			+								+								+	+					+			+	+	+	+								
16. *Cladophlebis* (*Asterotheca*?) *szeiana* PAN	+			+					+		+				+																+								
17. *C. shensiensis* PAN	+	+		+			+		+		+					+	+				+	+																	
18. *C. grabauiana* PAN									+																														
19. *C.* cf. *gigantea* Ôishi	+			+																																			
20. *C. raciborskii* Zeiller	+																																						
21. *C. kaoiana* sp. nov	+																																						
22. *C. graciles* sp. nov.		+																																					
23. *C. ichünensis* sp. nov.		+																																					
24. *C. stenophylla* sp. nov.		+																																					
25. *C. paralobifolia* sp. nov.																																			+				
26. *C. suniana* sp. nov		+																																					
27. *C.* sp. a	+																																						
28. *C.* sp. b	+																																						
29. *Phlebopteris*? *linearifolia* sp. nov	+																																						
30. *Sphenopteris chowkiawenensis* sp. nov.																																							+
31. *Sph.* sp. (cf. *Sph. arizonica* Dautherty)				+																																			
32. *Danaeopsis fecunda* Halle	+								+			+						+				+	+		+	+	+	+			+		+	+		+	+		
33. *D.*? sp.	+																																						
34. *Bernoullia zeilleri* PAN	+	+									+		+																		+								
35. *Thinnfeldia major* Raciborski		+																																	+				
36. *Th. rhomboidalis* Ettingshausen		+							+																														
37. ? *Th. nordenskiöldi* Nathorst		+							+																														
38. *Th. rigida* sp. nov.		+																																					
39. *Th. alethopteroides* sp. nov.		+																																					
40. *Th. laxusa* sp. nov.		+																																					
41. *Ctenopteris sarrani* Zeiller	+																																						
42. ? *Protoblechnum hughesi* (Feistm.) Halle (? sp. nov.)	+								+	+												+																	
43. *Sphenozamites changi* sp. nov		+																																					
44. *Drepanozamites*? *pani* sp. nov.	+																																						
45. *Sinozamites leeiana* gen. et sp. nov		+																																					
46. *Ginkgoites magnifolia* (Fontaine)																						+																	
47. *G. chowi* sp. nov.		+																																					
48. *G.* sp.		+																																					
49. *Glossophyllum*? *shensiensis* sp. nov.	+	+				+				+								+														+							
50. *Sphenobaiera crassinervis* sp. nov.																																	+						
51. ? *Sph. furcata* (Heer) Florin																												+											
52. *Psygmophyllum*? sp.		+																																					
53. *Podozamites lanceolatus* (L. & H.) Braun									+																														
54. *Sagenopteris spatulata* sp. nov.	+																																						
55. *S.* sp.		+																																					
56. *Swedenborgia cryptomerioides* Nathorst	+	+																																					
57. *Stenorachis*? (*Ixostrobus*?) *konianus* Ôishi et Huzioka	+																																						
58. *Carpolithus* spp.	+																																						
59. *Desmiophyllum* sp.														+																									
60. *Taeniocladopsis rhizomoides* gen. et. sp. nov.																																							+
61. *Radicites* sp.	+																																						
62. *Conites* sp.	+																+					+																	
63. *Problematicum* a				+																																			
64. *Problematicum* b			+																																				
65. *Problematicum* c (*Muscites*? sp)					+																																		
66. Undetermined Sterile pinnae																		+																					

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五. 種屬索引

五. 圖版及其說明

假使在圖版上沒有特別符號標出,所有的圖影都是從標本的原大攝取的。僅極少數的圖影,作者曾在底片上略有潤飾,極大多數的圖影都未加任何的潤飾。所有的標本都保存在中國科學院古生物研究所,攝影者係劉雪筠同志。

圖 版 I

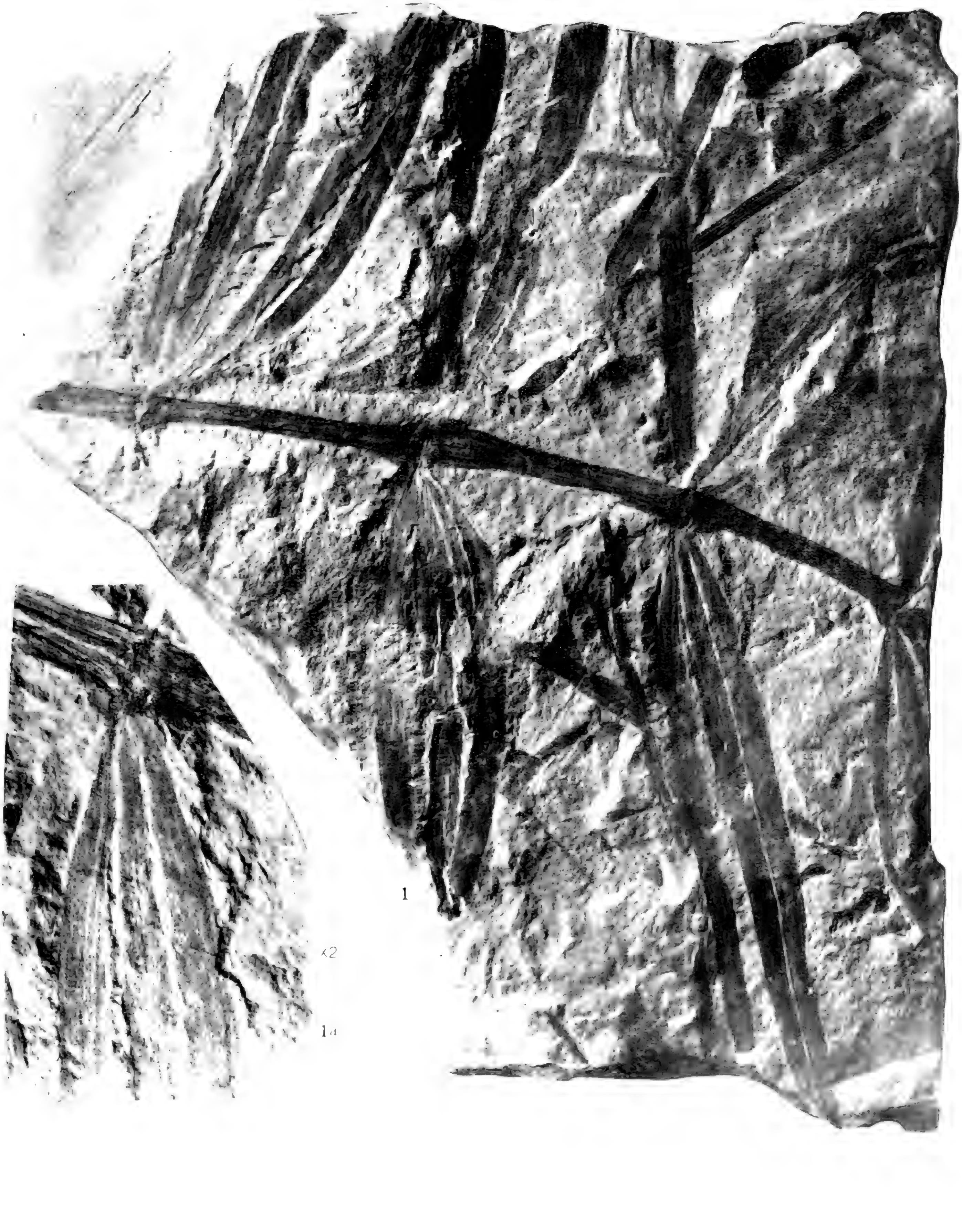
圖 1, 1a *Neocalamites carcinoides* Harris

圖 1a 放大× 2

地點: 陝西延長縣七里村

地層: 延長層上部

登記號碼: *PB. 2257.*



1

×2

1a

圖 版 II

圖 1, 1a *Neocalamites carcinoides* Harris

圖 1a 放大×2

地點：陝西延長縣七里村

地層：延長層上部

登記號碼：*PB. 2258*

圖 2 *Neocalamites* 的樹幹化石可能是屬於 *N. carcinoides* 的。

常和這一種保存在一起

地點：陝西延長縣七里村

地層：延長層上部

登記號碼：*PB. 2276*

圖 3 *Neocalamites* sp. 注意 5 個較大的圓形枝痕保存於樹幹上，此樹幹也可能是屬於 *N. carcinoides* 的。

地點：陝西延長縣城西渠口村河北岸

地層：延長層上部

登記號碼：*PB. 2273*

圖 4 ?*Equisetites sthenodon* Sze 新種

注意關節上的一行枝痕

地點：山西臨縣第八堡

地層：延長層底部

登記號碼：*PB. 2254*

圖 5 *Equisetites sarrani* Zeiller

地點：陝西延長縣七里村河南岸

地層：延長層上部

登記號碼：*PB. 2237*

2

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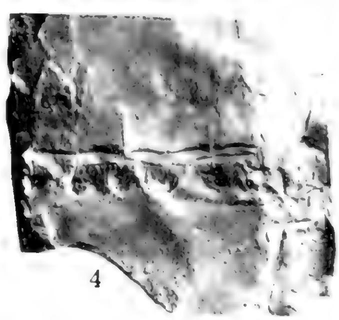

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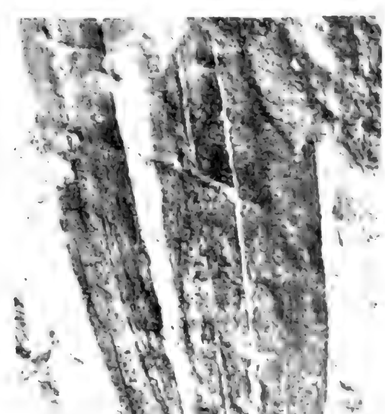

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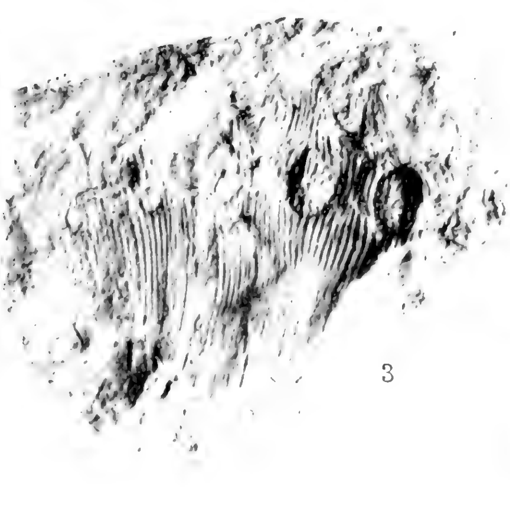

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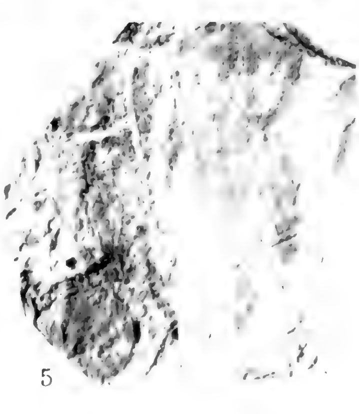


5

圖 版 III

圖 1—3 *Neocalamites carcinoides* Harris 的葉部化石。

圖 1　地點：陝西延長縣七里村

地層：延長層上部

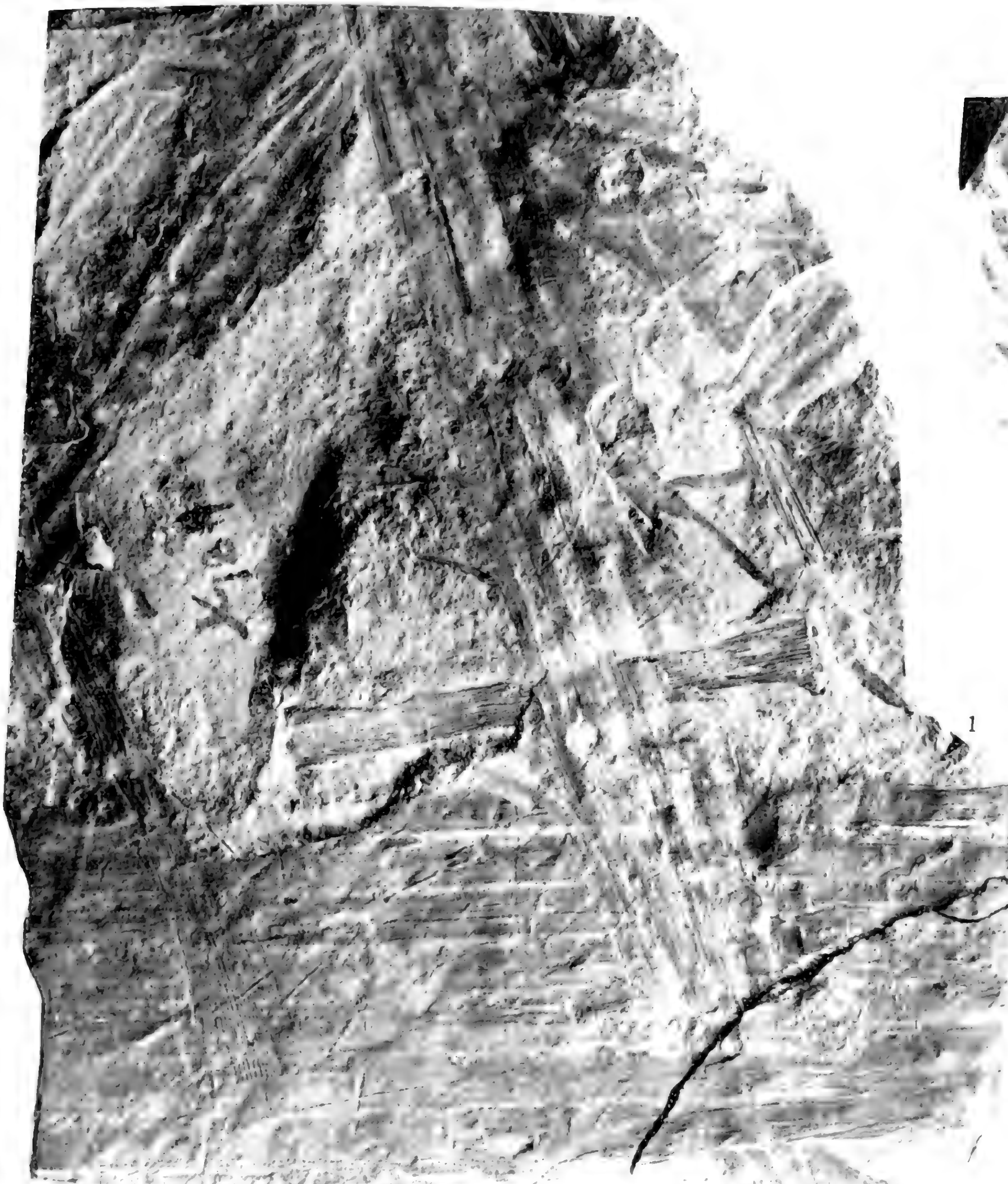
登記號碼：*PB. 2259*

圖 2,3 地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2260—PB. 2261.*

3



1

2

圖 版 IV

圖 1. *Neocalamites carcinoides* Harris 的樹幹化石。

注意在關節上每兩個葉痕相離較遠,每隔 5—6 條直肋有 1 個葉痕。

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2262*.

圖 2, 2a *Neocalamites carrerei* (Zeiller) Halle 樹幹化石。

注意關節上的葉痕彼此距離較近,每隔 2—3 條直肋有 1 個葉痕。

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2255*.

圖 3, 3a *Equisetites deltodon* Sze 新種,葉鞘化石。

地點: 陝西宜君縣焦家坪

地層: 延長層上部

登記號碼: *PB. 2247*.

圖 4, 5, 5a *Equisetites sarrani* Zeiller

圖 4 樹幹化石, 圖 5, 5a 關節盤化石, 5a 放大 × 3。

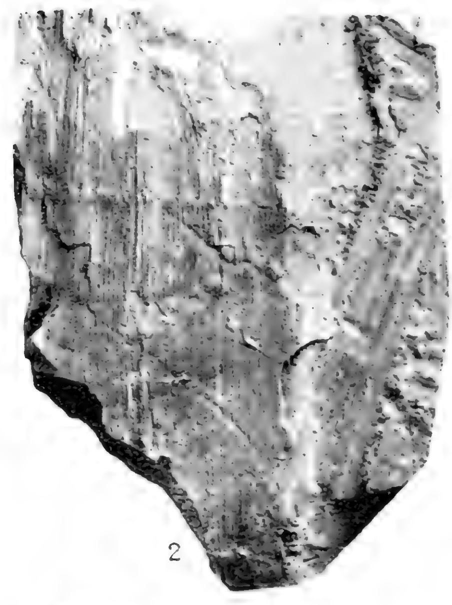
地點: 陝西延長縣七里村

地層: 延長層上部

登記號碼: *PB. 2238—PB. 2239*.

1

2a ×2



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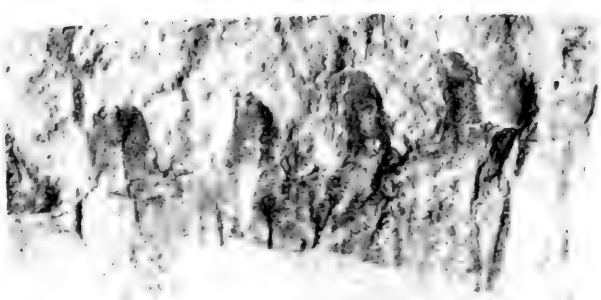
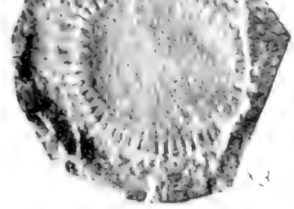
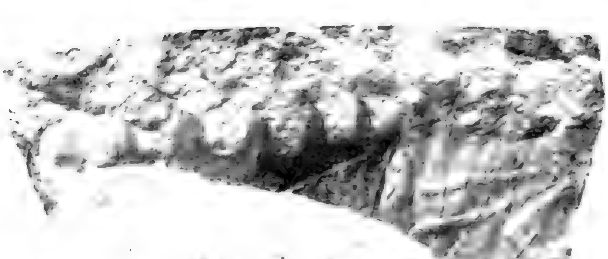


3a ×2

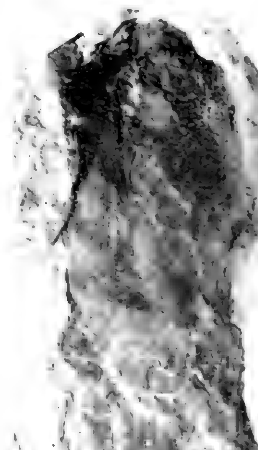


5a ×3



3

5



4

圖版 V

圖 1, 1a *Equisetites brevidentatus* Sze 新種 1a 放大× 2。

地點：山西臨縣第八堡

地層：延長層下部

登記號碼：*PB. 2243.*

圖 2, 2a *Equisetites acanthodon* Sze 新種。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2246.*

圖 3 *Neocalamites brevifolius* Sze 新種。

地點：陝西延長縣七里村煉廠

地層：延長層上部

登記號碼：*PB. 2266.*

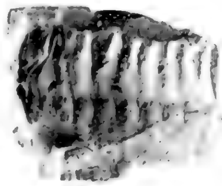
圖 4 *Equisetites* sp. (Strobili of *Equisetites*), 子囊穗化石。

地點：陝西延長縣七里村

地層：延長層上部

登記號碼：*PB.* 2250.

3



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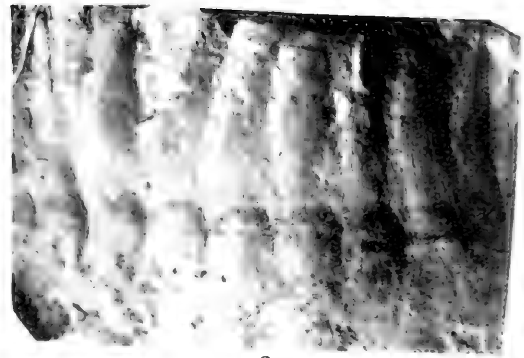
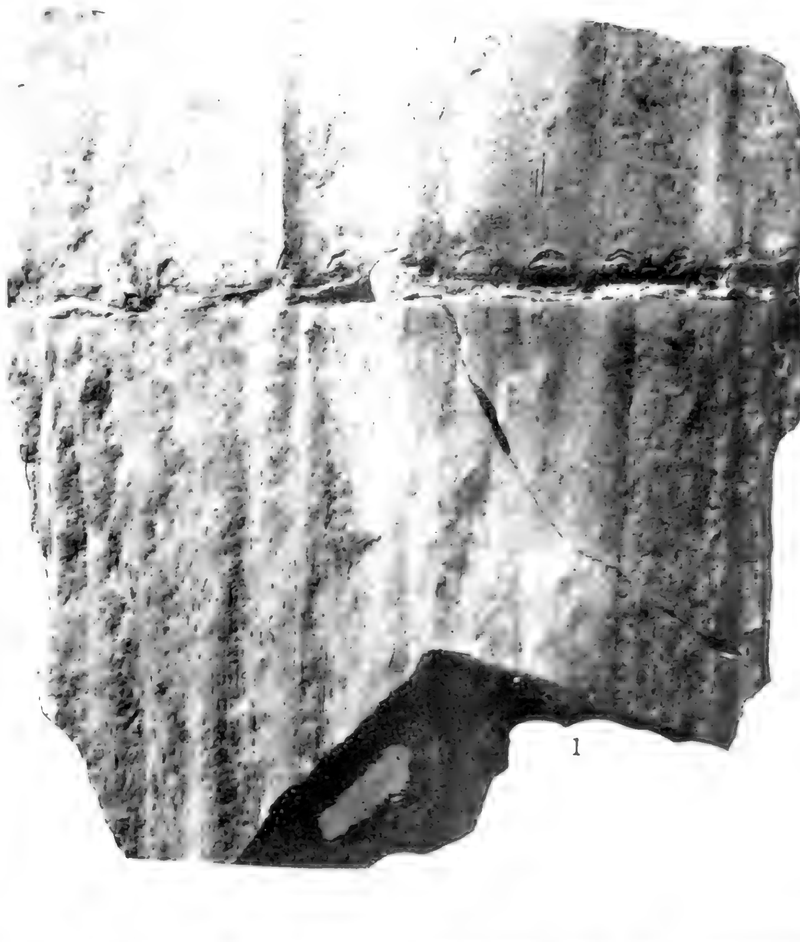


2a ×3



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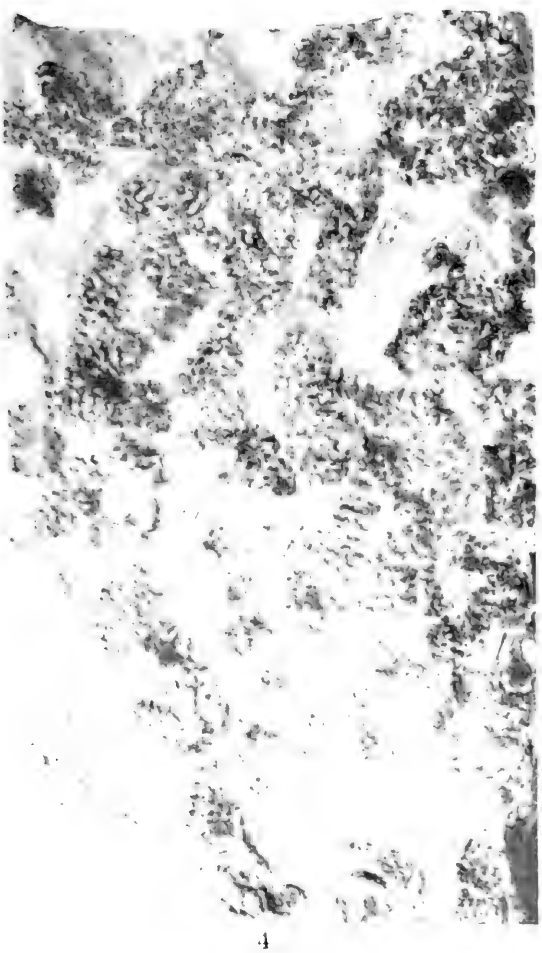

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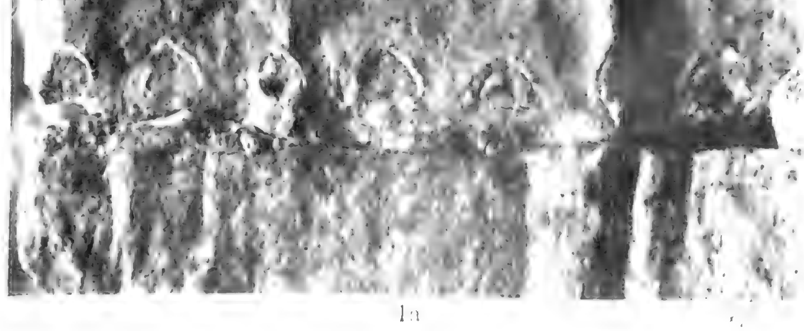


1a

圖 版 VI

圖 1, 1a, 2 *Equisetites sthenodon* Sze 新種,葉鞘化石, 1a 放大× 2。

地點: 陝西耀縣房兒上

地層: 延長層層位不明

登記號碼: *PB. 2244—PB. 2245*.

圖 3—5, 5a *Equisetites sarrani* Zeiller 關節盤化石, 5a 放大× 3。

地點: 陝西延長縣七里村

地層: 延長層上部

登記號碼: *PB. 2240—PB. 2242*.

圖 6 *Neocalamites carrerei* Zeiller

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2256*.

圖 7 *Neocalamites carcinoides* Harris

注意關節上的 4 個圓形枝痕以及每隔 5—7 條直肋的細的葉痕。

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2263*.

圖 8 *Neocalamites* 的樹幹化石,可能屬於 *N. carcinoides* Harris 的。

和這一種常保存在一起

地點: 陝西延長縣七里村

地層: 延長層上部

登記號碼: *PB. 2277*.

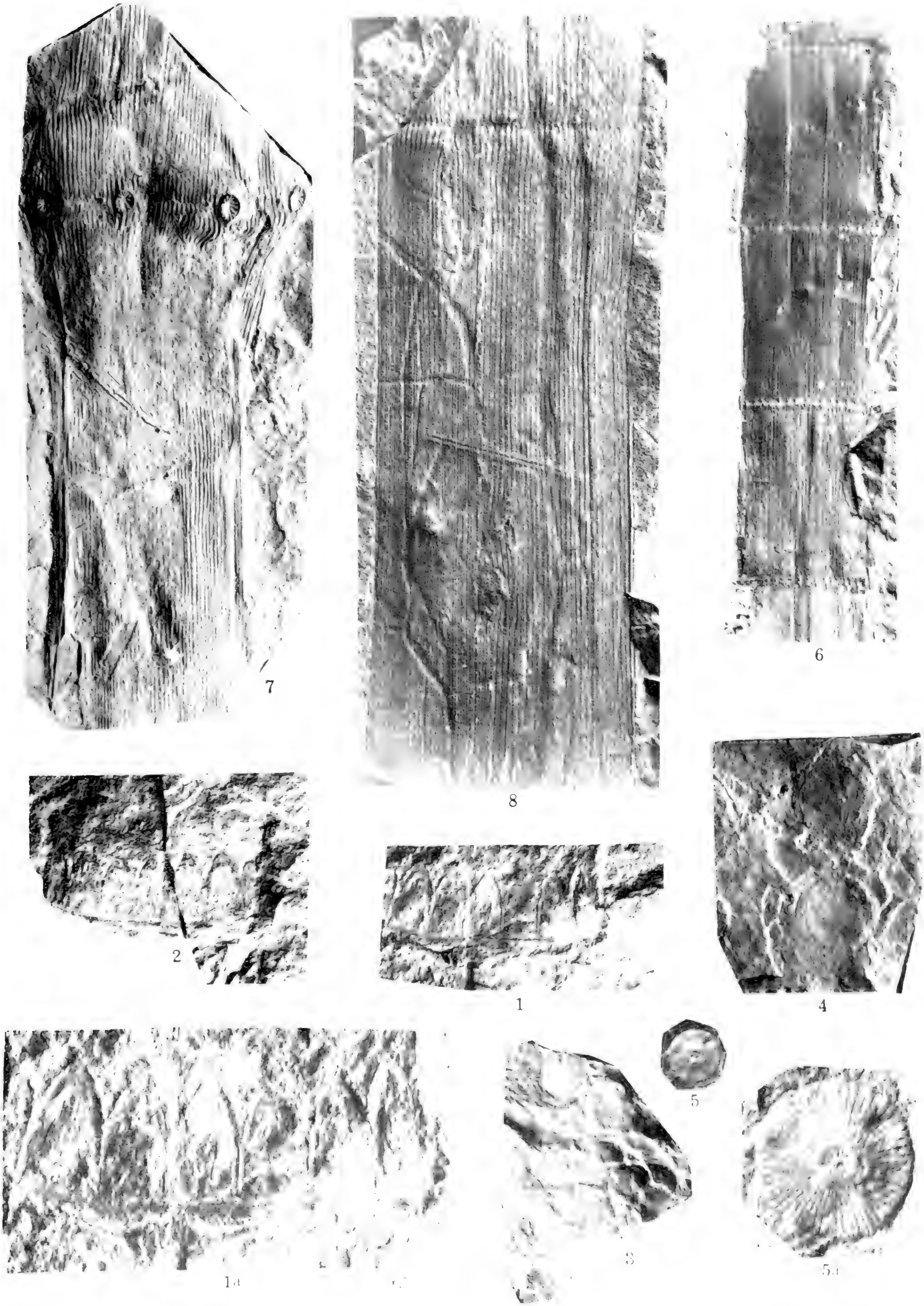

7
8
6
2
1
4
1a
3
5
5a

圖 版 VII

圖 1, 1a, 2, 2a *Neocalamites*? sp. 髓模化石，圖 1, 2 是側面的形態，1a 及 2a 是頂面的形態，都是代表標本的原大。*Equisetites* 的髓模化石也大致作同樣的形態，但此類化石似以屬於 *Neocalamites* 的成分爲較大。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2274—PB. 2275.*

圖 3, 4, 4a *Equisetites*? sp. (Cf. *E. rogersi* Schimper) 葉鞘化石，4a放大× 3。

地點：陝西宜君縣高崖底

地層：延長層底部

登記號碼：*PB. 2248—PB. 2249.*

圖 5—7, 7a *Equisetites* sp. (Strobili of *Equisetites*) 子囊穗化石，7a 放大× 2。

圖 5,6 地點：陝西延長縣七里村

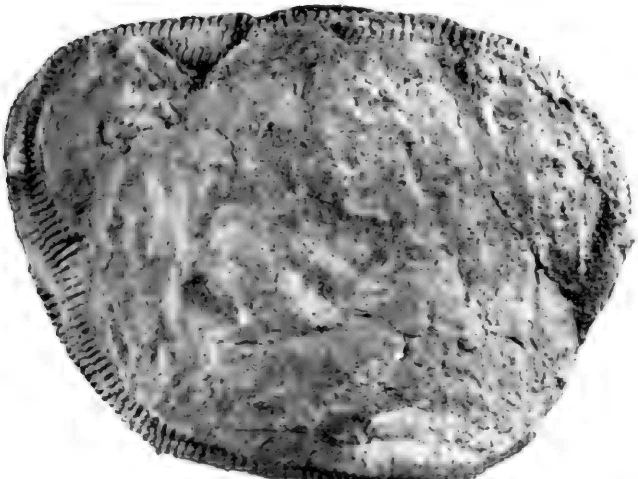
地層：延長層上部

登記號碼：*PB. 2251—PB. 2252.*

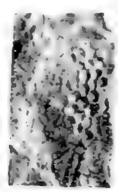
圖7,7a 地點：山西興縣李家凹

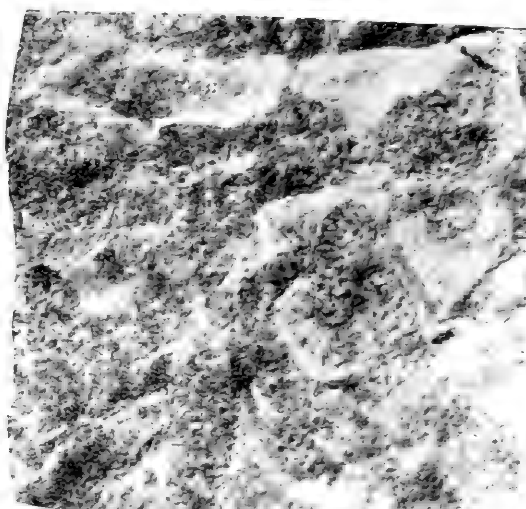
地層：延長層下部

登記號碼：*PB. 2253.*

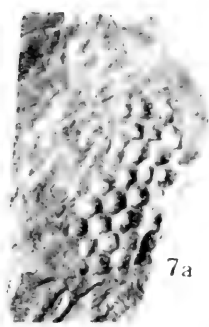

1a

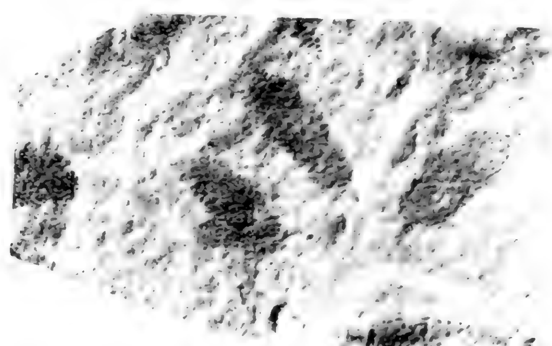

1

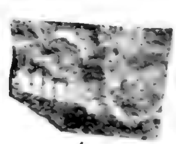

7

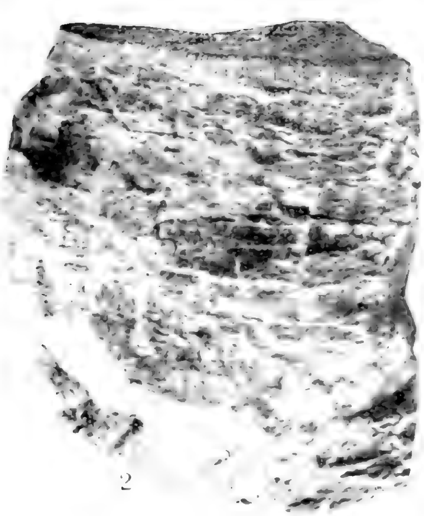

5


2a


×2　7a


6


4


2


3

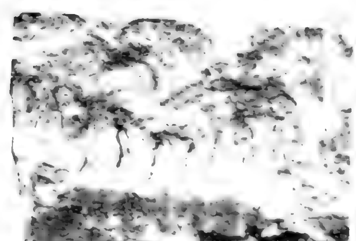

4a　×3

圖 版 VIII

圖 1—3, 1a, 3a *Neocalamites rugosus* Sze 新種，1a 放大×2；3a 放大×3。

注意圖 1，1a 樹幹上的關節及關節上面的枝痕並且有些還保留着樹幹表面的直肋。

圖 1, 1a 地點：陝西延長縣馮家村溝

地層：延長層上部

登記號碼：*PB. 2267.*

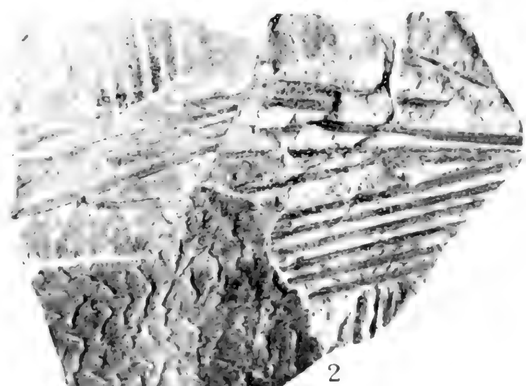
圖 2, 3 地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2268—PB. 2269.*

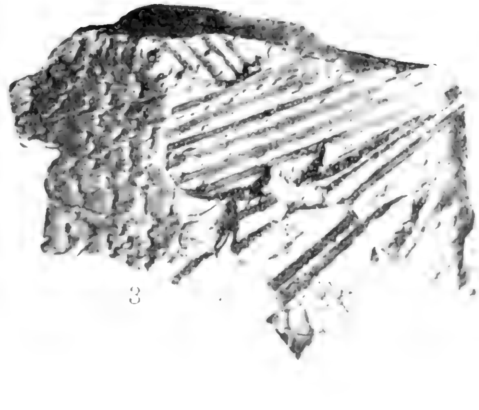
1

1a ×2



2

3a ×3



3

圖 版 IX

圖 1 *Neocalamites carcinoides* Harris

地點：陝西延長縣七里村

地層：延長層上部

登記號碼：*PB. 2264.*

圖 2，2a *Neocalamites carcinoides* Harris，2a 放大× 2。

注意關節上每隔 4—6 條直肋有一個葉痕。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2265.*

圖 3，4 *Cladophlebis* cf. *gigantea* Ôishia

注意小羽片中的葉脈是分叉三次的。

圖 3 地點：陝西延長縣七里村

圖 4 地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2326—PB. 2327.*

圖 5，5a *Sphenobaiera crassinervis* Sze 新種。

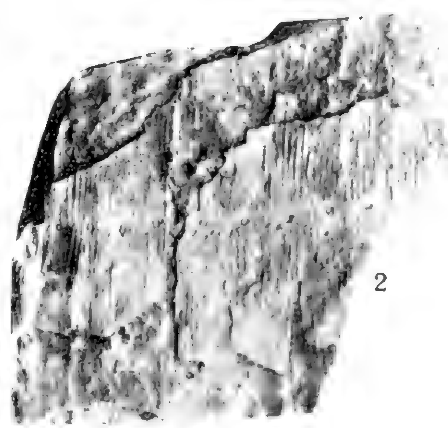
地點：陝西黃龍縣（詳細地點不明）

地層：延長層（層位不明）

登記號碼：*PB. 2468.*

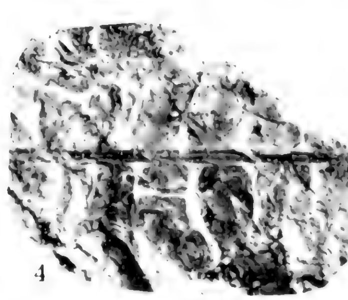

1


2a ×2


2


5


5a ×2


4


3

圖 版 X

圖 1—3, 1a, 2a *Cladophlebis shensiensis* P'an 1a, 2a 放大× 2。

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2322—PB. 2324.*

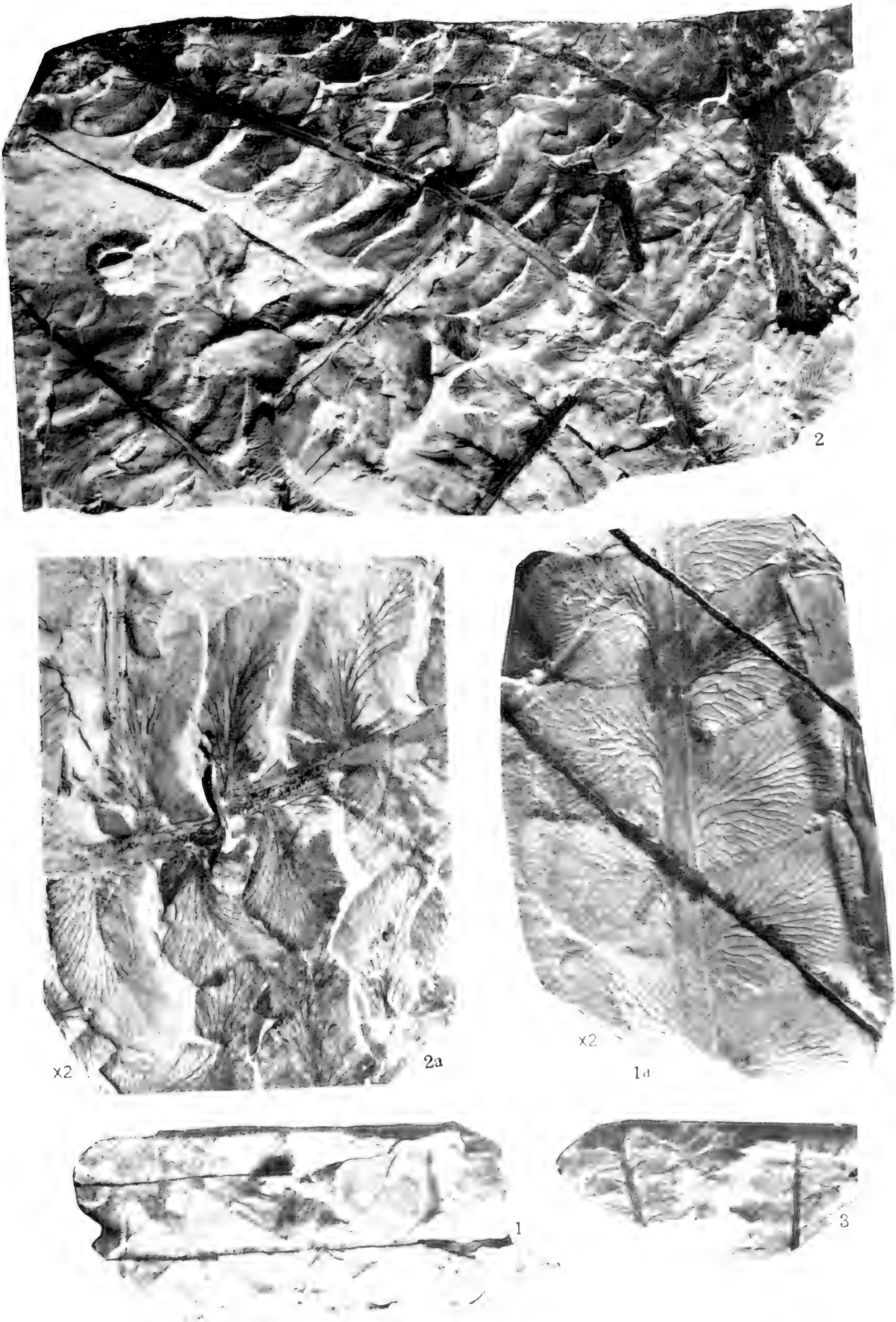

2
x2
2a
x2
1a
1
3

圖 版 XI

圖 1—3 *Cladophlebis shensiensis* P'an

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2278—PB. 2280*.

1

2

3

圖 版 XII

圖 1—5 *Cladophlebis shensiensis* P'an

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2281—PB. 2285.*

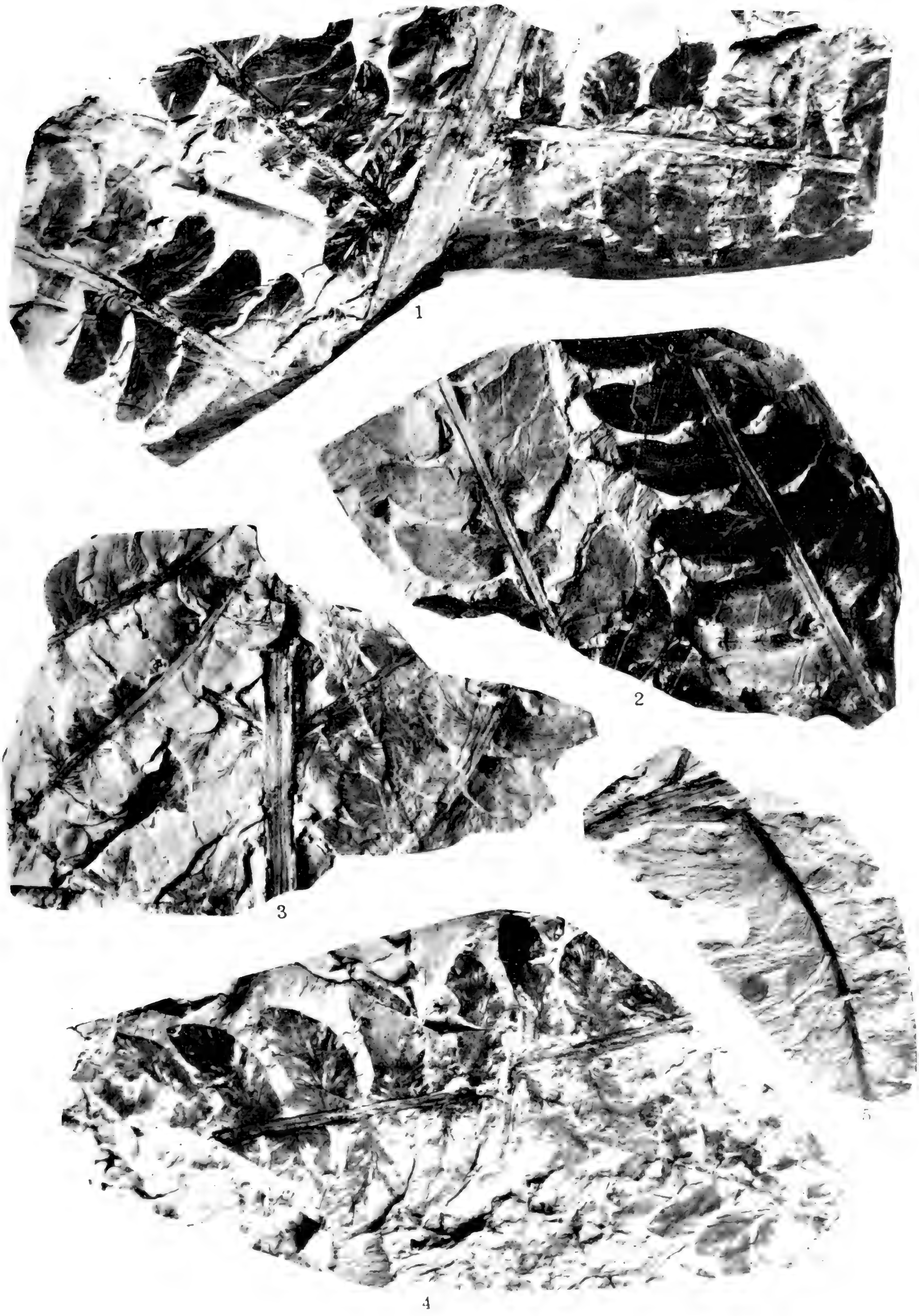

1
2
3
4
5

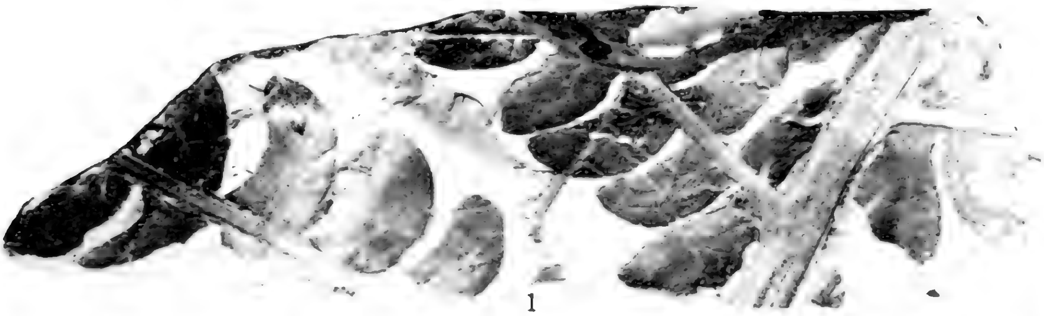
圖 版 XIII

圖 1—4 *Cladophlebis shensiensis* P'an

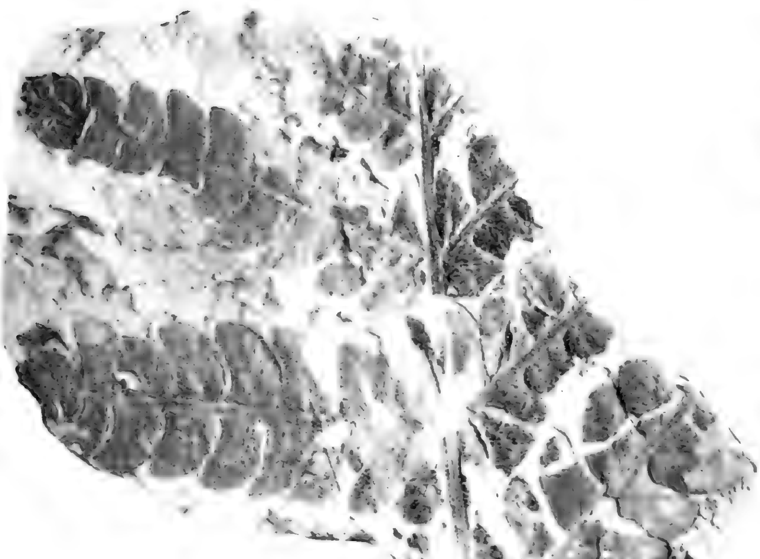
地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

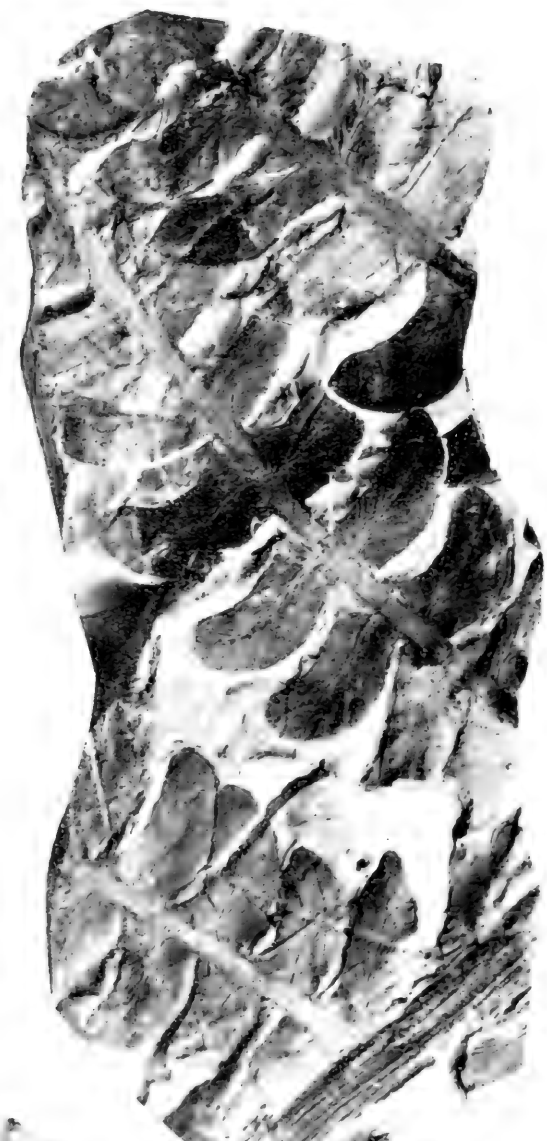
登記號碼：*PB. 2286—PB. 2289.*



1



4



2

3

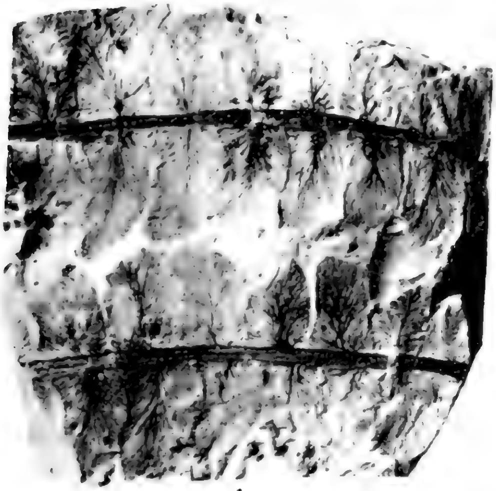
圖 版 XIV

圖 1—5 *Cladophlebis shensiensis* P'an，1a 及 3a 放大× 3。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

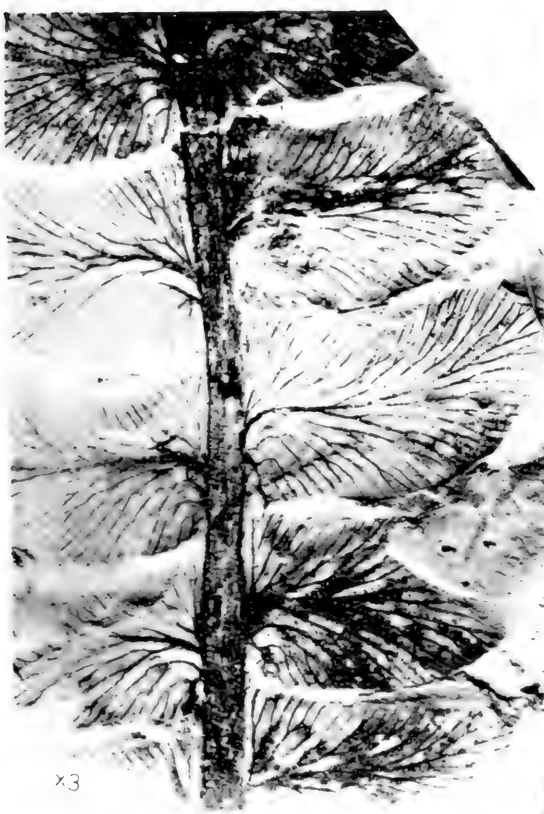
登記號碼：*PB. 2290—PB. 2294.*



1

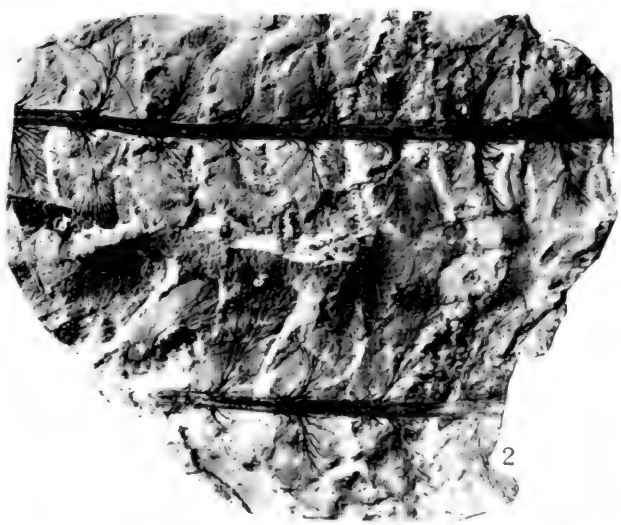
5

4

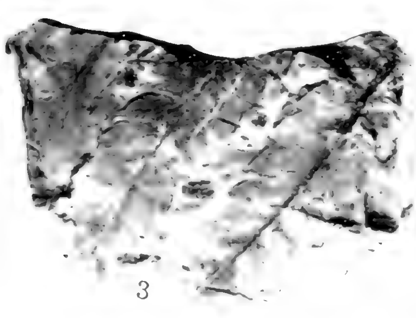


×3

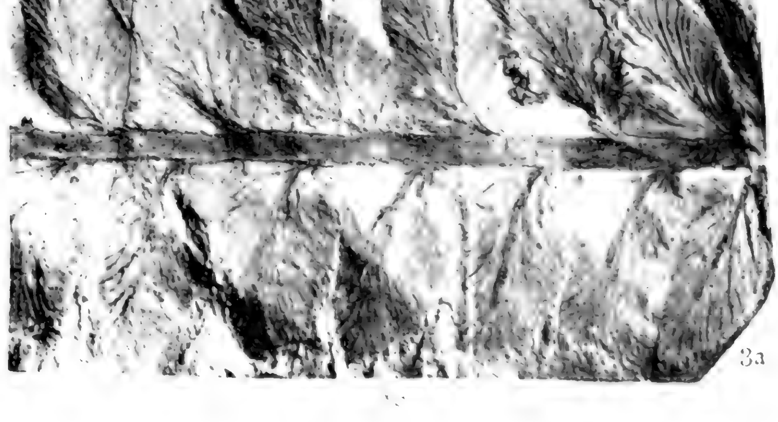
1a



2



3



3a

圖版 XV

圖 1—17 *Cladophlebis shensiensis* P'an 1a, 2a, 3a 放大× 3。

圖 1—16 實羽片化石；圖 17 和實羽片相同的一枚裸小羽片化石。

地點：陝西延長縣七里村及宜君縣四郎廟

地層：延長層上部

登記號碼：*PB. 2295—PB. 2311*.

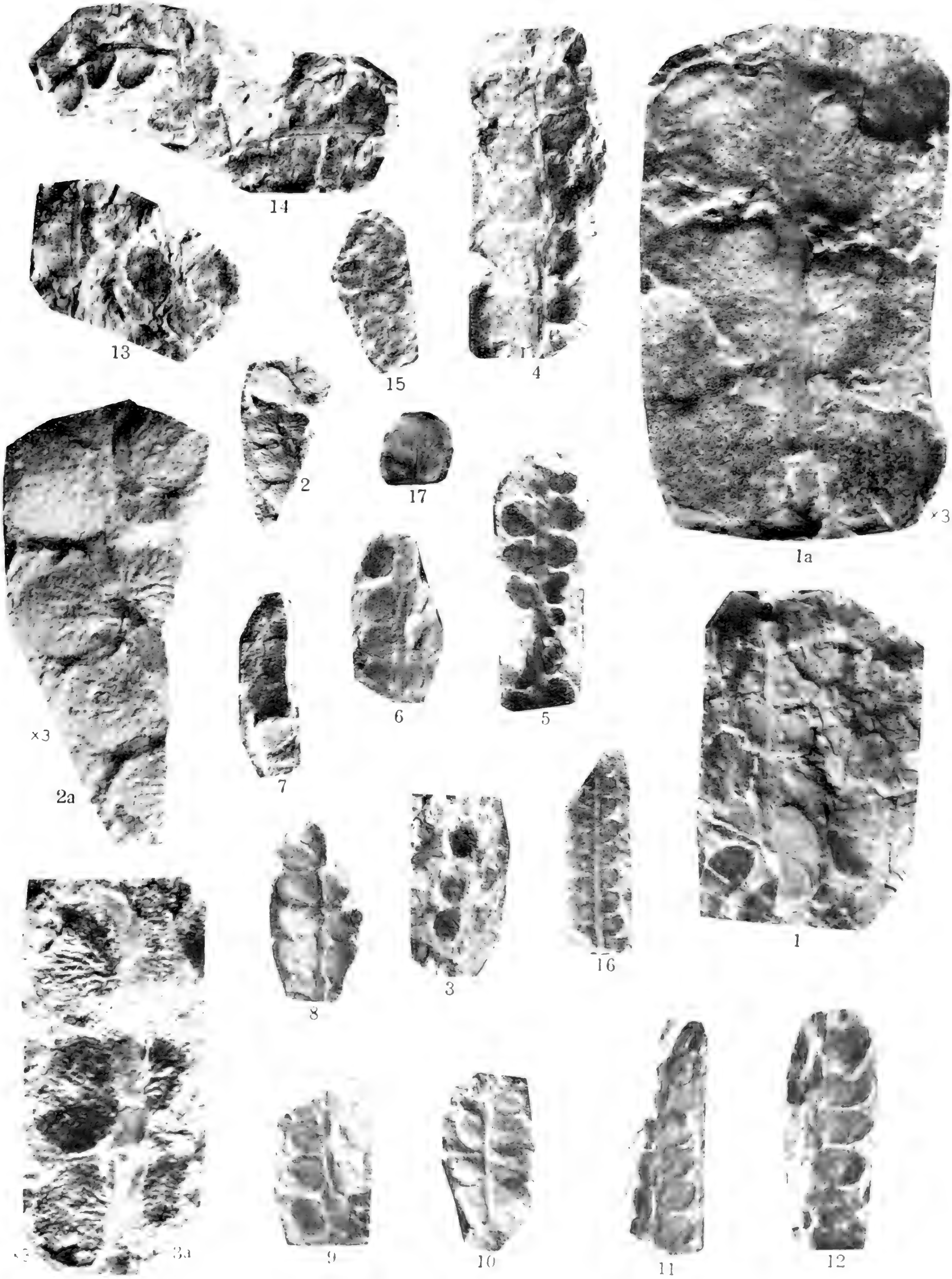

14
13
15
4
2
17
1a
×3
×3
2a
7
6
5
8
3
16
1
3a
9
10
11
12

圖 版 XVI

圖 1—4 *Cladophlebis szeiana* P'an, 1a 及 2a 放大× 3。

圖 1, 1a 裸羽片化石;圖 2, 2a 實羽片化石。

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

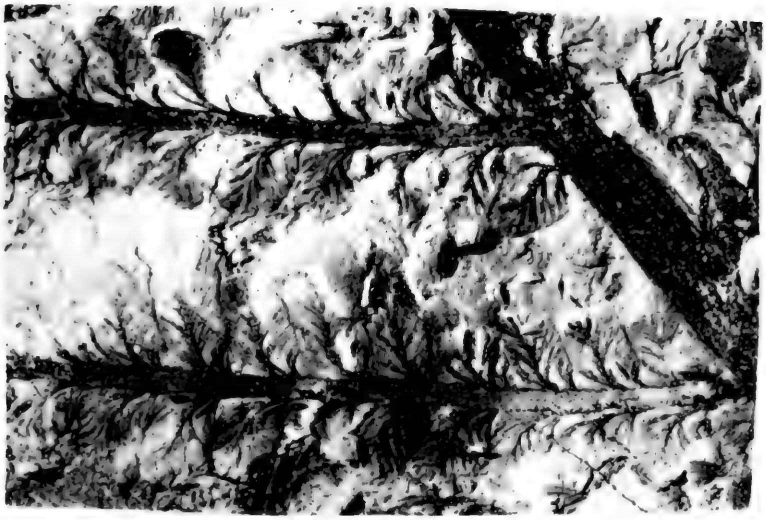
登記號碼: *PB. 2398—PB. 2401.*

圖 5 *Cladophlebis shensiensis* P'an

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2312.*



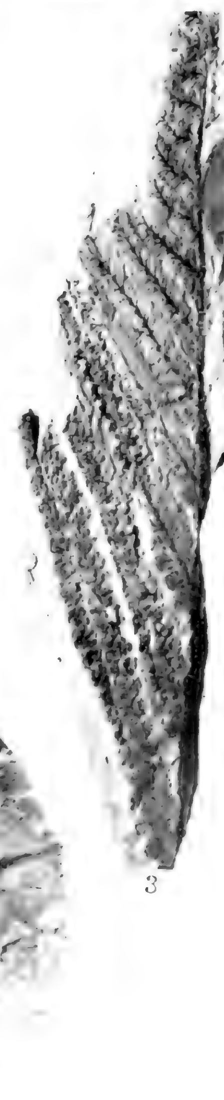
1a　×3

1

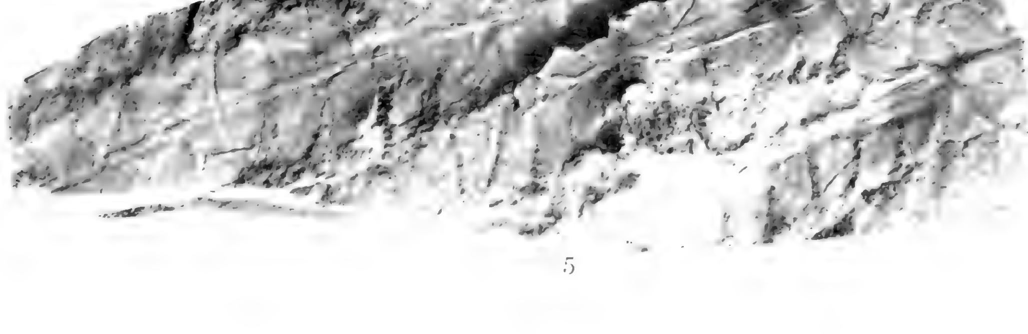
×3
2a

2

4



3



5

圖 版 XVII

圖 1—5 *Cladophlebis szeiana* P'an, 1a, 4a 放大× 3; 3a 放大× 2。

圖 1, 2. 裸羽片化石; 圖 3—5 實羽片化石。

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2402—PB. 2406*.

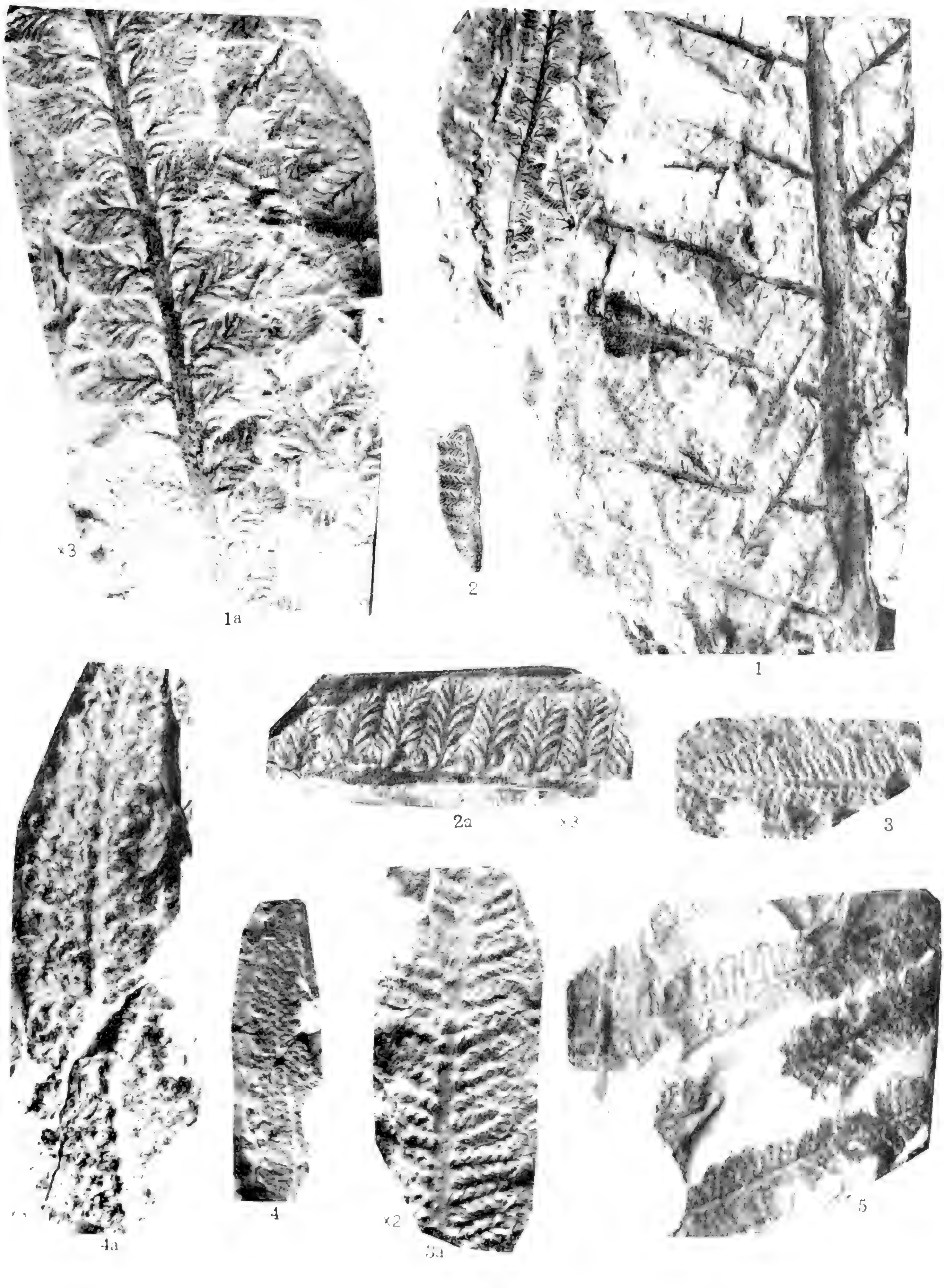

×3
1a
2
1
2a
×3
3
4a
4
×2
3a
5

圖 版 XVIII

圖 1—5 *Cladophlebis shensiensis* P'an

圖 1 地點：陝西延長縣七里村

地層：延長層上部

登記號碼：*PB. 2313*.

圖2-5 地點：陝西宜君縣四郎廟炭河溝

地層：延長層上部

登記號碼：*PB. 2314—PB. 2317*.

圖 6 *Cladophlebis* sp. a

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2366*.

圖 7—9 *Cladophlebis suniana* Sze 新種 7a 放大× 2。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2363—PB. 2365*.

圖 10，11 *Cladophlebis ichünensis* Sze 新種。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2353—PB. 2354*.

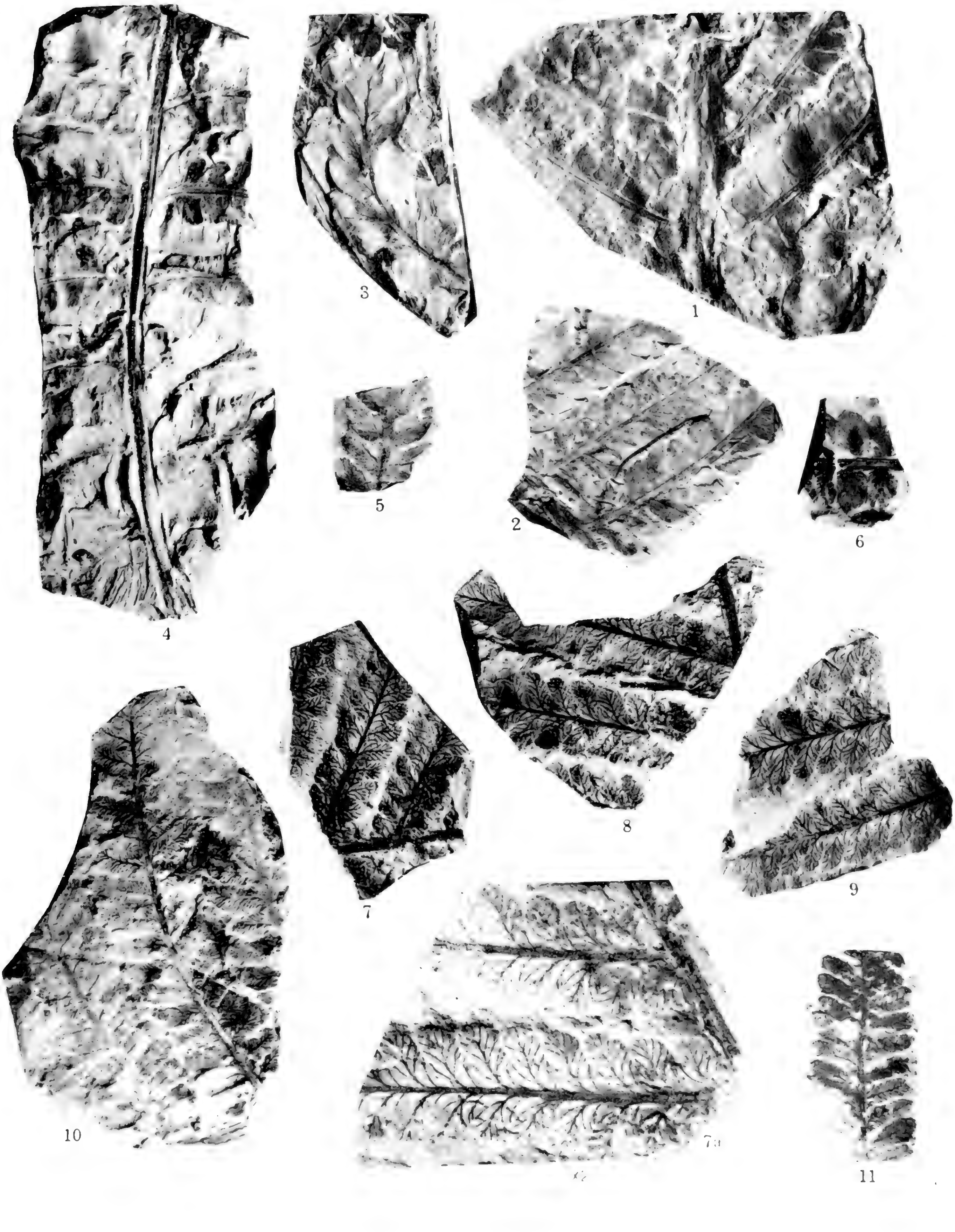

4
3
1
5
2
6
8
7
9
10
7a
11

圖 版 XIX

圖 1, 1a, 2 *Cladophlebis kaoiana* Sze 新種, 1a 放大 × 2。

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2341—PB. 2342*.

圖 3—4 *Cladophlebis shensiensis* P'an

地點: 陝西宜君縣四郎廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2318—PB. 2319*.

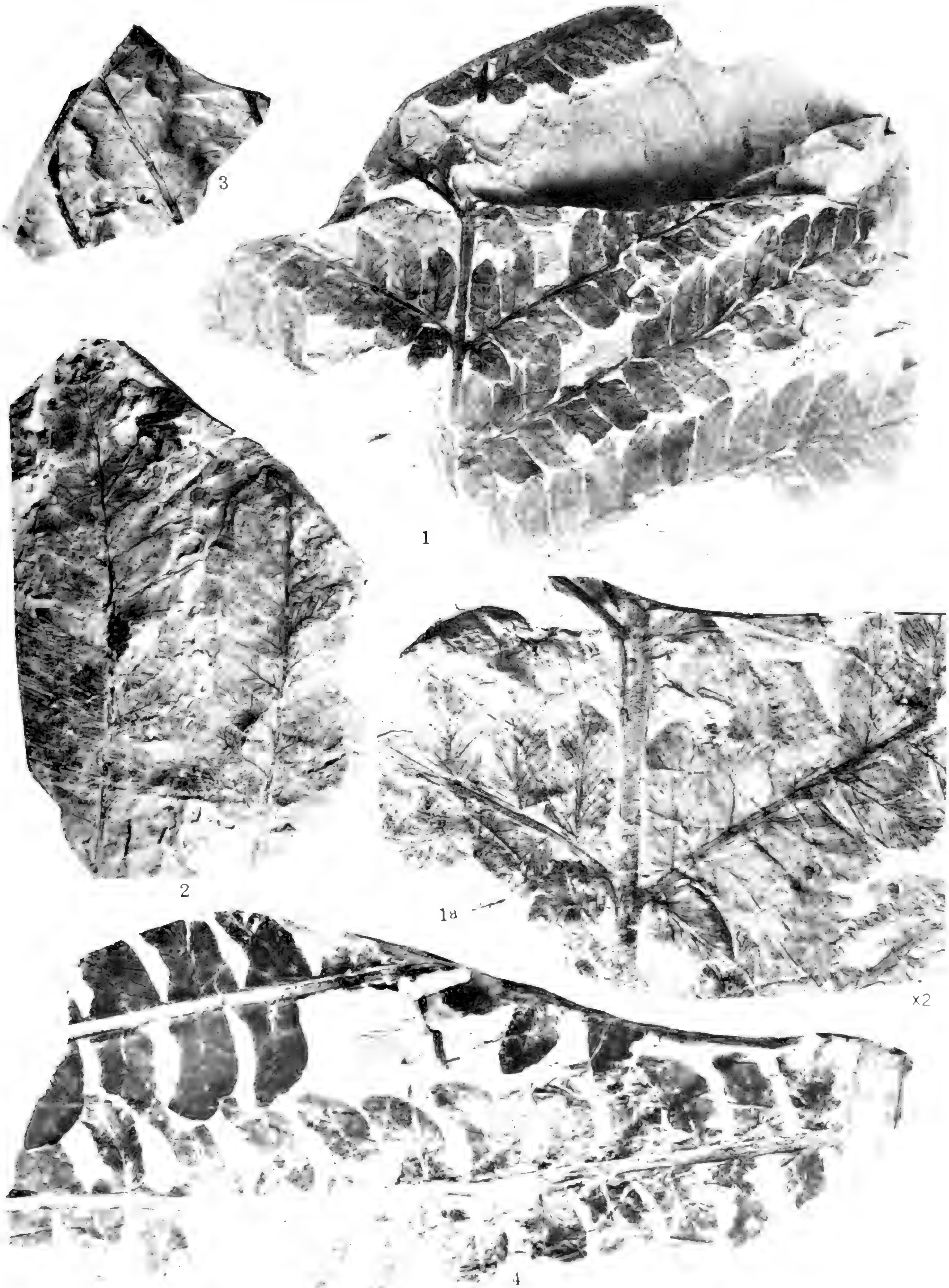

3
1
2
1a
×2
4

圖 版 XX

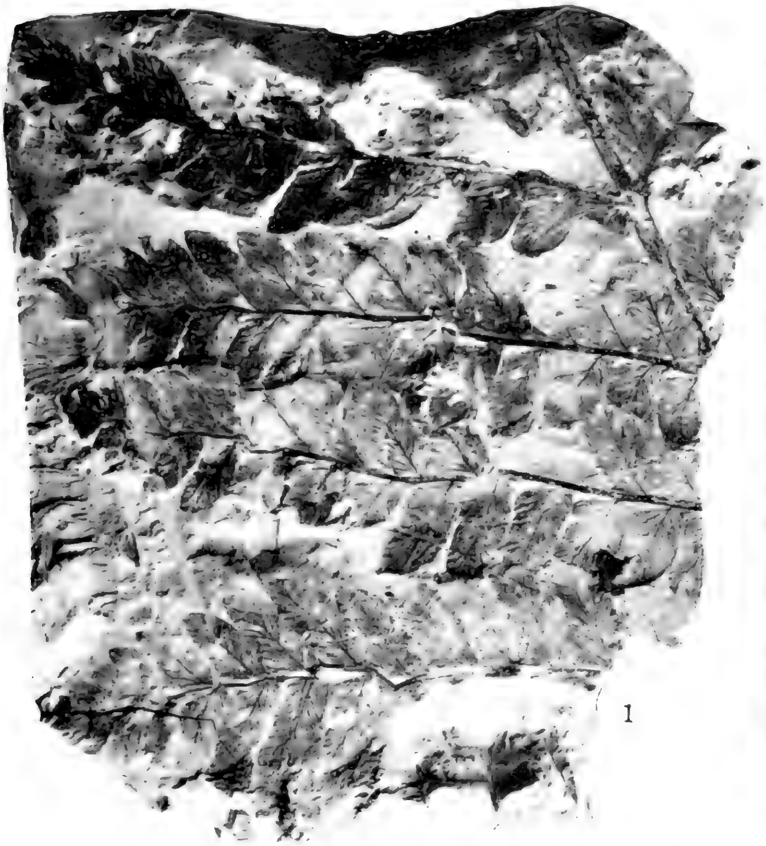
圖 1—3 *Cladophlebis kaoiana* Sze 新種，1a 2a 放大 3。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2343—PB. 2345*。

/



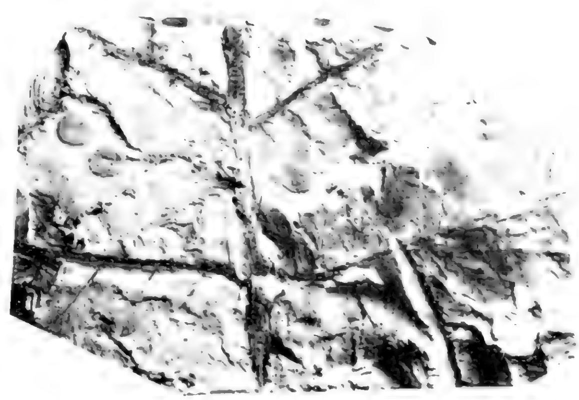
1

×3

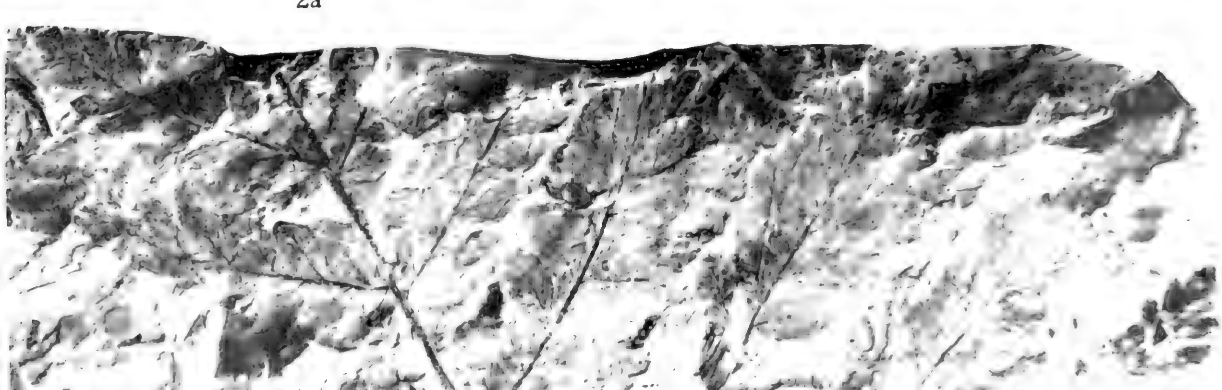
1a

×3

2a



3



2

圖 版 XXI

圖 1—4 *Cladophlebis stenophylla* Sze 新種，1a 放大× 3；3a 放大× 5。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2358—PB. 2361.*

圖 5 *Cladophlebis shensiensis* P'an

地點：甘肅華亭縣劍溝河

地層：延長層上部

登記號碼：*PB. 2320.*

圖 6 *Cladophlebis szeiana* P'an 實羽片化石。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2407.*

圖 7 *Cladophlebis raciborskii* Zeiller

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2328.*

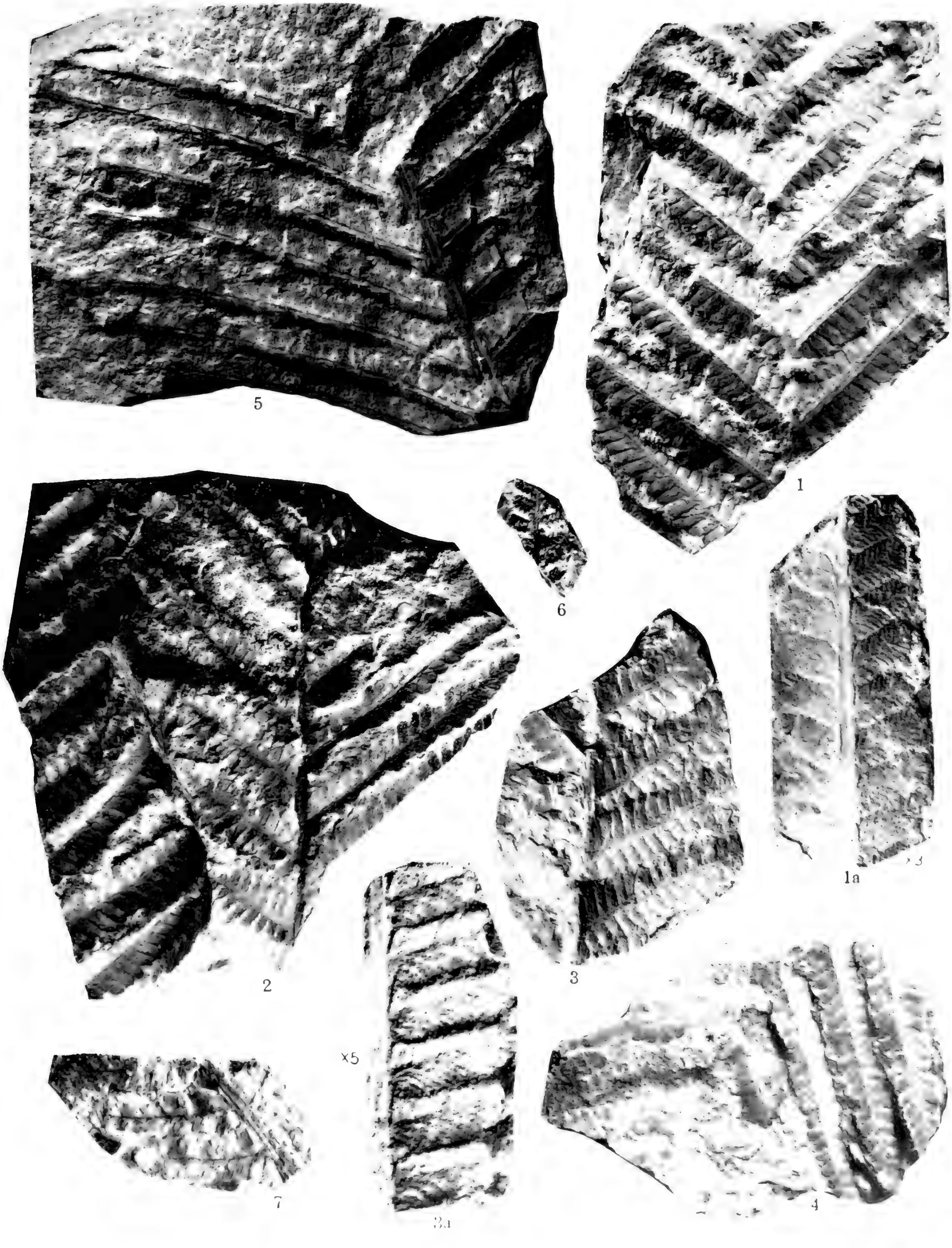

5
1
6
1a
×3
2
3
×5
7
3a
4

圖 版 XXII

圖 1, 1a *Cladophlebis kaoiana* Sze 新種 1a 放大 ×3。

地點：陝西宜君縣西郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2346*.

圖 2, 2a *Cladophlebis paralobifolia* Sze 新種，2a 放大×2。

地點：陝西延安縣詳細地點不明

地層：延長層層位不明

登記號碼：*PB. 2362*.

圖 3, 3a *Cladophlebis raciborskii* Zeiller，3a 放大×3。

地點：陝西宜君縣西郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2329*.

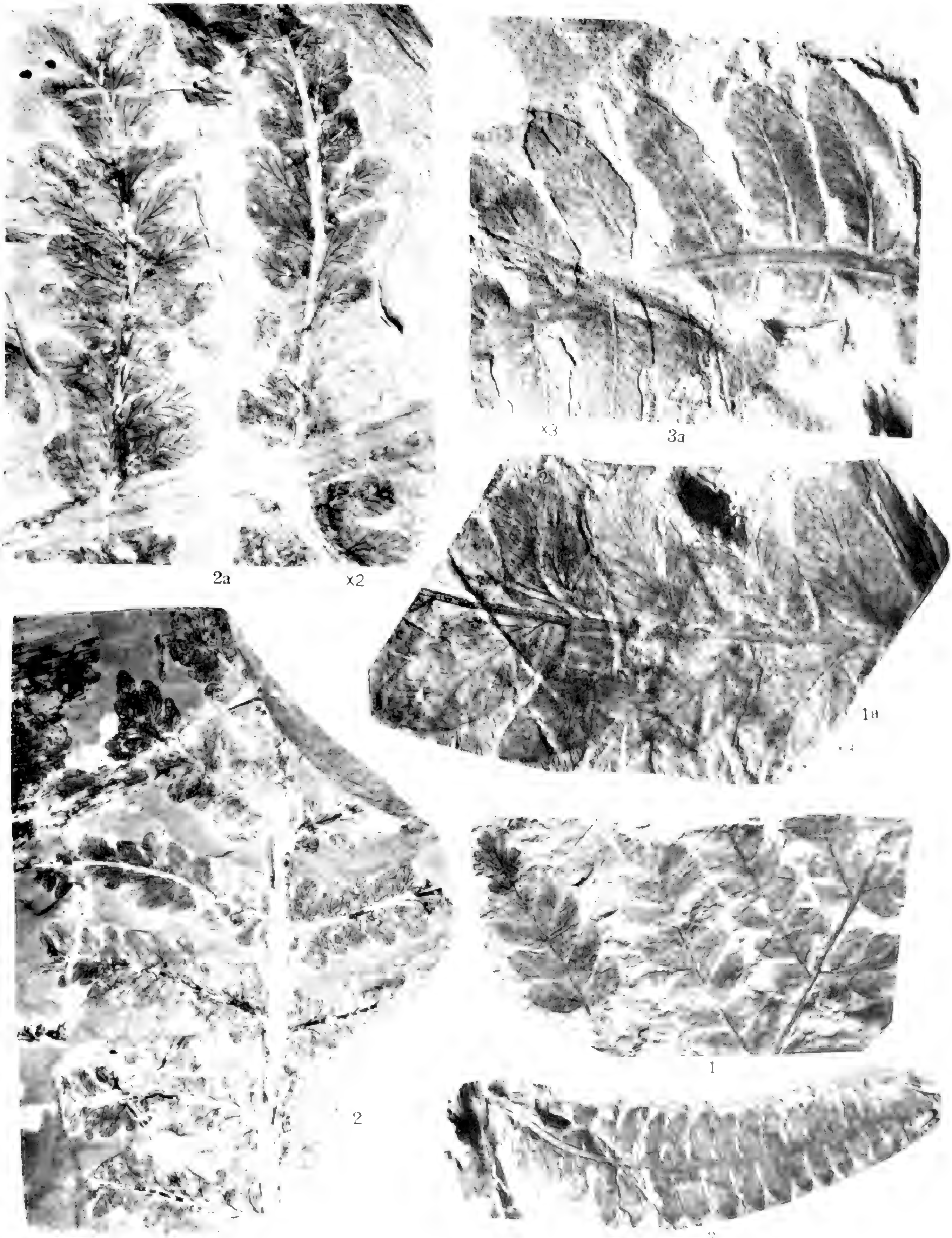

2a
×2
×3
3a
1a
×3
1
2
3

圖 版 XXIII

圖 1 *Cladophlebis paralobifolia* Sze 新種。

此圖係從圖版 XXII 圖 2 的標本的一部分放大× 3。

圖 2，2a *Cladophlebis grabauiana* P'an，2a 放大×3。

此係潘鍾祥 1936，Pl. IX figs. 1，1a 的標本，重新登載於此。本文所研究的材料中，並無這一種化石。

地點：陝西綏德縣延家坪

地層：延長層上部

登記號碼：*PB. 732.*（*Cat. No. P. 86*）

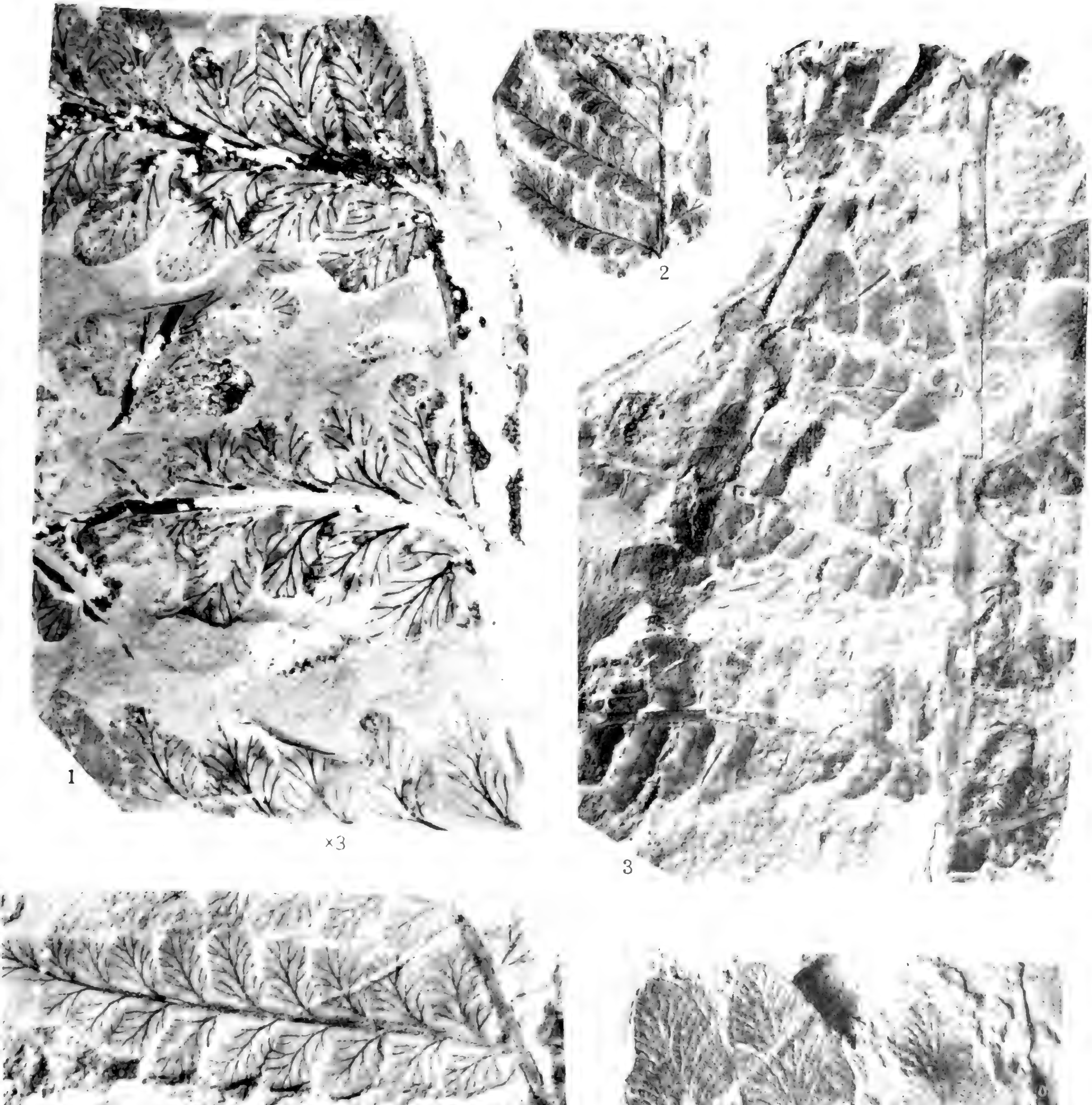
圖 3，3a *Cladophlebis* cf. *gigantea* Ôishia，3a 放大×3。

此係潘鍾祥 1936，Pl. VII，figs. 1，1a 的標本，重新登載於此。注意小羽片中的側脈俱分叉 3 次。

地點：陝西綏德縣沙灘坪

地層：延長層中部

登記號碼 *PB. 715.*（*Cat. No. 69*）



1　×3　2　3

2a　3a

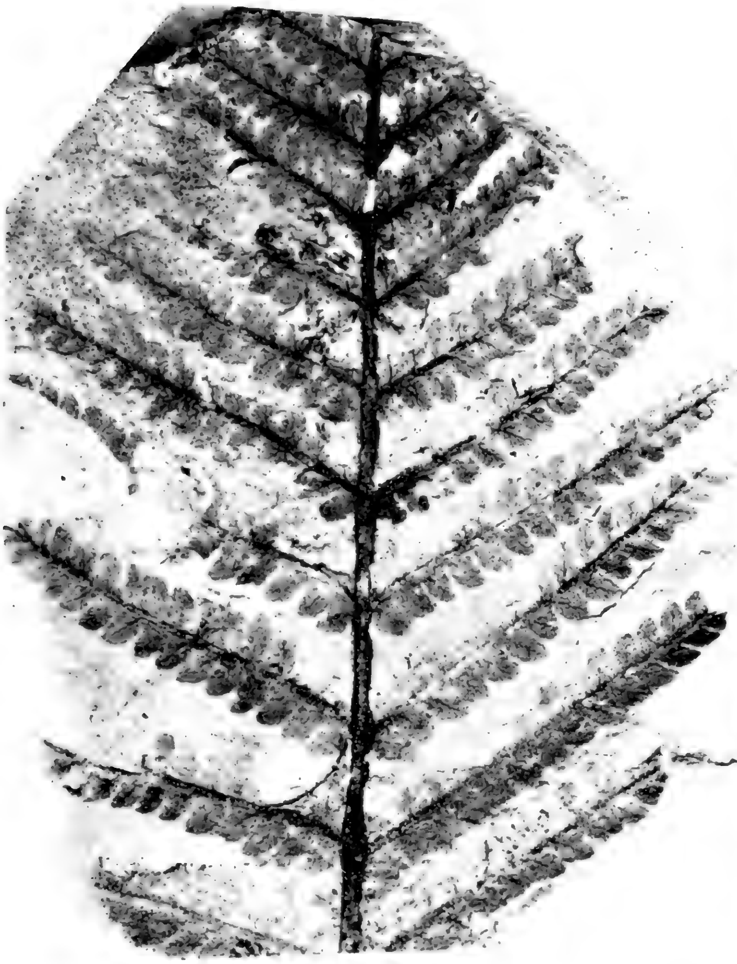
圖 版 XXIV

圖 1, 1a, 2 2a *Cladophlebis graciles* Sze，新種 1a 放大 ×2; 2a 放大×3。

地點：陝西宜君縣杏樹坪的七母橋

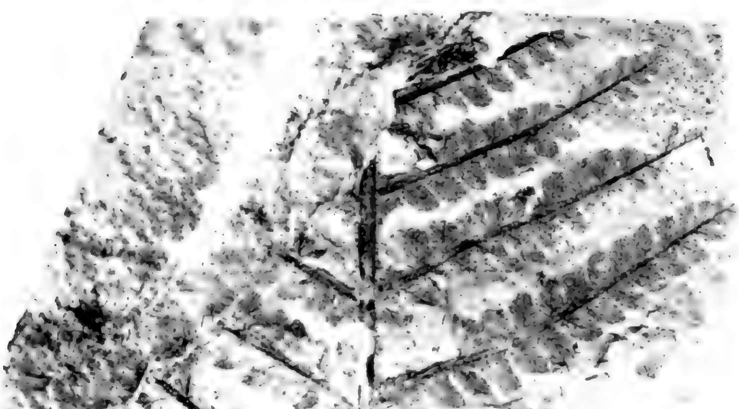
地層：延長層上部

登記號碼：*PB. 2347—PB. 2348*.



1

1a　×2



2

2a

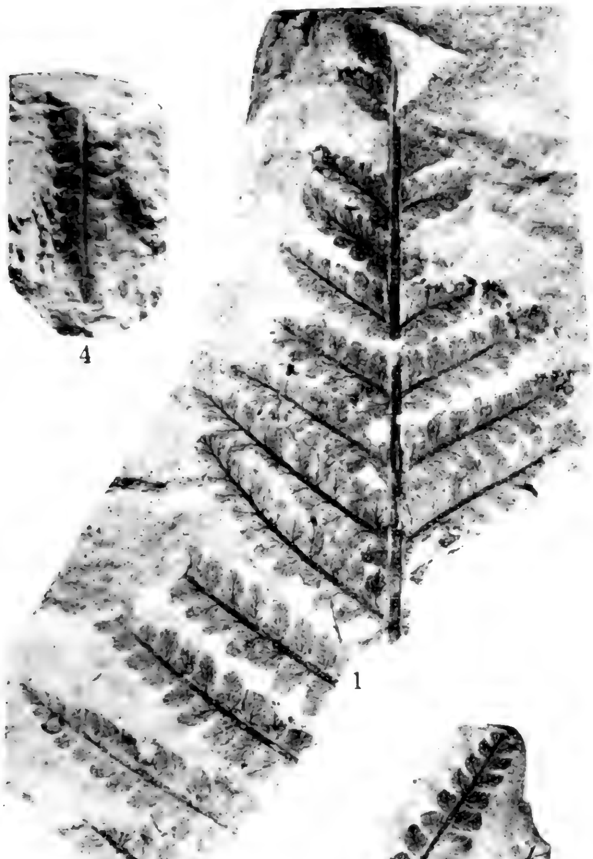
圖 版 XXV

圖 1—4 *Cladophlebis graciles* Sze 新種，2a 放大 ×6；3a 放大 ×3；3b 放大×8。

地點：陝西宜君縣杏樹坪的七母橋

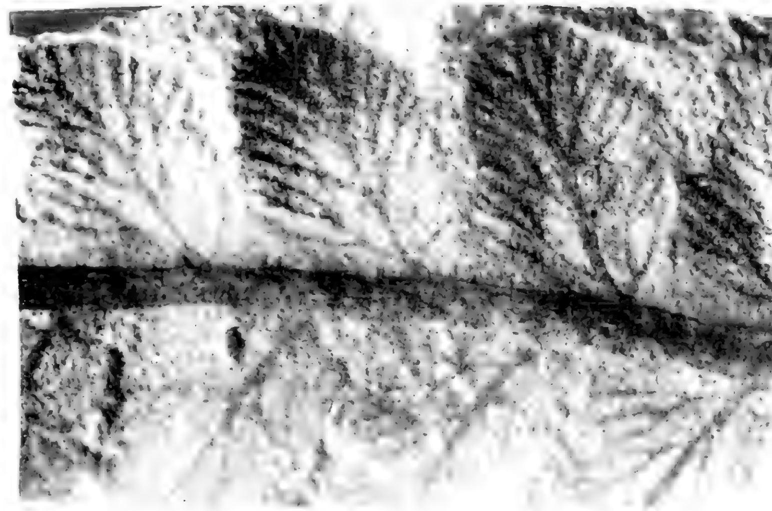
地層：延長層上部

登記號碼：*PB. 2349—PB. 2352*.

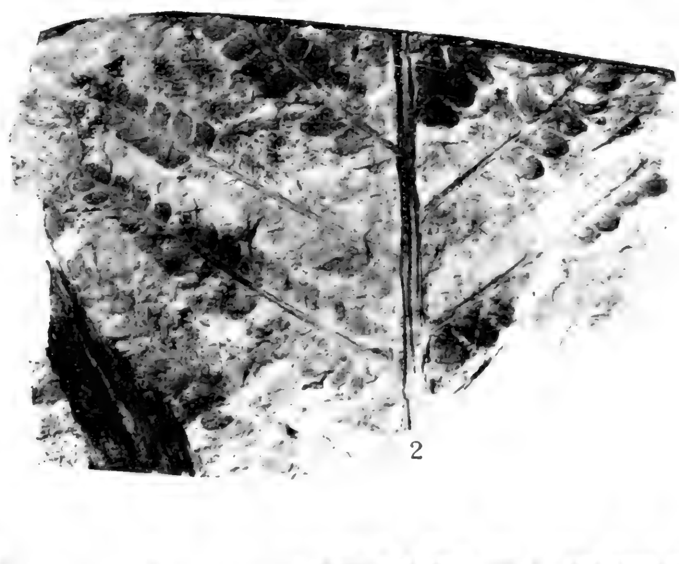


4

1

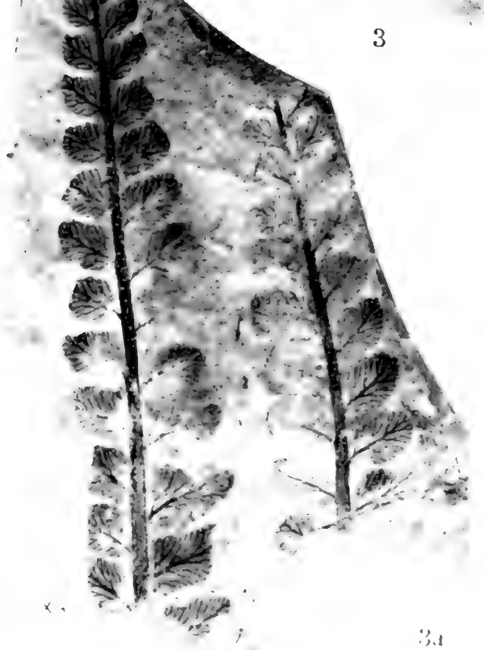


3b　　×8

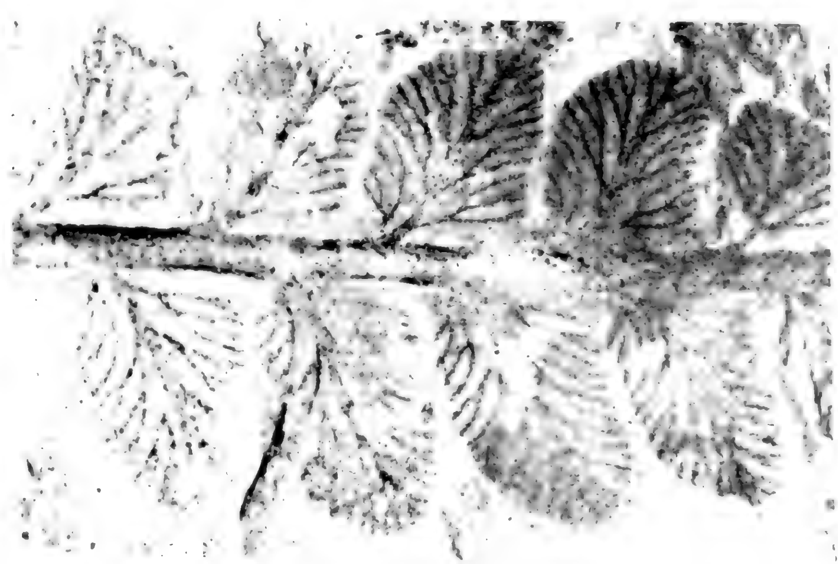


2

3



3a



2a　　×6

圖 版 XXVI

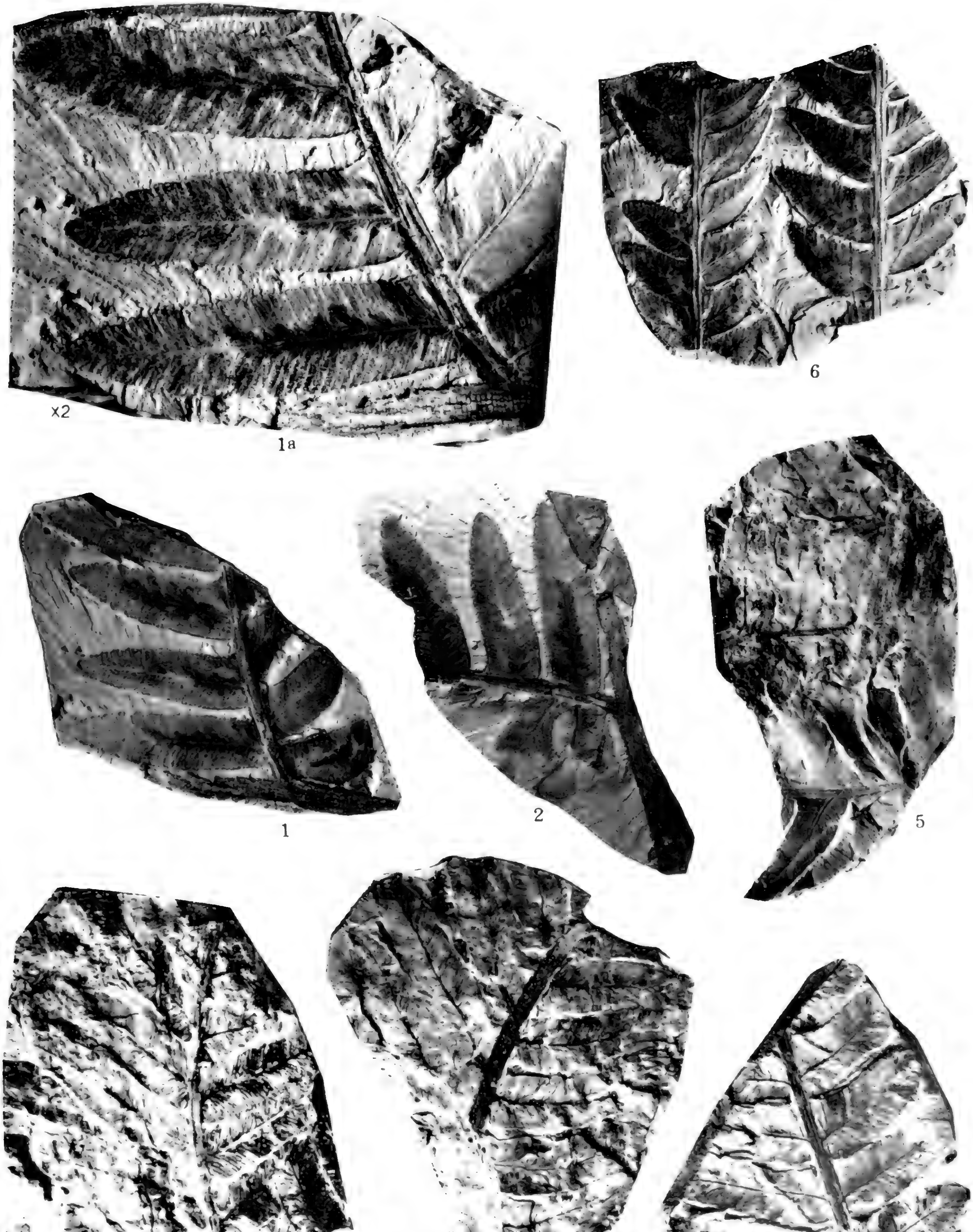
圖 1—7 *Cladophlebis raciborskii* Zeiller, 1a 放大×2。

注意小羽片中的側脈，俱作 2 次分叉狀態。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2330—PB. 2334.*



×2
1a
6
1
2
5
3
4
7

圖 版 XXVII

圖 1—5 *Cladophlebis raciborskii* Zeiller，1a 放大×2。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2335—PB. 2339.*

圖 6 *Cladophlebis shensiensis* P'an

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2321.*

圖 7，7a *Phlebopteris? linearifolia* Sze 新種，7a 放大×3。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2325.*

圖 8，8a *Sphenopteris* sp. (Cf. *Sph. arizonica* Daugherty)，8a 放大×2。

地點：陝西延長縣七里村

地層：延長層上部

登記號碼：*PB. 2368.*

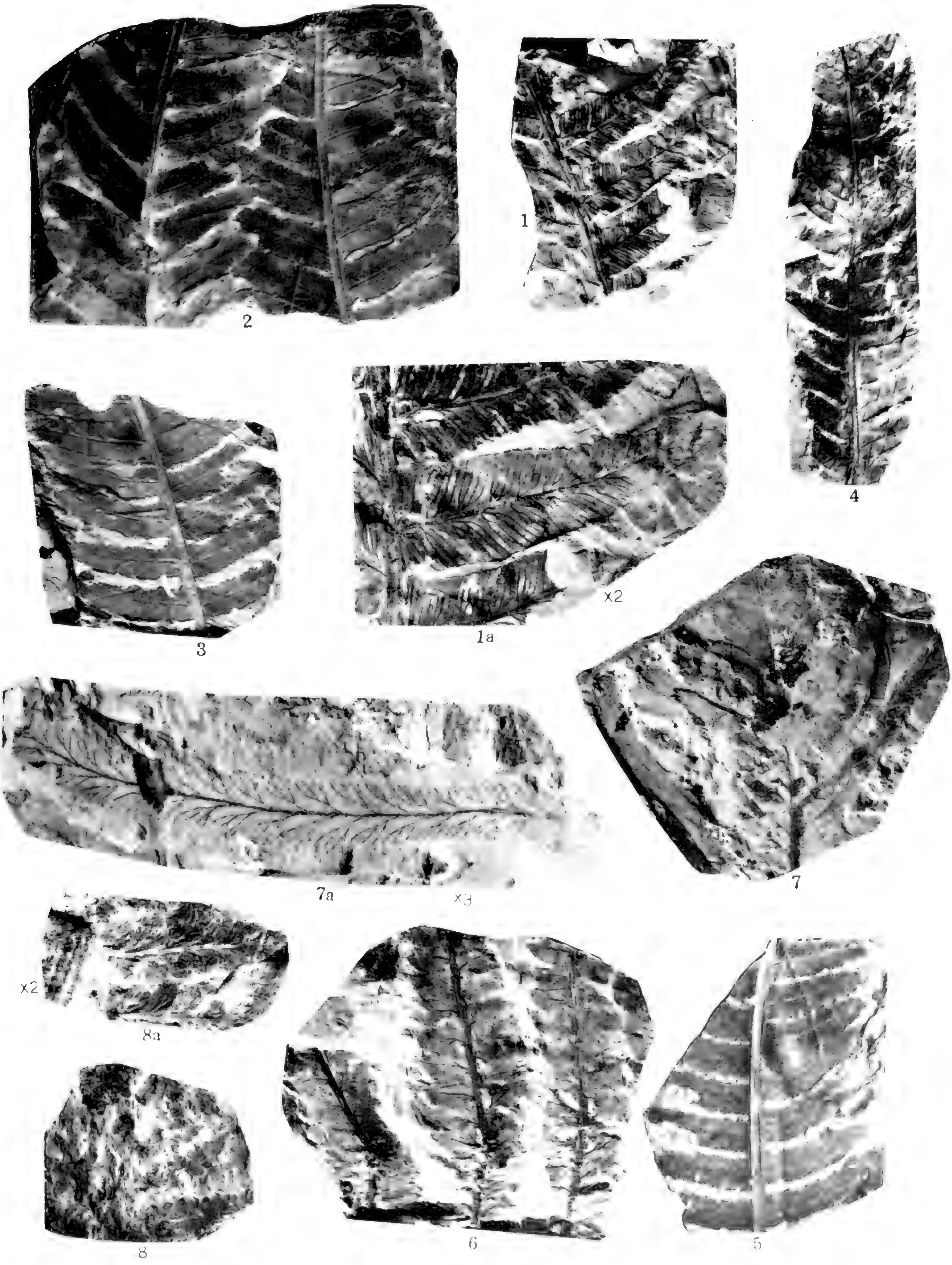

2
1
4
3
1a
×2
7a
×3
7
×2
8a
8
6
5

圖 版 XXVIII

圖 1，2 *Cladophlebis ichünensis* Sze 新種，1a 放大×2。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2355—PB. 2356.*

圖 3，3a *Sphenopteris? chowkiawanensis* Sze 新種，3a 放大×3。

地點：陝西延長縣周家灣

地層：延長層層位不明

登記號碼：*PB. 2369.*

圖 4，4a *Cladophlebis* sp. b，4a 放大×2。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2367.*

圖 5，6 未鑑定的裸羽片化石 (Undetermined Sterile Pinnae)。

地點：陝西葭縣大會坪

地層：延長層下部

登記號碼：*PB. 2370—PB. 2371.*

圖 7，8，疑問的化石 a，(Problematicum a)。

地點：陝西延長縣七里村

地層：延長層上部

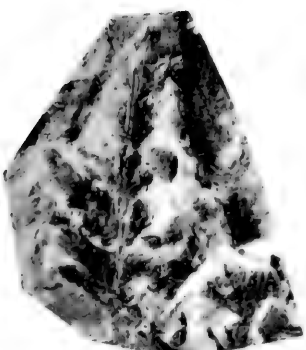
登記號碼：*PB. 2488—PB. 2489.*

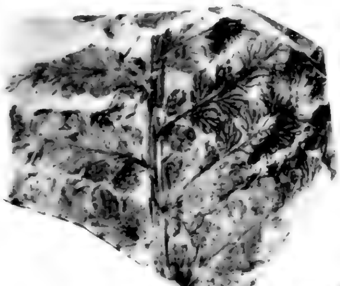

3a　×3


×2
1a

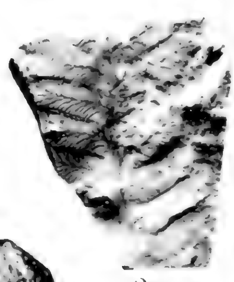

1


4


5


3


×2
4a


2


6


8


7

圖 版 XXIX

圖 1,2 *Danaeopsis fecunda* Halle, 1a, 1b 放大×2。

注意側脈互相接合而成爲網脈。

圖 1　地點：陝西葭縣大會坪。

地層：延長層下部

登記號碼：*PB. 2372*.

圖 2　地點：山西臨縣馬家灣

地層：延長層下部

登記號碼：*PB. 2373*.

圖 3, 3a *Bernoullia zeilleri* P'an, 3a 放大×3。

注意每一條側脈自中軸伸出後，繼續地分叉後有成組的形勢，並且到達葉邊時並不互相接合而成爲網脈。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2381*.

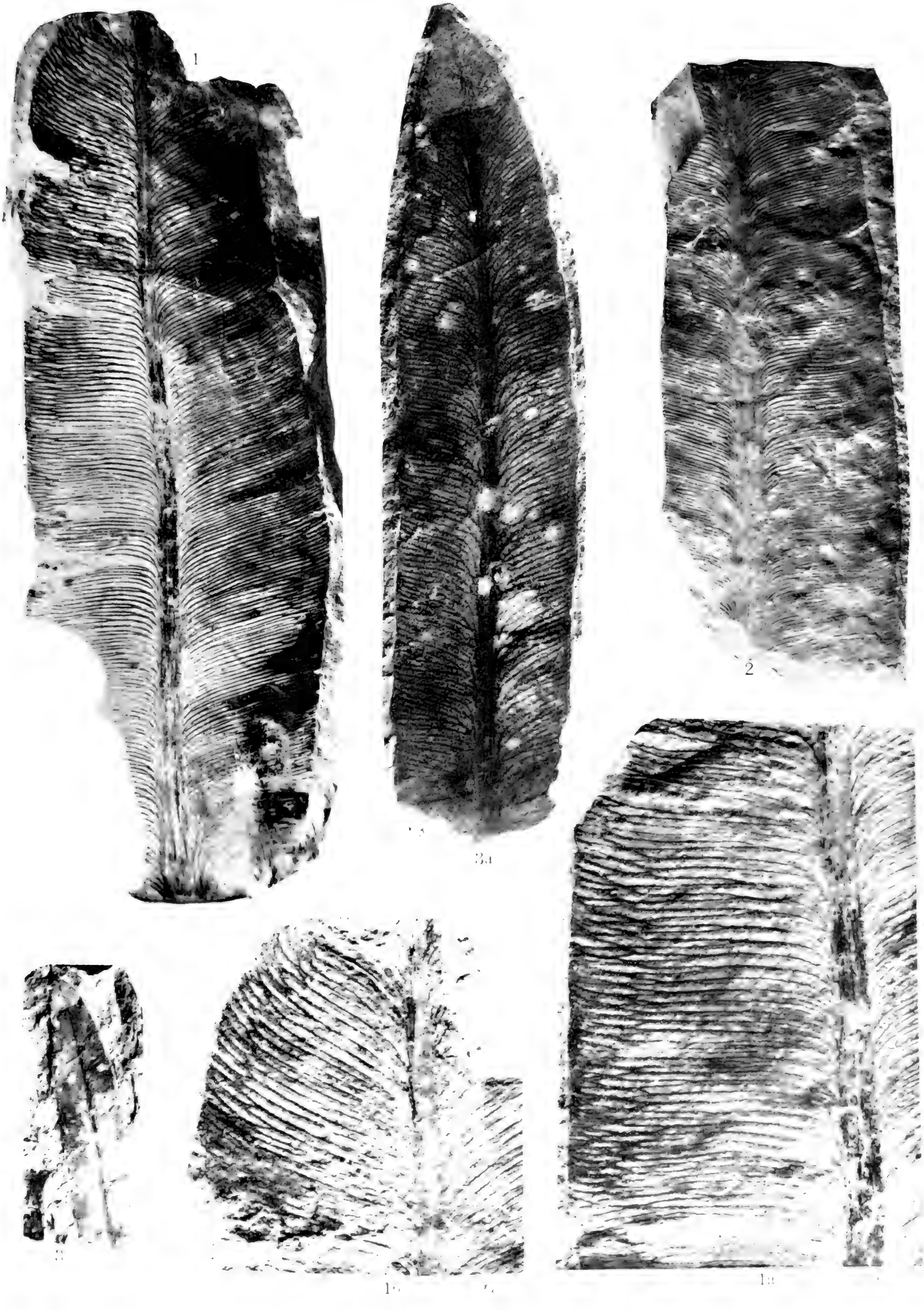

1
2
3a
1b
1a

圖 版 XXX

圖 1—4 *Danaeopsis fecunda* Halle

圖 1　注意其寬闊的中軸。

地點：陝西耀縣，蕭馬河南（涇河岸）

地層：延長層層位不明

登記號碼：*PB. 2374*.

圖 2,3 地點：陝西宜君縣四郎廟的炭河溝

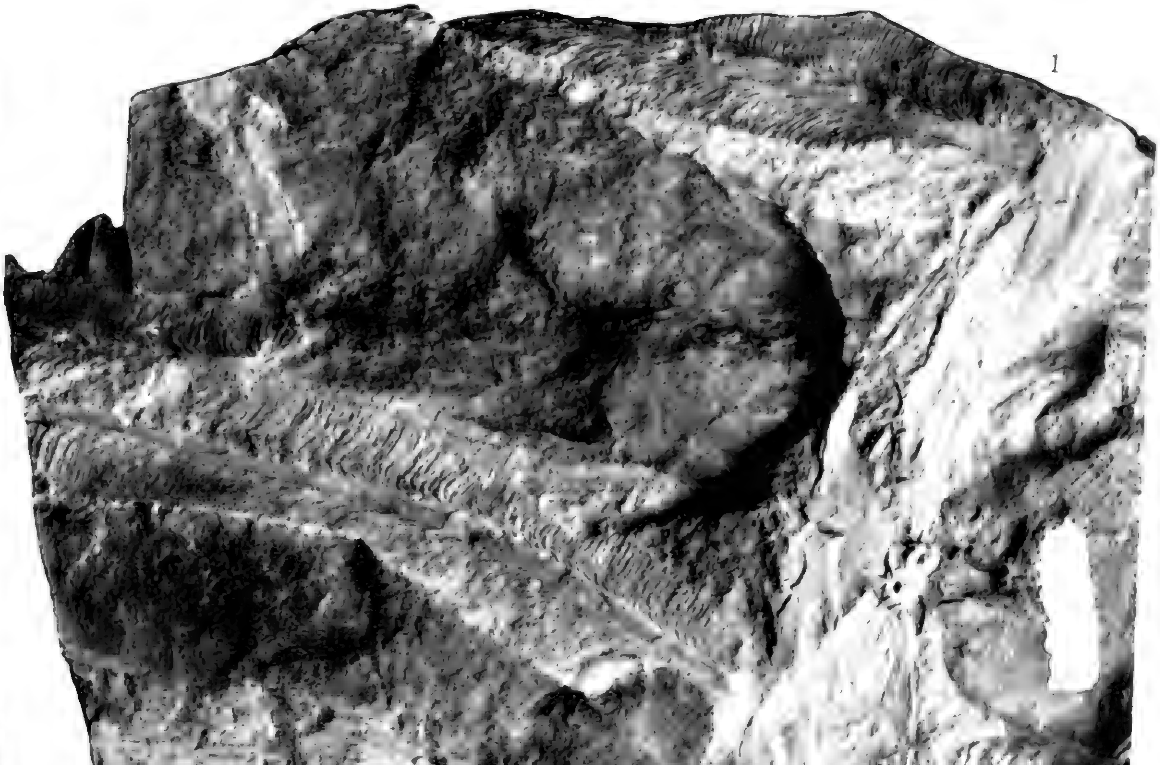
地層：延長層上部

登記號碼：*PB. 2375—PB. 2376*.

圖 4　地點：陝西淳化縣坪底刺坪裏。

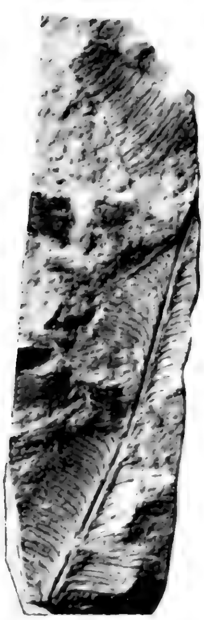
地層：延長層層位不明

登記號碼：*PB. 2377*.

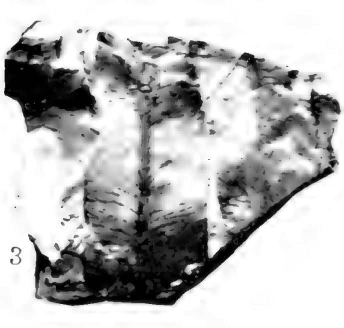


1

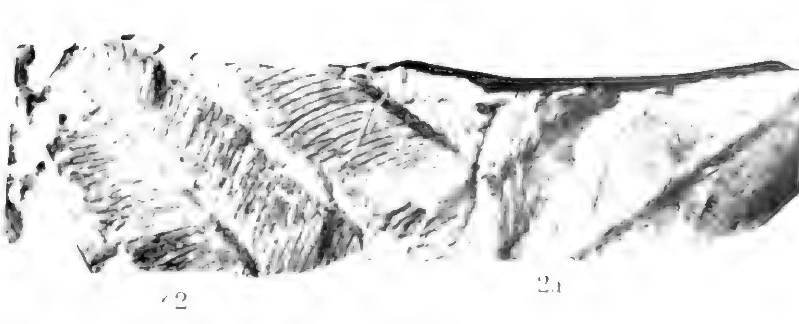
2



4



3



2　　2a

圖 版 XXXI

圖 1 1a—f *Danaeopsis fecunda* Halle

圖 1 係斯行健、李星學 1951, Pl. 1, fig. 5 的標本,重新登載於此。

1a, 放大×3; 1b, 放大×8; 1c—1e 放大×15; 1f 放大× 30。

注意孢子囊的形態及其排列的狀況。

地點: 甘肅武威縣南營兒

地層: 延長層上部

登記號碼: *PB. 2015.*

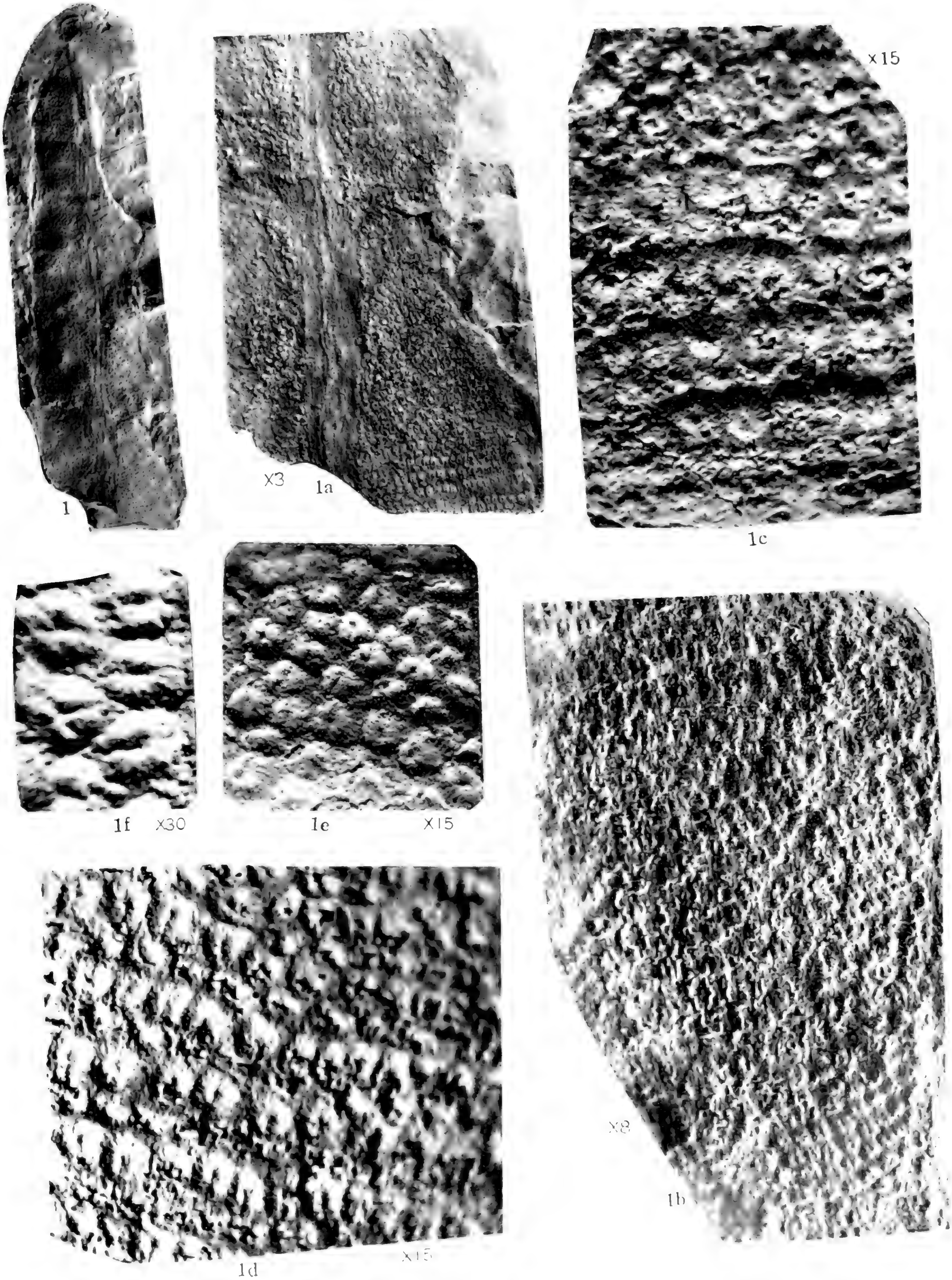

1
X3
1a
x15
1c
1f
X30
1e
X15
X8
1b
1d
x15

圖 版 XXXII

圖 1—3 *Bernoullia zeilleri* P'an，1a 放大×2。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2382—PB. 2384.*

圖 4 ?*Thinnfeldia major* Raciborski

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2410.*

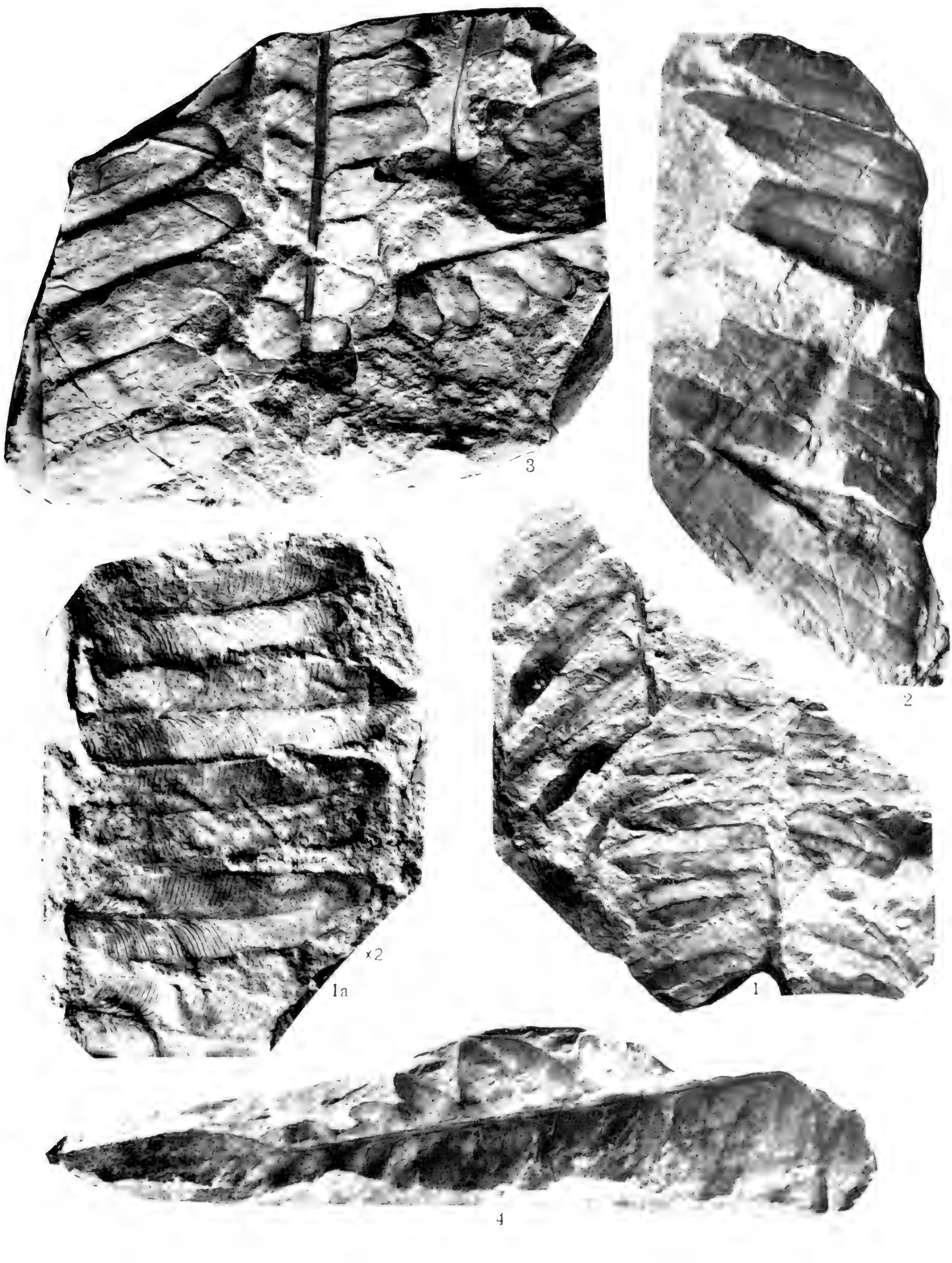

3
2
×2
1a
1
4

圖 版 XXXIII

圖 1—3 *Bernoullia zeilleri* P'an，1a，1b，1c 放大×3。

圖 1,2 是兩塊實羽片標本並且這兩塊標本是代表着一個植物體的正負兩面 (Part & Counterpart).
注意聚合囊的排列狀況。

圖 3 是裸羽片化石

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2385—PB. 2387*.

圖 4 ?*Danaeopsis* sp. 可能是 *Danaeopsis* 的年青蕨葉 (Frond)。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2380*.

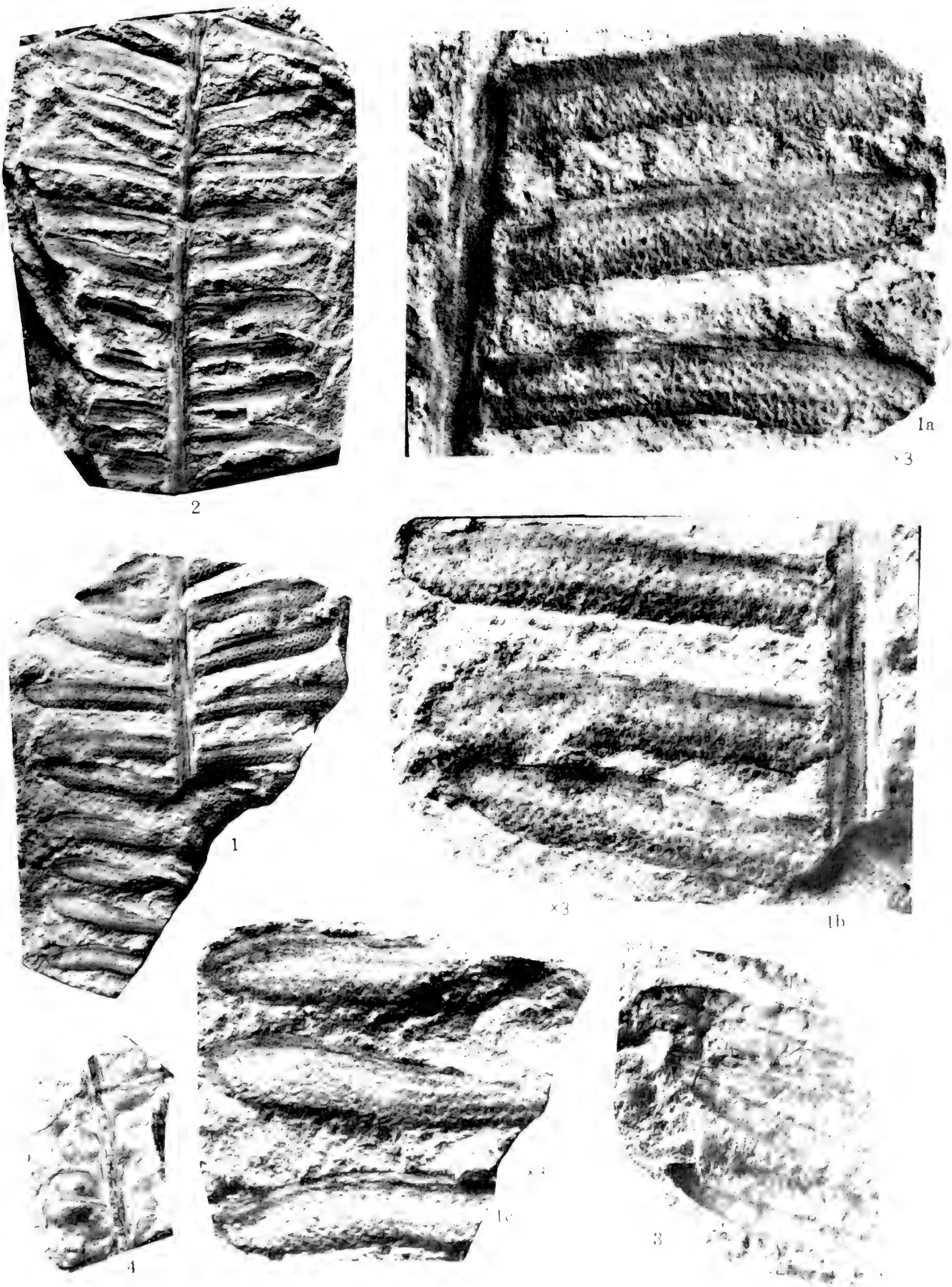

2
1a
×3
1
×3
1b
1c
4
3

圖 版 XXXIV

圖 1—4 *Bernoullia zeilleri* P'an，3a 放大×3。

圖 1,2,4 地點：陝西宜君縣杏樹坪的七母橋

圖 3 地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2388—PB. 2391.*

圖 5，5a *Thinnfeldia rhomboidalis* Ettingshausen，5a 放大×2。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

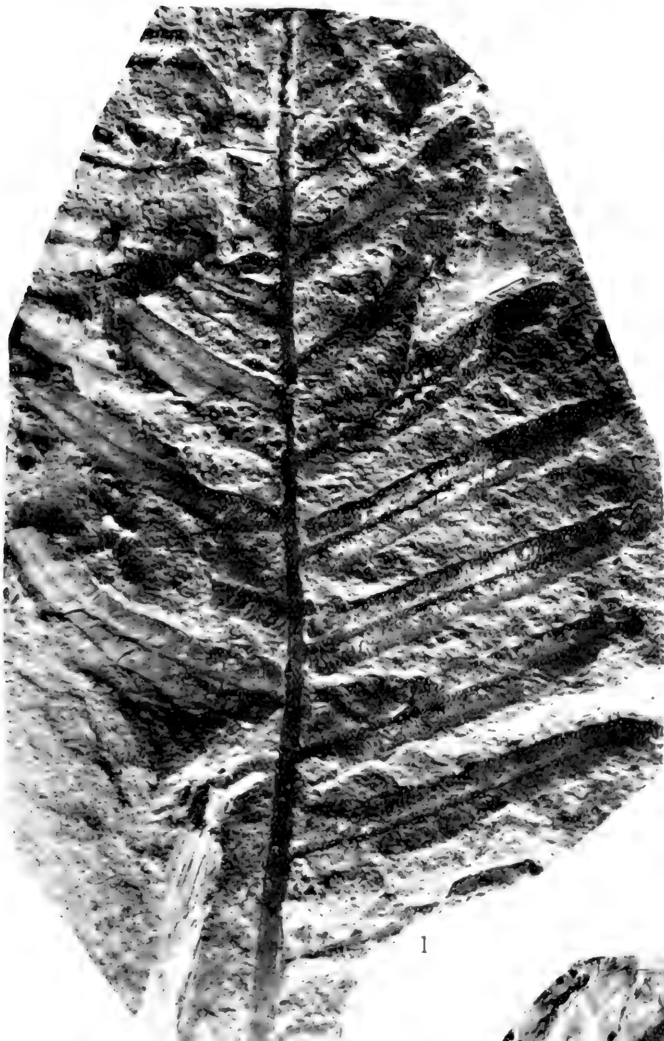
登記號碼：*PB. 2408.*

圖 6 *Thinnfeldia alethopteroides* Sze 新種。

地點：陝西宜君縣杏樹坪的七母橋

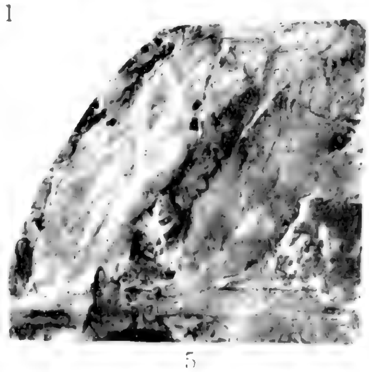
地層：延長層上部

登記號碼：*PB. 2421.*

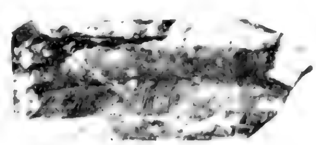


1

2

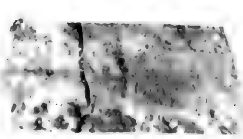


5

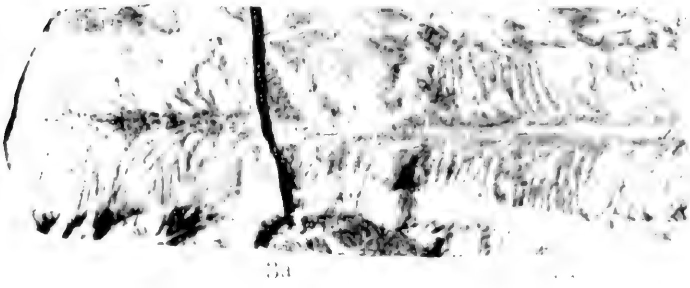


4

6



3



3a

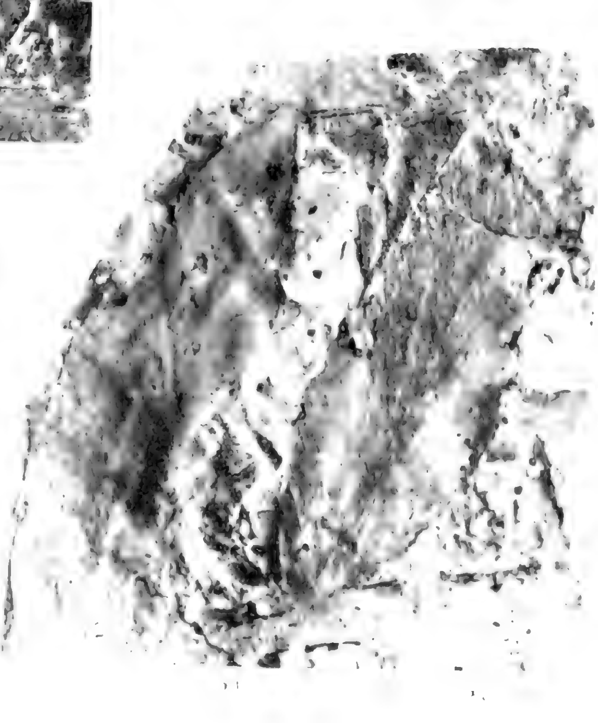


圖 版 XXXV

圖 1, 1a *Sagenopteris spatulata* Sze 新種，1a 放大×2。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2472.*

圖 2, 2a *Sagenopteris* sp., 2a 放大×2。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2473.*

圖 3,4 *Ctenopteris sarrani* Zeiller，3a 放大×2。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

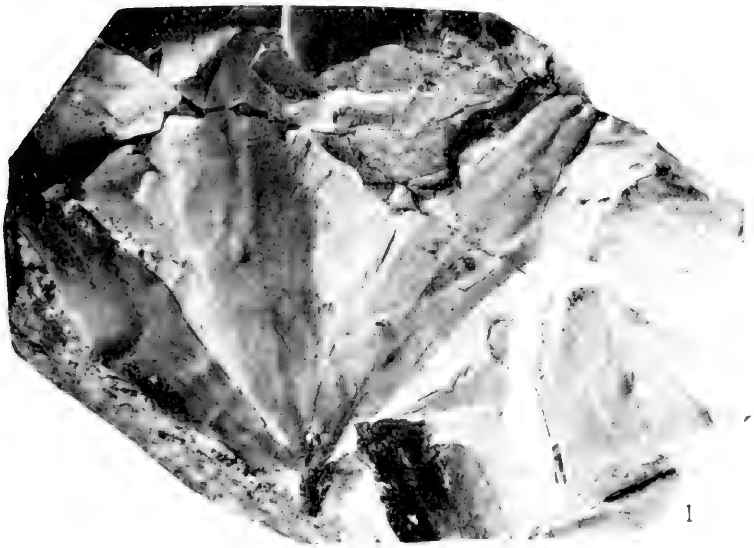
登記號碼：*PB. 2430—PB. 2431.*

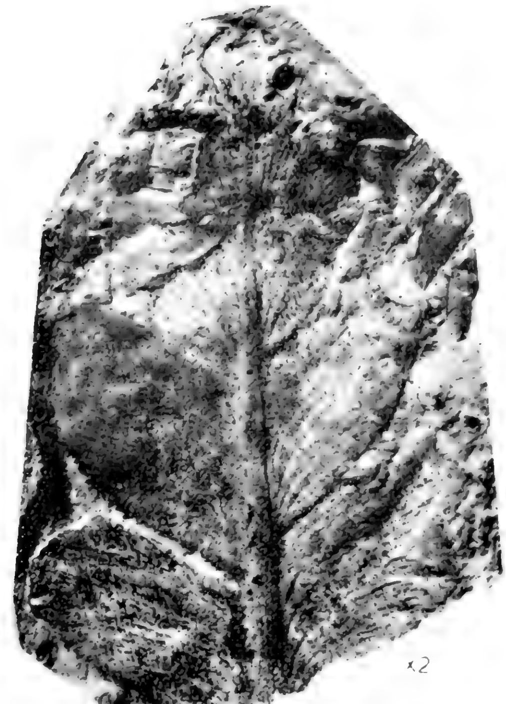
圖 5 *Danaeopsis fecunda* Halle

地點：陝西鱗游縣北馬坊

地層：延長層層位不明

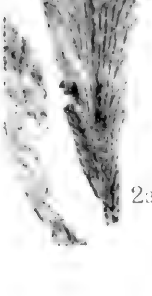
登記號碼：*PB. 2378*。


1


×2
3a


×2
1a


4


2a


2


3


5

圖 版 XXXVI

圖 1,2 *Sphenozamites changi* Sze 新種，都是原大。

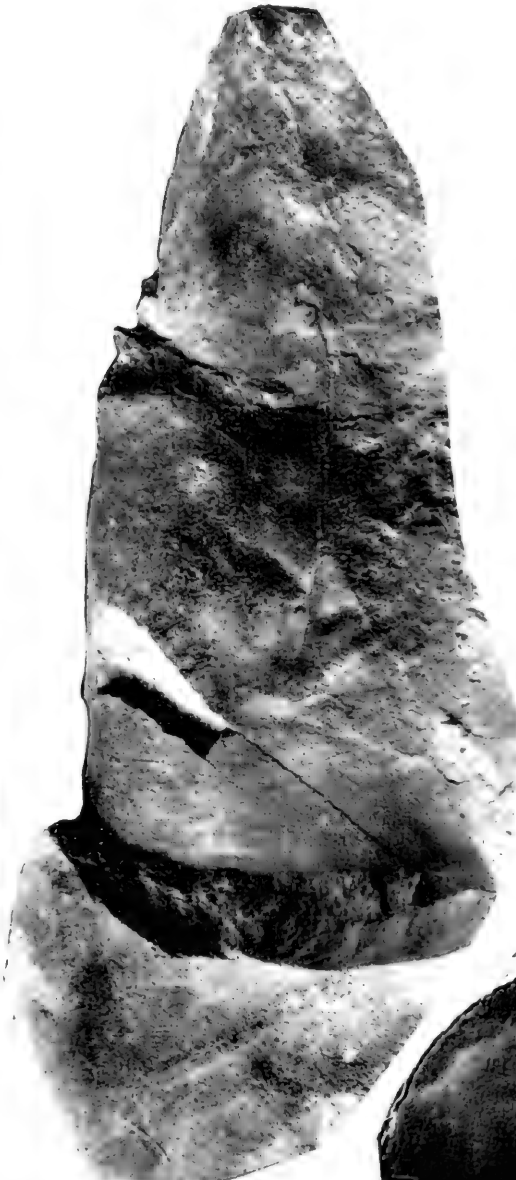
圖 1, 1a, 1b, 是一塊標本,圖 1 是標本的正面；1a 是標本的右面；1b 是標本的左面；1a 和 1b 互成一個約 30° 的角度。這塊標本的保存狀況,不是平鋪着于母岩上面的。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2435—PB. 2436*.

1



1a

1b

2

圖 版 XXXVII

圖 1—5 *Sphenozamites changi* Sze 新種，都是原大。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2437—PB. 2441.*

圖 6—8 ?*Thinnfeldia nordenskiöldi* Nathorst

圖 6,7 地點：陝西宜君縣杏樹坪的七母橋

登記號碼：*PB. 2411—PB. 2412.*

圖 8 地點：陝西綏德縣葉家坪（即潘 1936 Pl, XII, fig. 6 的標本）

地層：延長層上部

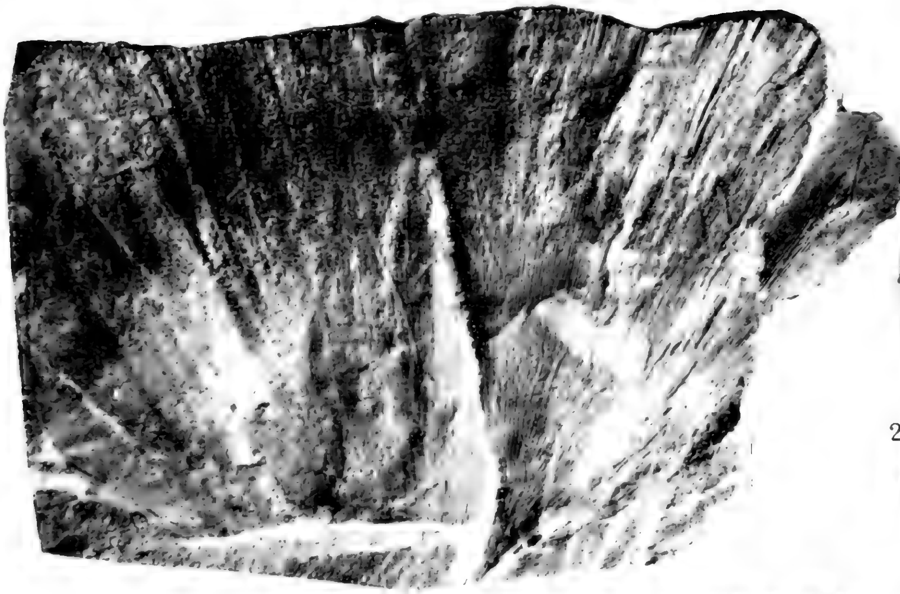
登記號碼：*PB. 756*（*P. 110*）

圖 9 *Bernoullia zeilleri* P'an

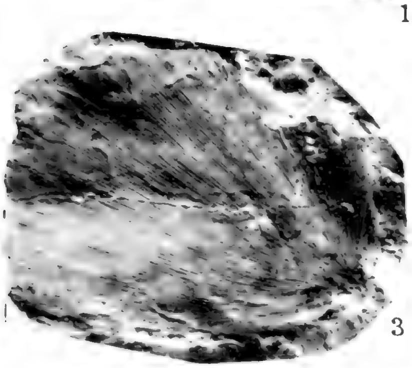
地點：陝西宜君縣杏樹坪的七母橋

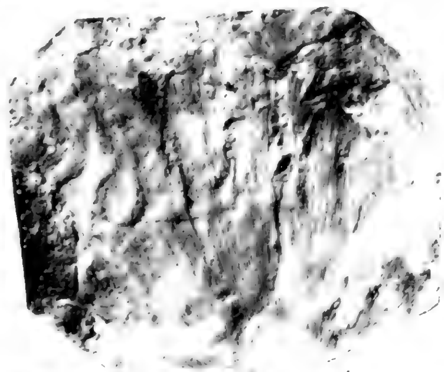
地層：延長層上部

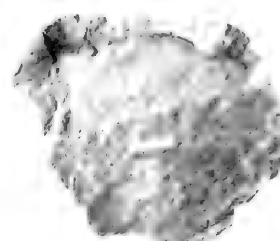
登記號碼：*PB. 2392.*

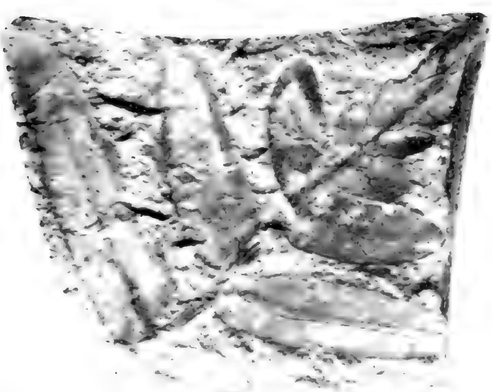

1

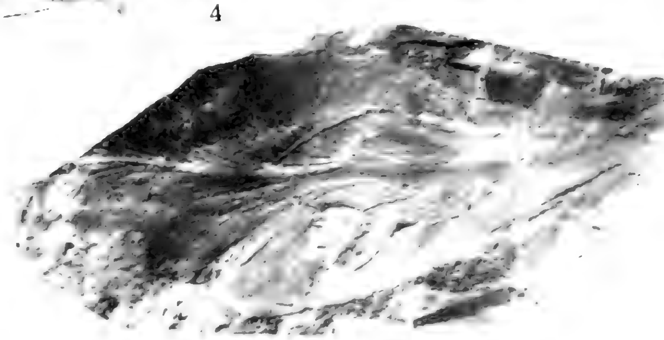

2

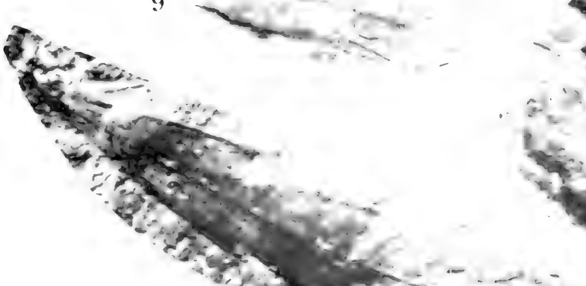

3


4


5


9


6


8

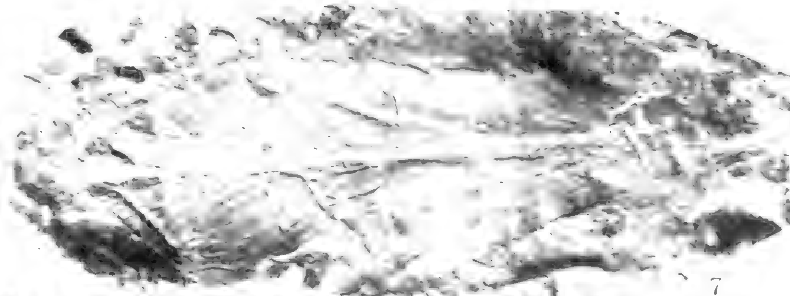

7

圖 版 XXXVIII

圖 1—3 *Sphenozamites changi* Sze 新種，都是原大。

地點：陝西宜君縣杏樹坪的七母樹

地層：延長層上部

登記號碼：*PB. 2442—PB. 2444.*

圖 4，4a *Glossophyllum? shensiense* Sze 新種，4a 放大×2。

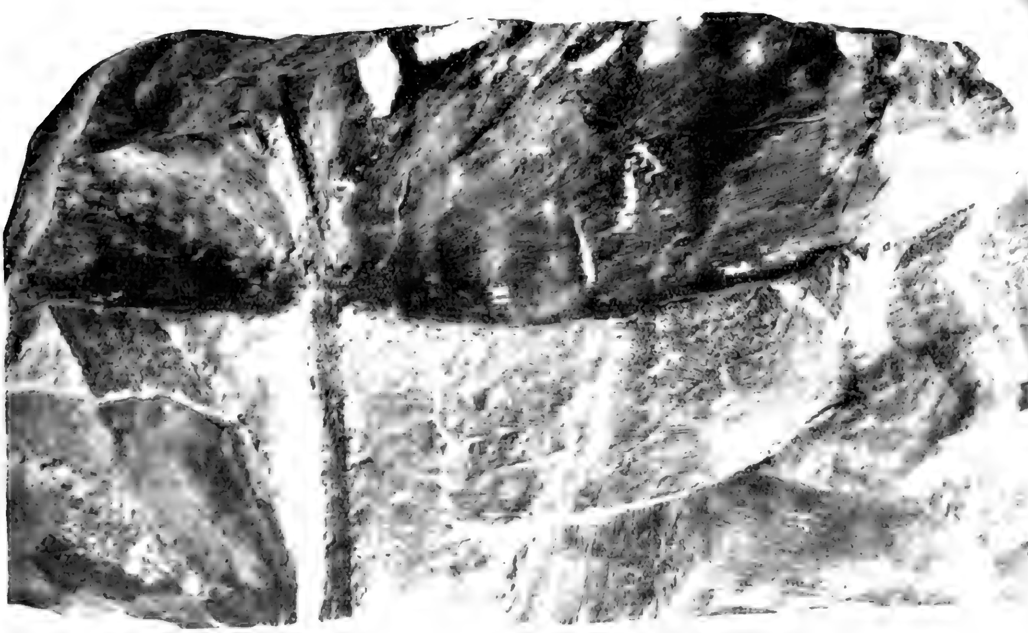
地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

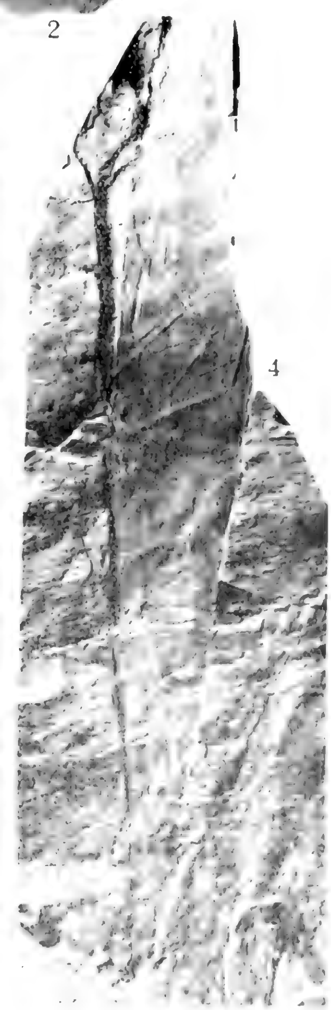
登記號碼：*PB. 2455.*

3

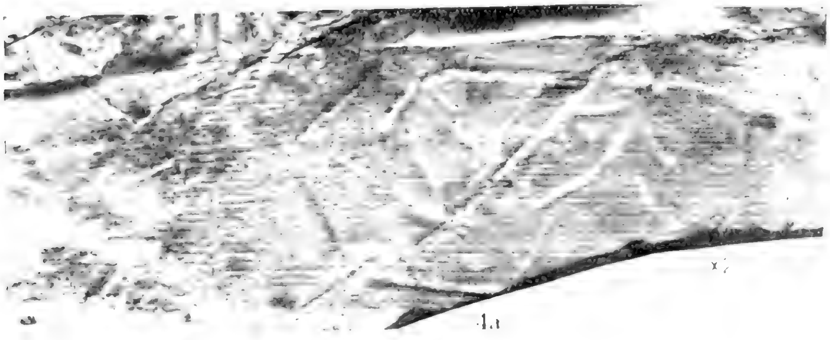
2



1



4



4a

圖 版 XXXIX

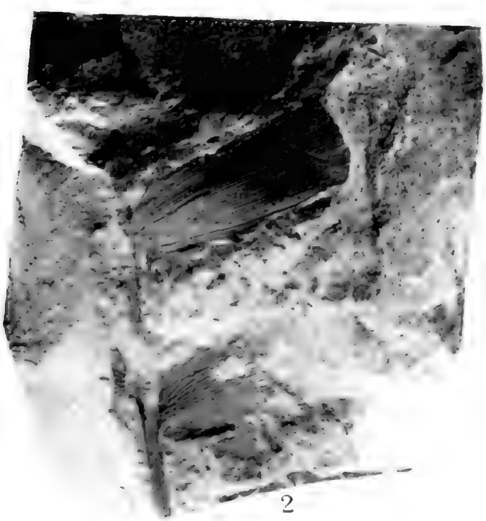
圖 1—3 *Sinozamites leeiana* Sze 新屬,新種, 1a 放大×2。

地點: 陝西宜君縣杏樹坪的七母橋

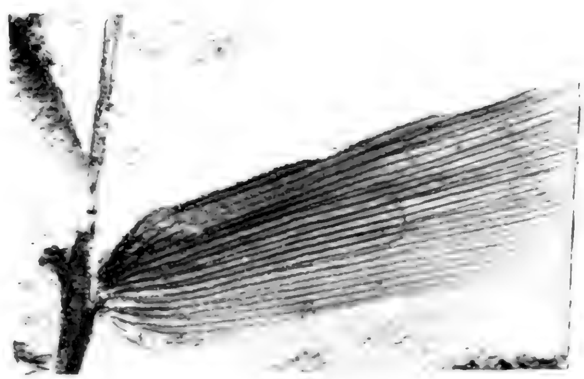
地層: 延長層上部

登記號碼: *PB. 2447—PB. 2449*.

1



2



1a　×2

3

圖 版 XL

圖 1, 1a, 2 *Drepanozamites? p'ani* Sze 新種，1a 放大×2。

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2445—PB. 2446.*

圖 3 *Ginkgoites chowi* Sze 新種。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2451.*

圖 4—6 *Neocalamites rugosus* Sze 新種。

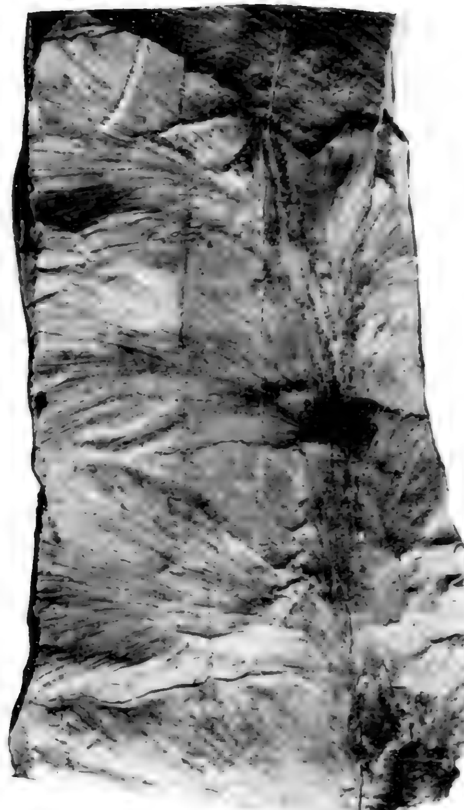
地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

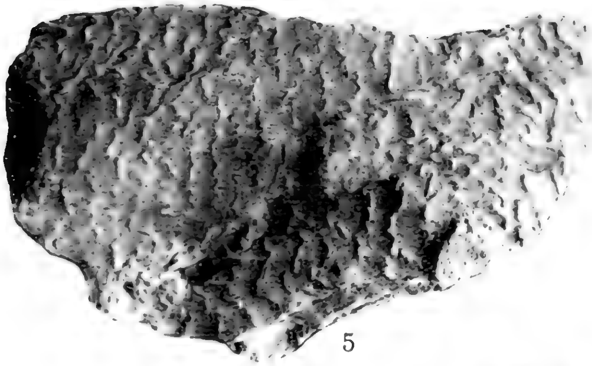
登記號碼：*PB. 2270—PB. 2272.*

4

6

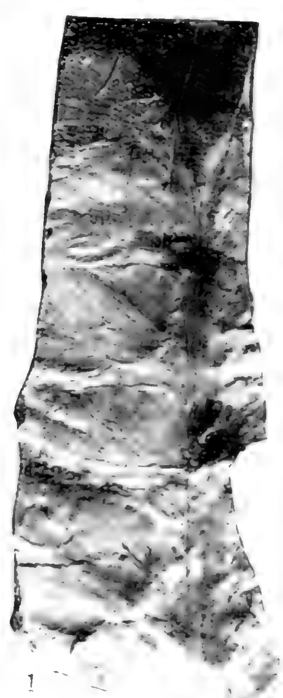


1a ×2



5

2



1

3

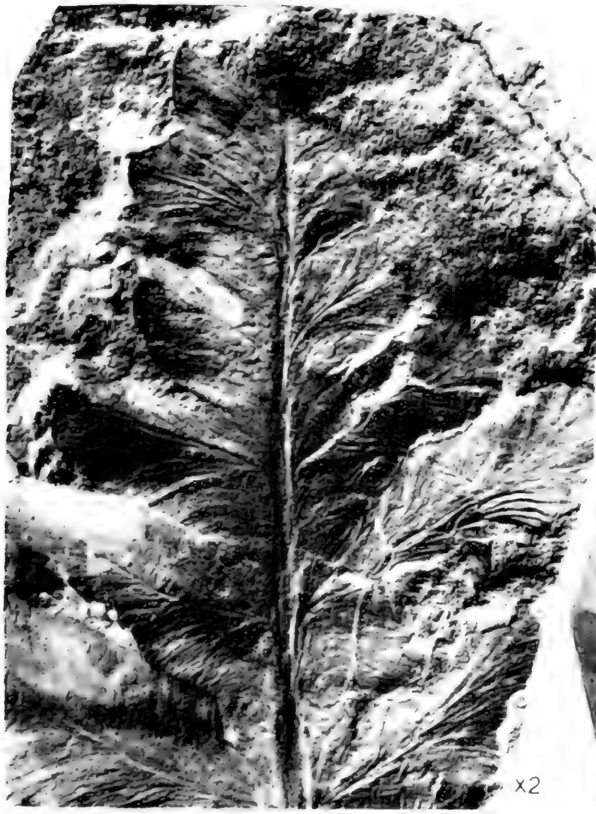
圖 版 XLI

圖 1—3 *Thinnfeldia rigida* Sze 新種，1a 放大×2。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2413—PB. 2415.*



1a ×2

1

2

3

圖 版 XLII

圖 1,2, 2a *Thinnfeldia rigida* Sze 新種，2a 放大×2。

圖 1a 是圖版 XLI, 圖 2 的標本放大× 2 的。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2417.*

圖 3 *Thinnfeldia major* Raciborski

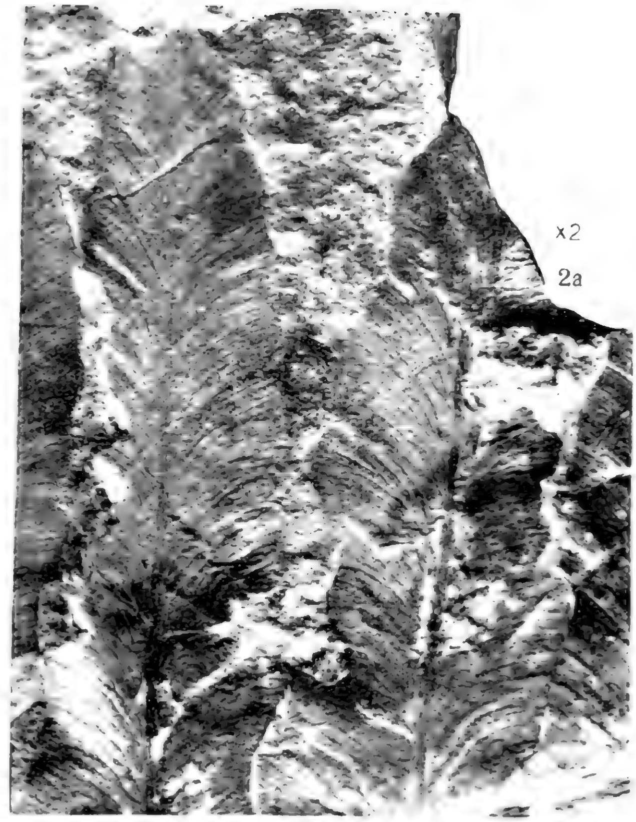
地點：陝西延安縣（詳細地點不明）

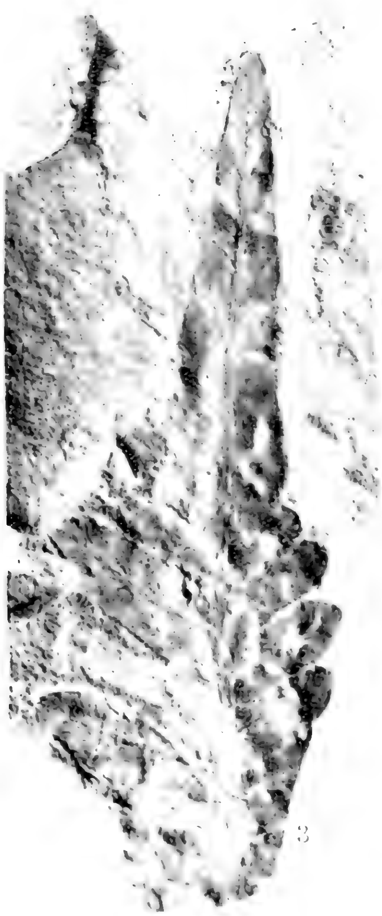
地層：延長層層位不明

登記號碼：*PB. 2409.*

/


2


×2
2a


3


1

圖 版 XLIII

圖 1 *Danaeopsis fecunda* Halle

此係潘鍾祥 1936, Pl. X, fig. 3 的標本,重新登載於此。

地點: 陝西綏德縣葉家坪

地層: 延長層上部

登記號碼: *PB. 741* (*P. 95*).

圖 2 *Bernoullia zeilleri* P'an

地點: 陝西宜君縣杏樹坪的七母橋

地層: 延長層上部

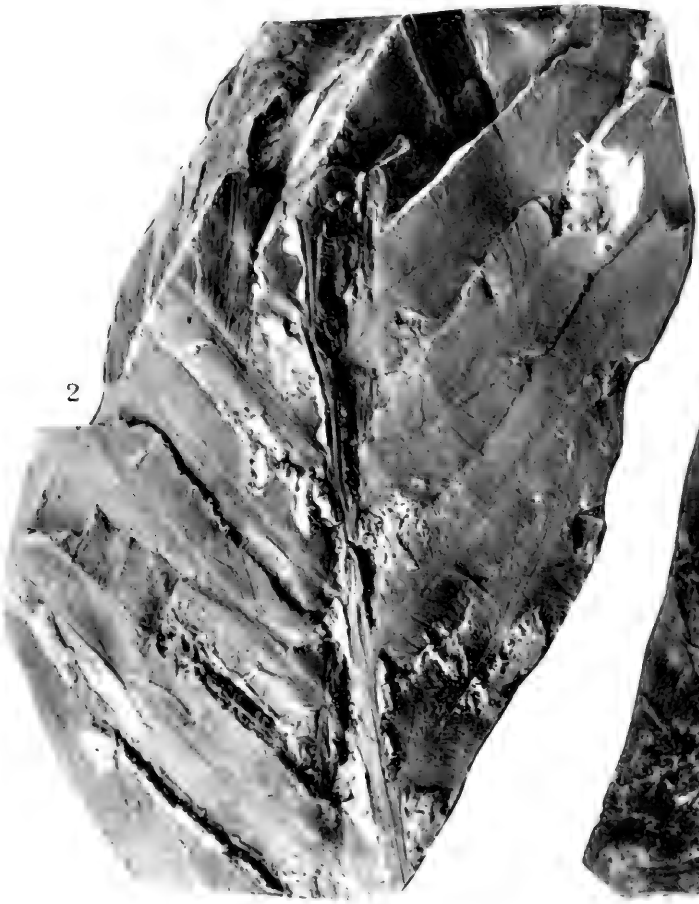
登記號碼: *PB. 2393*.

圖 3, 4 *Thinnfeldia rigida* Sze 新種。

地點: 陝西宜君縣杏樹坪的七母橋

地層: 延長層上部

登記號碼: *PB. 2418—PB. 2419*.



2

1

3

4

圖 版 XLIV

圖 1—4 *Thinnfeldia laxusa* Sze 新種，1a 放大×3。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2424—PB. 2427.*

圖 5,6 *Bernoullia zeilleri* P'an，5a 放大×3。

圖 5　地點：陝西宜君縣四郎廟的炭河溝

圖 6　地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

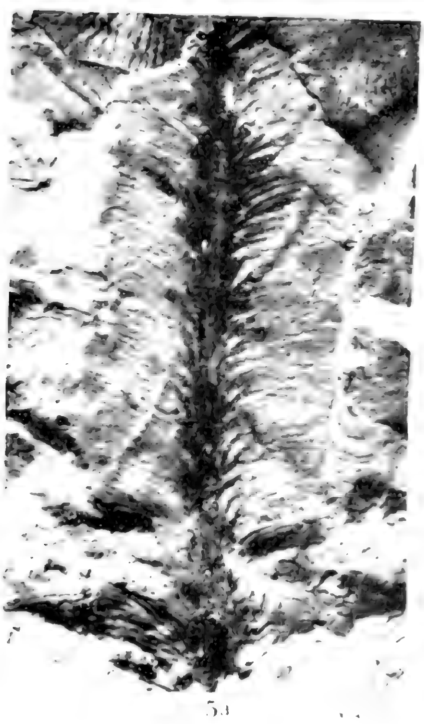
登記號碼：*PB. 2394—PB. 2395.*

1a　×3

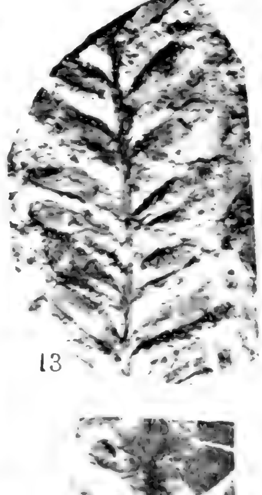
1

2

4



5a



13

5

6

圖 版 XLV

圖 1-2 *Thinnfeldia alethopteroides* Sze 新種，放大×2。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2422—PB. 2423.*

圖 3,4 *Thinnfeldia laxusa* Sze 新種，3a 放大×3。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

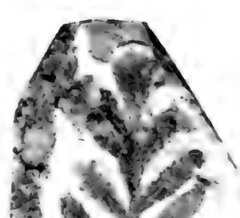
登記號碼：*PB. 2428—PB. 2429.*

1

1a ×2

3

2



4

3a

圖 版 XLVI

圖 1—3 ?*Protoblechnum hughesi* (Feistm.) Halle (? 新種)。

圖 1,2 是潘鍾祥,1936,Pl, IX, fig. 2 及 Pl. X, fig. 1 的標本重新登載於此以資比較。

地點: 陝西安定縣蟠龍鎮南的窰坪。

地層: 瓦窰堡系下部

登記號碼: *PB. 733 (P. 87)*. *PB. 739 (P. 93)*.

圖 3 是潘鍾祥 1936, Pl. IX, fig. 4 的標本,重新登載於此;

地點: 陝西綏德縣葉家坪

地層: 延長層上部

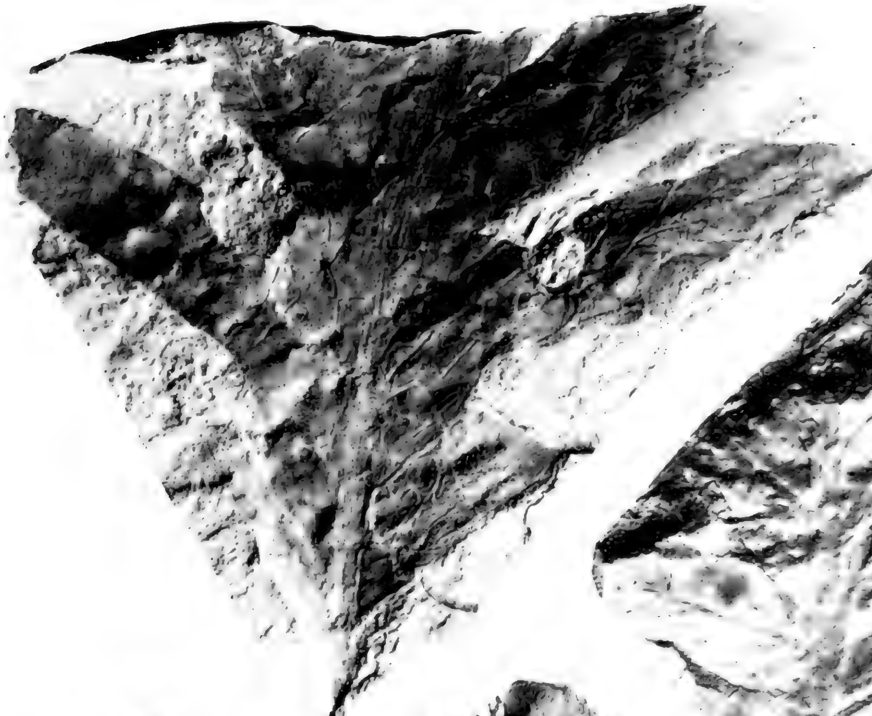
登記號碼: *PB. 735 (P. 89)*.

圖 4—6 ?*Protoblechnum hughesi* (Feistm.) Halle (? 新種)

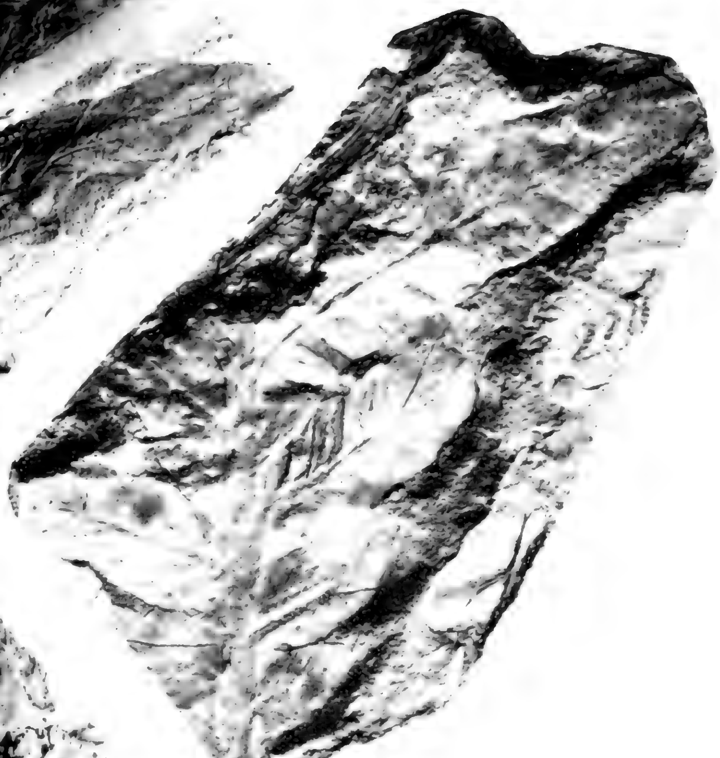
地點: 陝西宜君縣四耶廟的炭河溝

地層: 延長層上部

登記號碼: *PB. 2432—PB. 2434*.



1



3

6

5

4

2

圖 版 XLVII

圖 1 *Ginkgoites magnifolia* (Fontaine)

此係潘鍾祥, 1936, Pl. XII, fig. 9 的標本,重新登載於此。

地點: 陝西綏德縣高家庵

地層: 延長層下部

登記號碼: *PB. 759* (*P. 113*).

圖 2 *Ginkgoites chowi* Sze 新種。

地點: 陝西宜君縣杏樹坪的七母橋

地層: 延長層上部

登記號碼: *PB. 2452*.

圖 3, 4 *Ginkgoites* sp.

地點: 陝西宜君縣杏樹坪的七母橋

地層: 延長層上部,

登記號碼. *PB. 2453—PB. 2454*.

圖 5 *Psygmophyllum*? sp.

地點: 陝西宜君縣杏樹坪的七母橋

地層: 延長層上部

登記號碼: *PB. 2471*.

圖 6, 6a, 6b ?*Sphenobaiera furcata* (Heer) Florin, 6a 放大×100; 6b 放大×250。

圖6a,6b 表皮及小氣孔的構造。

地點: 山西興縣李家凹

地層: 延長層下部

登記號碼: *PB. 2469—PB. 2470*.

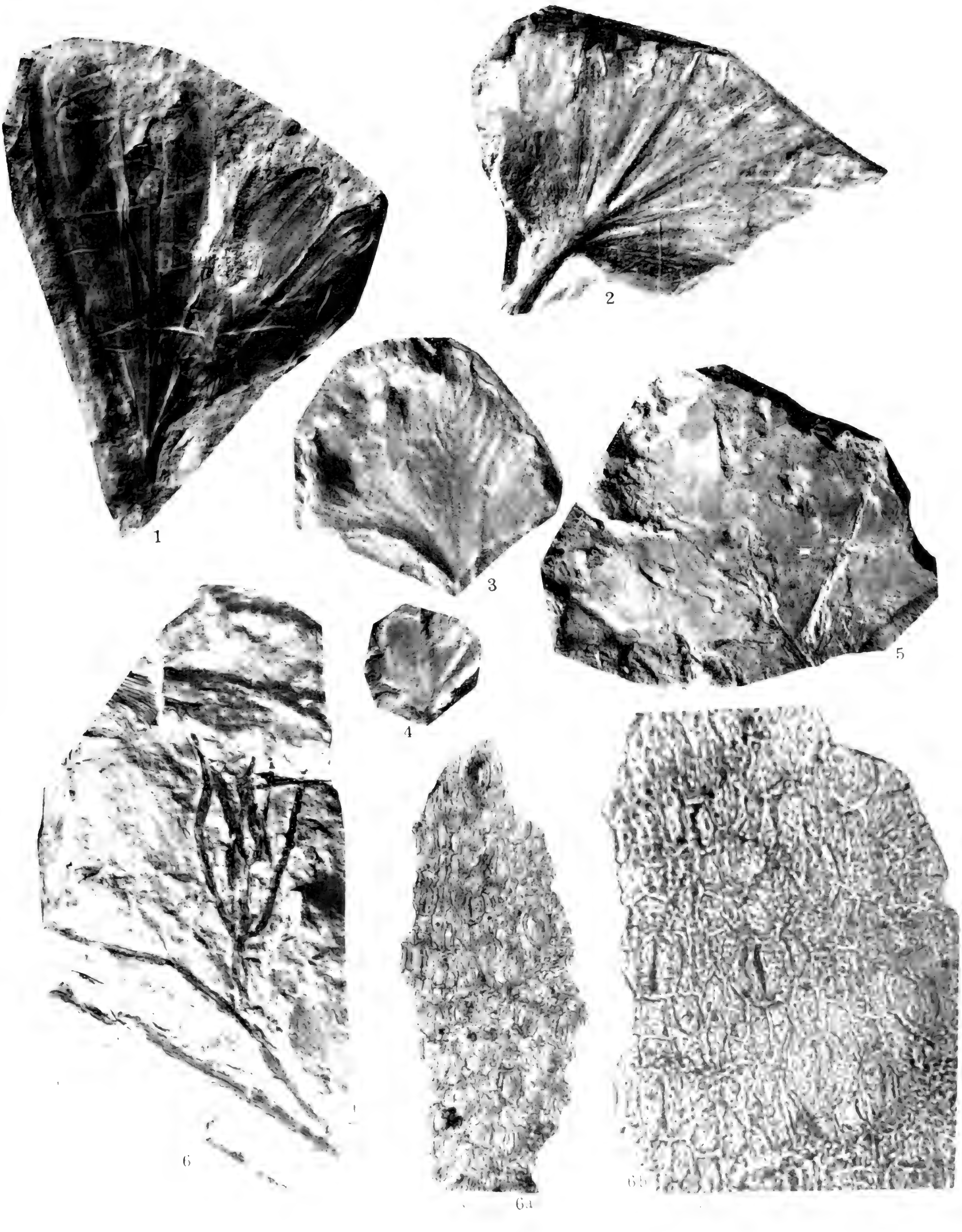

1
2
3
4
5
6
6a
6b

圖 版 XLVIII

圖 1—3 *Glossophyllum? shensiense* Sze，新種。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2456—PB. 2458.*

1

2

3

圖 版 XLIX

圖 1—6 *Glossophyllum? shensiense* Sze 新種，5a 放大×3。

圖 5,6 可能是這一個種的枝部化石，注意作眼睛狀的葉痕。

圖 1,2 地點：陝西宜君縣杏樹坪的七母橋

圖 3-6 地點：陝西宜君縣四郎廟的炭河溝

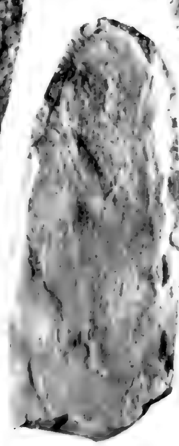
地層：延長層上部

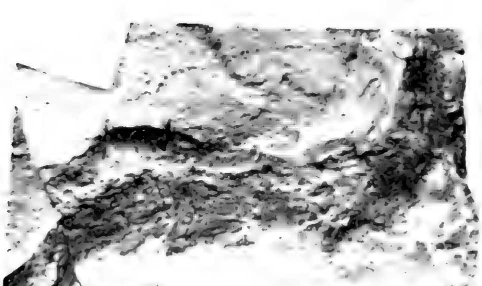
登記號碼：*PB. 2459—PB. 2468.*


1


2


3


4


6


5

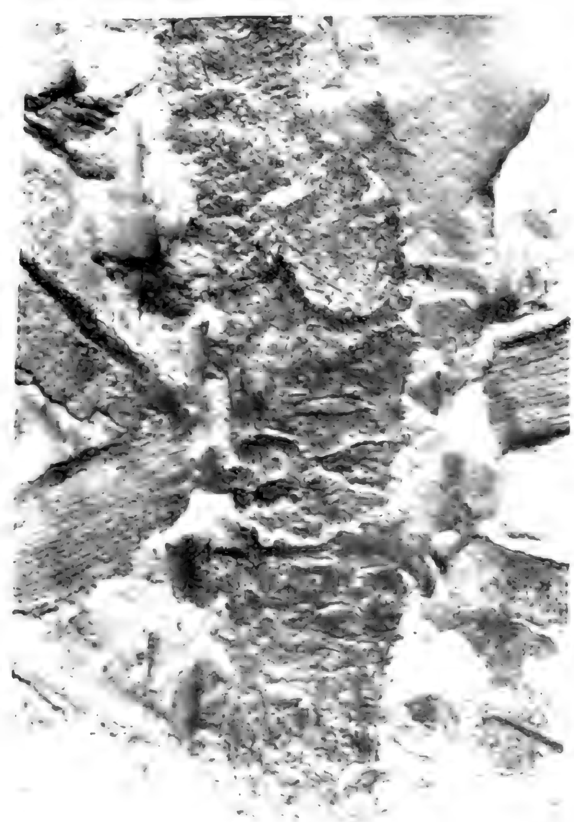

5a

圖 版 L

圖 1—3 *Glossophyllum? shensiense* Sze 新種，1a，2a 放大×3。

圖 1　是潘鍾祥 1936, Pl. XIII, fig. 1 的標本重新登載於此。

地點：陝西綏德縣沙灘坪

地層：延長層中部

登記號碼：*PB. 761* (*P. 115*).

圖 2　地點：陝西宜君縣四郎廟的炭河溝

圖 3　地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2465—PB. 2466.*

圖 4 *Sinozamites leeiana* Sze 新屬,新種。

此係自圖版 XXXIX,圖 3 的標本的一部分放大× 2。

地層：延長層上部

登記號碼：*PB. 2449.*

4　×2

2

3

1

1a

2a

圖 版 LI

圖 1—3 *Swedenborgia cryptomerioides* Nathorst，1a，1b 放大× 3。

圖 1　地點：陝西宜君縣四郎廟的炭河溝　S. 代表兩個種子化石。

圖 2,3 地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2475—PB. 2477.*

圖 4—6 ?*Stenorachis* (*Ixostrobus*?) *konianus* Ôishi & Huzioka

圖 4,5 係兩塊標本，代表着一個植物體的正負兩面 (Part & Counterpart)

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2478—PB. 2479.*


S
S
1b
×3
1
×3
1a
6
2
3a
×2
3
4
5

圖 版 LII

圖 1 *Podozamites lanceolatus* (L. & H.) Braun

此係潘鍾祥 1936, Pl. XV, fig. 1 的標本,重新登載於此。

地點: 陝西綏德縣葉家坪

地層: 延長層上部

登記號碼: *PB. 779* (*P. 133*).

圖 2 *Thinnfeldia rigida* Sze 新種。

注意葉體 (Frond) 作兩次羽狀分裂的形態

地點: 陝西宜君縣杏樹坪的七母橋

登記號碼: *PB. 2420*.

圖 3 *Bernoullia zeilleri* P'an

地點: 陝西宜君縣杏樹坪的七母橋

地層: 延長層上部

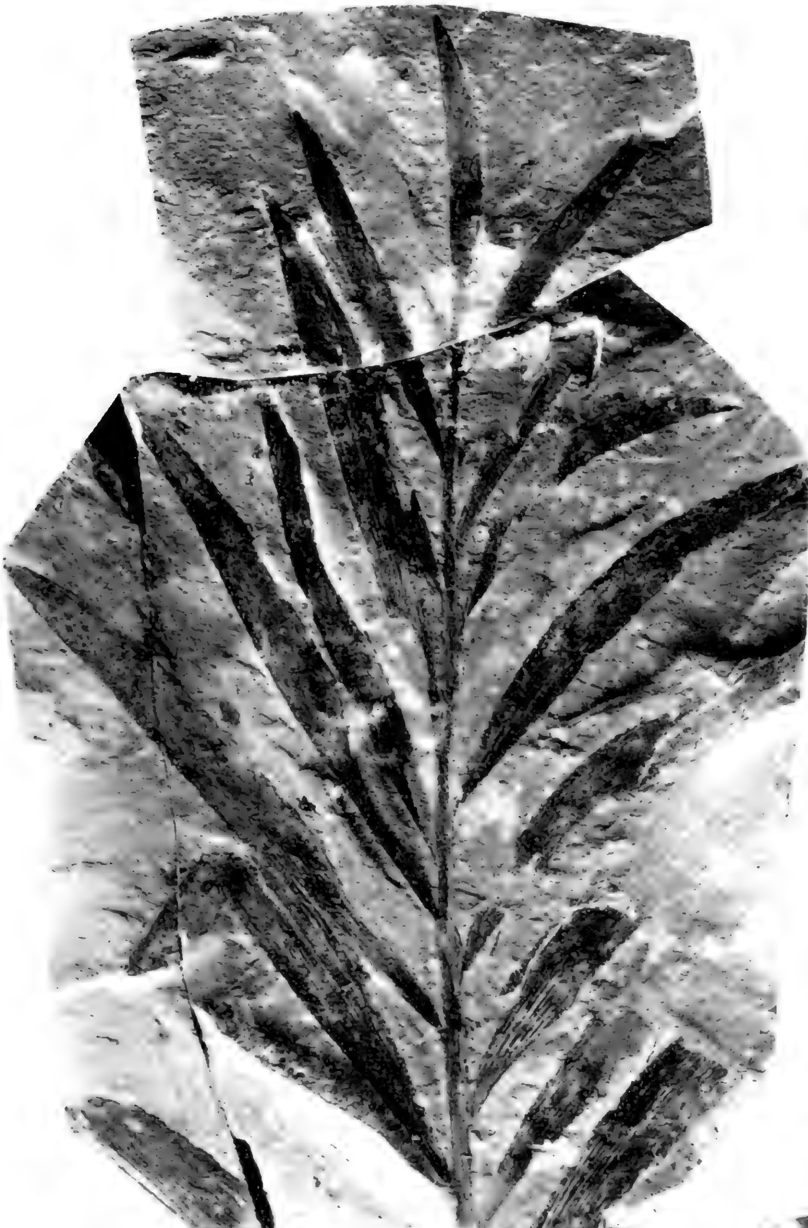
登記號碼: *PB. 2396*.

圖 4 *Danaeopsis fecunda* Halle

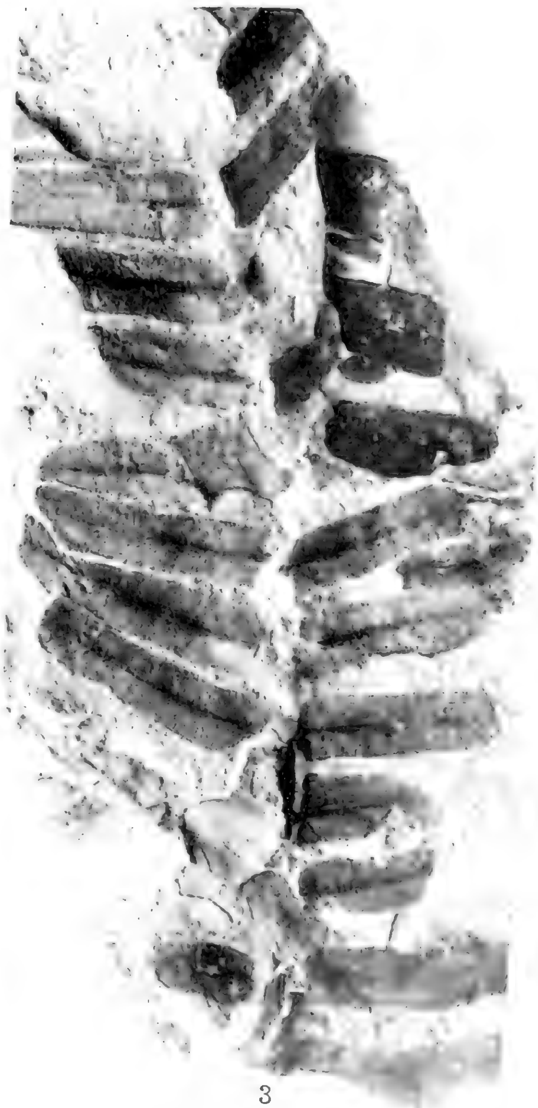
地點: 山西興縣李家凹

地層: 延長層下部

登記號碼: *PB. 2379*.

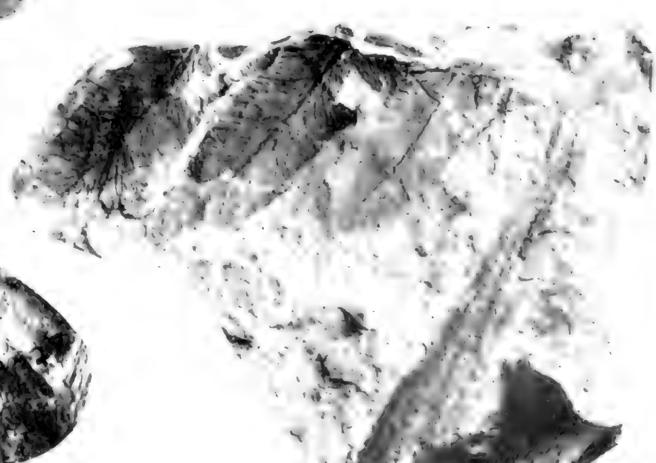


1



3

4



2

圖 版 LIII

圖 1 *Podozamites lanceolatus* (L. & H.) Braun

此係潘鍾祥 1936, Pl. XV, fig. 3 的標本重新登載於此。

地點：陝西綏德縣葉家坪

地層：延長層上部

登記號碼：*PB. 781* (*P. 135*).

圖 2 *Bernoullia zeilleri* P'an

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2397*.

圖 3 *Cladophlebis raciborskii* Zeiller

地點：陝西宜君縣四郎廟的炭河溝

地層：延長層上部

登記號碼：*PB. 2340*.

圖 4 *Cladophlebis ichünensis* Sze 新種。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2357*.

圖 5 *Sinozamites leeiana* Sze 新屬，新種。

地點：陝西宜君縣杏樹坪的七母橋

地層：延長層上部

登記號碼：*PB. 2450*.

圖 6 *Desmiophyllum* sp.

地點：陝西淸澗縣王家渠

地層：延長層中部

登記號碼：*PB. 2474*.

圖 7a *Danaeopsis*? sp.

圖 7b *Glossophyllum*? *shensiense* 的枝部化石，卽圖版 XLIX 圖 5 的標本。

地點：陝西宜君縣四郎廟炭河溝

地層：延長層上部

登記號碼：*PB. 2463*.

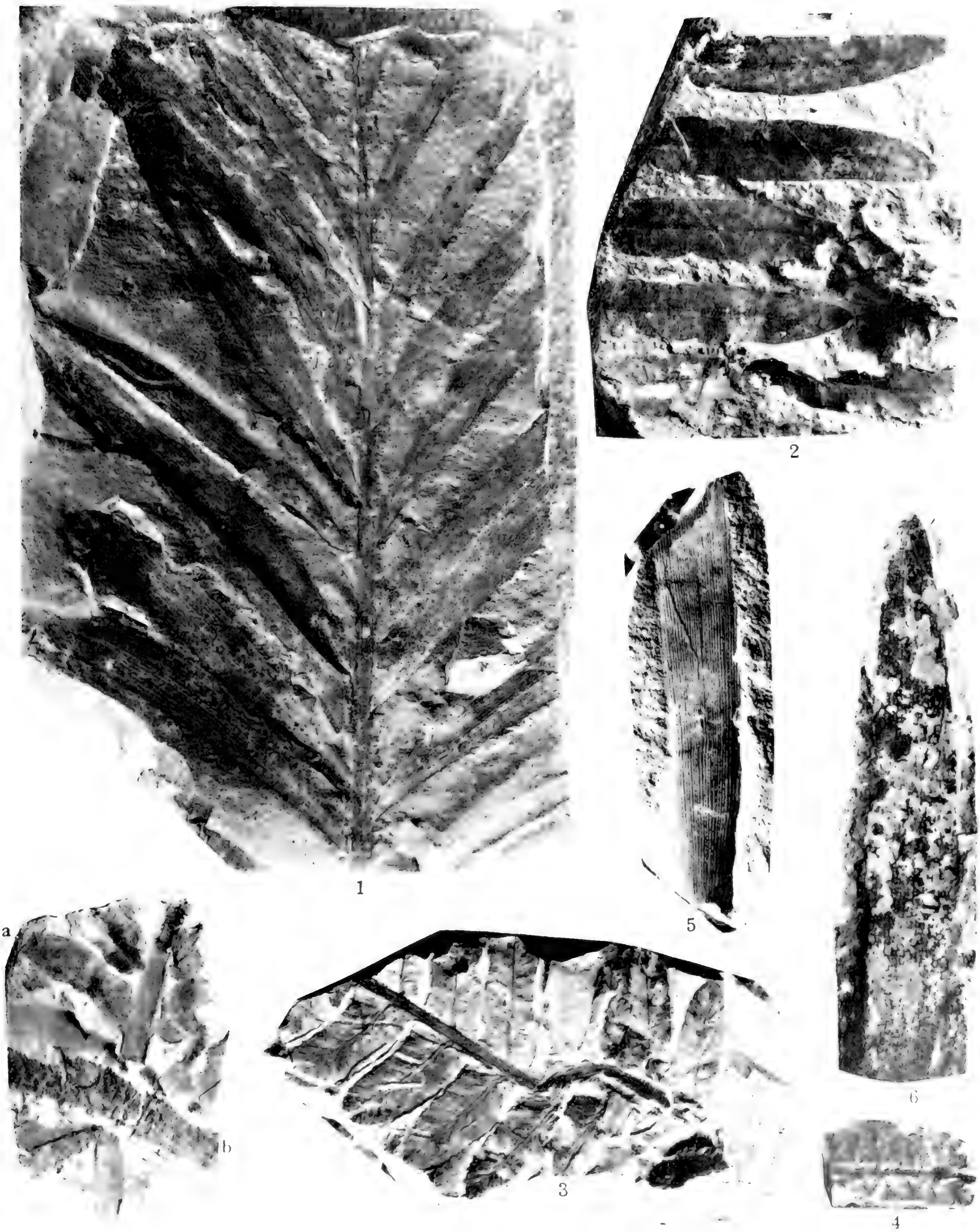

1
2
5
6
a
b
7
3
4

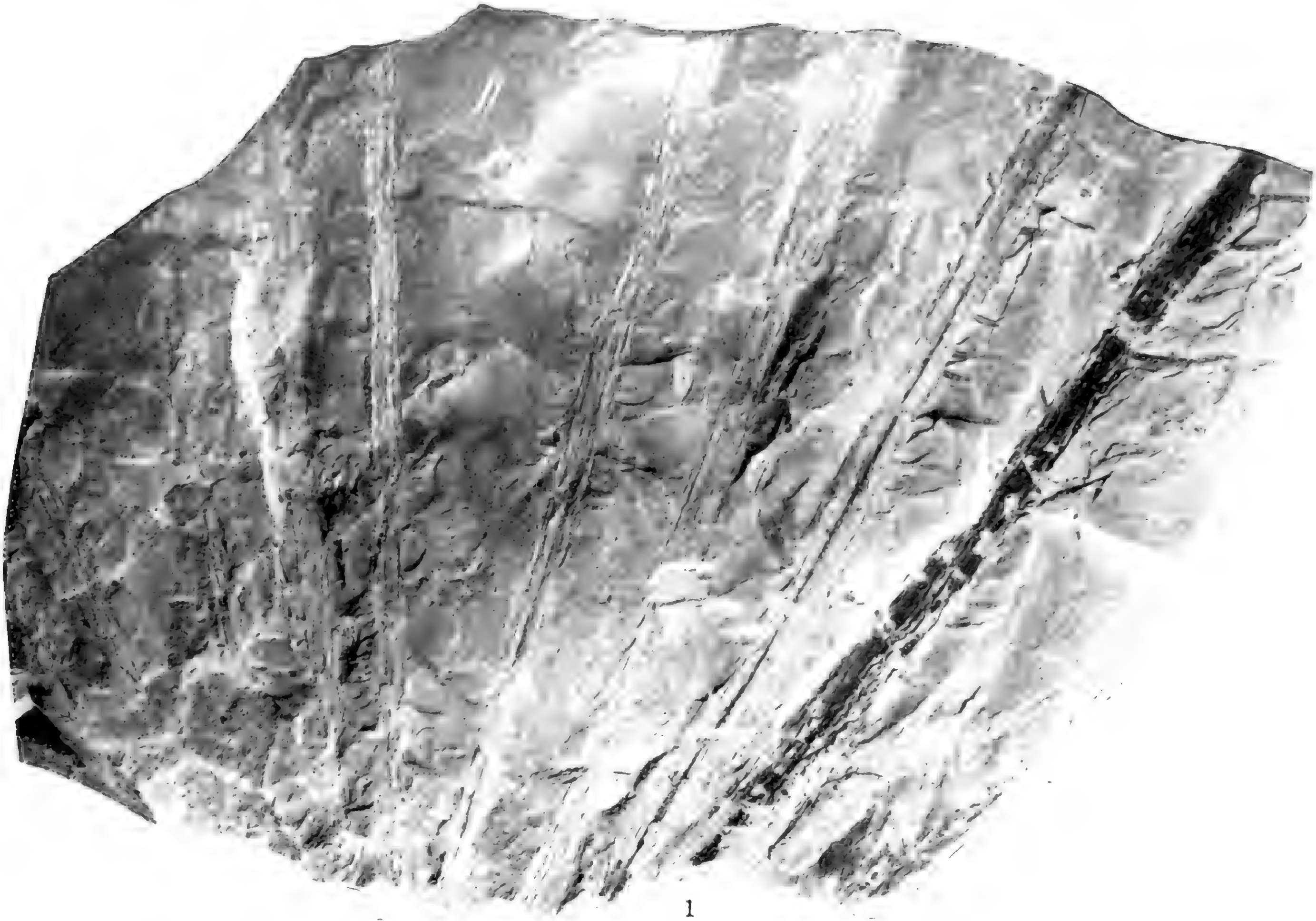
圖 版 LIV

圖 1, 1a *Taeniocladopsis rhizomoides* Sze 新屬,新種 1a 放大× 2。

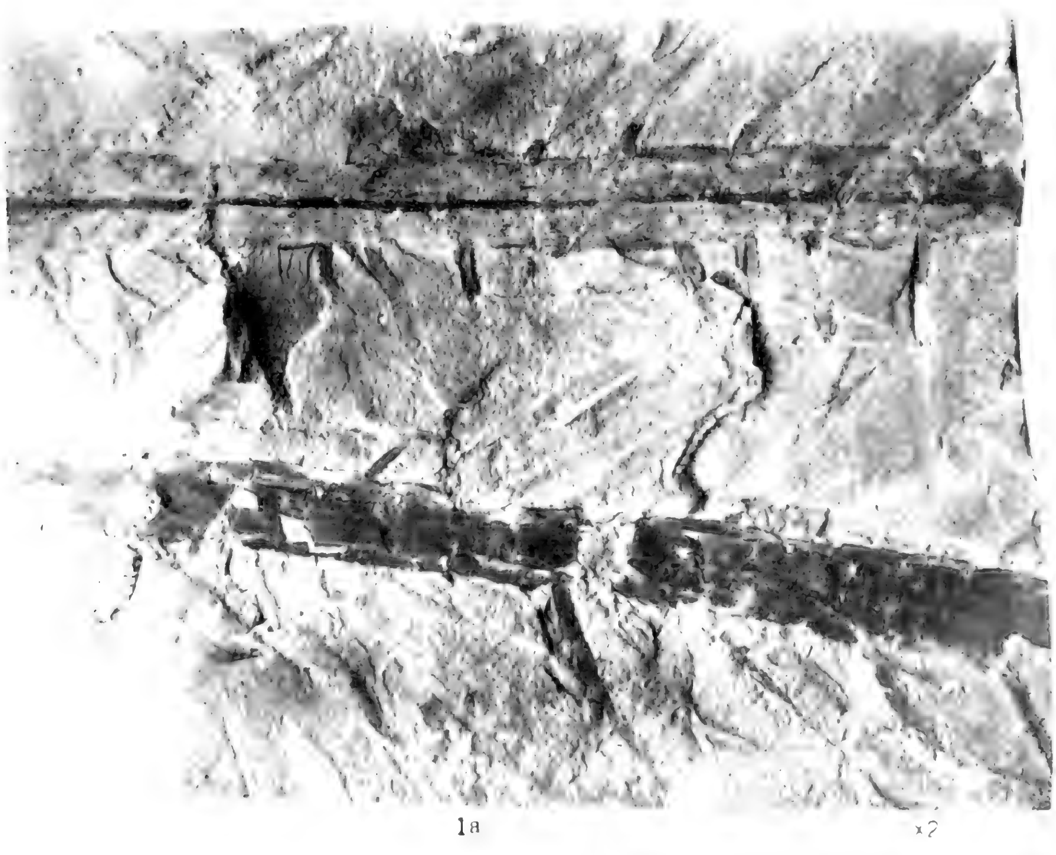
地點：陝西延長縣周家灣

地層：延長層層位不明

登記號碼：*PB. 2494*。



1



1a　　×2

圖 版 LV

圖 1—4 *Taeniocladopsis rhizomoides* Sze 新屬,新種。

注意圖 1,2,3 的基部都有 Neocalamites 的碎片。

地點: 陝西延長縣周家灣

地層: 延長層層位不明

登記號碼: *PB. 2496—PB. 2499.*

圖 5 *Glossophyllum? shensiense* Sze 新種。

地點: 陝西延長縣城西渠口村

地層: 延長層上部

登記號碼: *PB. 2467.*

圖 6, 6a 昆虫的翼部化石 (Insect-wing), 6a 放大× 3。

地點: 陝西黃龍縣 (詳細地點不明)

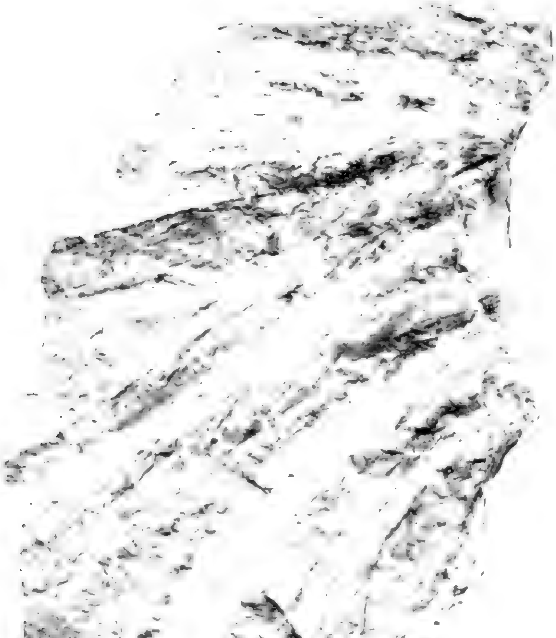
地層: 延長層層位不明

登記號碼: *PB. 2500.*

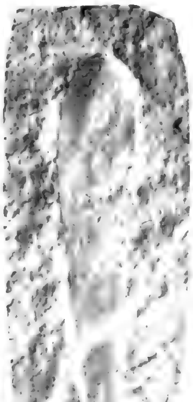

1


6


2


3


6 a


5


4

圖 版 LVI

圖 1—2 *Thallites* sp., 1a 放大× 3。
地點：陝西宜君縣四郎廟的炭河溝
地層：延長層上部
登記號碼：*PB. 2236*.

圖 3 *Conites* sp.
地點：陝西宜君縣四郎廟的炭河溝
地層：延長層上部
登記號碼：*PB. 2480*.

圖 4 疑問的化石 b (Problematicum b)
地點：陝西宜君縣焦家坪
地層：延長層上部
登記號碼：*PB. 2490*.

圖 5 5a 疑問的化石 c (Problmaticum c, *Muscites*? sp.), 5a 放大× 3。
注意中軸上的葉座 ("Polsterbildung")
地點：陝西延長縣城南
地層：延長層上部
登記號碼：*PB. 2491*.

圖 6, 7 根部化石 (*Radicites* sp.)
地點：陝西宜君縣四郎廟的炭河溝
地層：延長層上部
登記號碼：*PB. 2492—PB. 2493*.

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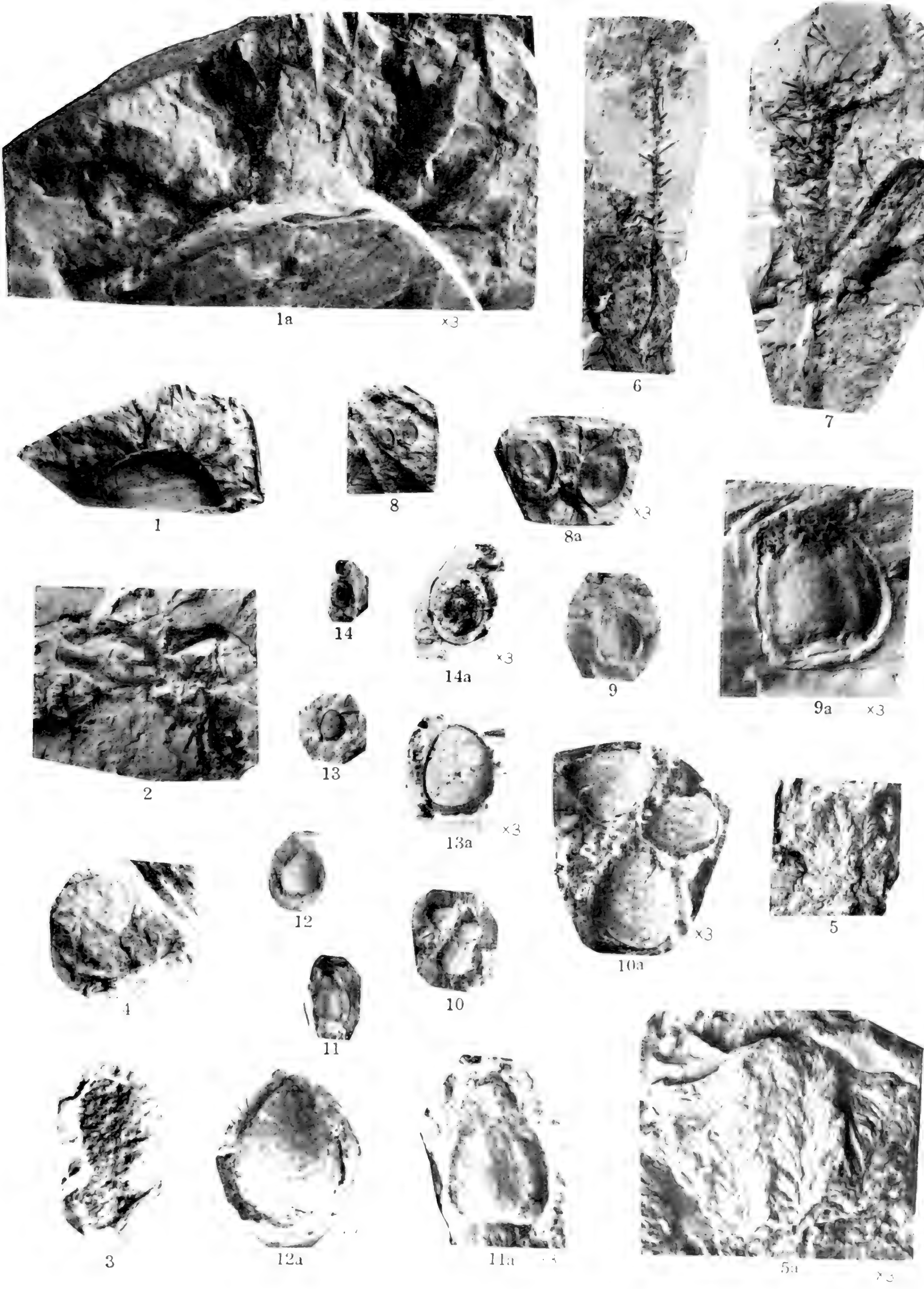
圖 8 地點：陝西宜君縣杏樹坪的七母橋
圖 9–14 地點：陝西宜君縣四郎廟的炭河溝
地層：延長層上部
登記號碼：*PB. 2481—PB. 2487*.


1a ×3
6
7
1
8
8a ×3
14
14a ×3
9
9a ×3
2
13
13a ×3
10a ×3
5
12
4
10
11
3
12a
11a
5a

PALAEONTOLOGIA SINICA

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OLDER MESOZOIC PLANTS FROM THE YENCHANG FORMATION, NORTHERN SHENSI

by

H. C. Sze

With 56 Plates

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OLDER MESOZOIC PLANTS FROM THE YENCHANG FORMATION, NORTHERN SHENSI

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INTRODUCTION

Discovery of fossil plants in the Yenchang Formation of Northern Shensi dates back to the latest part of the nineteenth century. The great and venerable geologist, Prof. W. A. Obrutschew, was the first to collect fossil plants in the Yenchang Formation of Northern Shensi. During his laborious and successful geological explorations in Central Asia and China in 1893—1894, Prof. Obrutschew discovered many impressive specimens of fossil plants from different localities of Sinkiang, Kansu, Shansi and Northern Shensi. This important material was described by Prof. F. Krasser of Austria in 1900 in a paper entitled "Die von W. A. Obrutschew in China und Centralasien 1893—1894 gesammelten fossilen Pflanzen" which was published in der Denkschriften der Mathematisch-Naturwissenschaften Classe Bd. 70 of Vienna. The fossil plants discovered from Northern Shensi were believed by Krasser as belonging to the Gondwana System. Krasser summarized the occurrence of two forms found from that part of China as follows (1900, p. 14):

"Gondwana System

Schlucht beim Dorfe San-schi-li-pu (Provinz Schen-si)

Untere *Glossopteris*-Facies (Perm.): Cordaitaceenblätter (? *Noeggerathiopsis hislopi* (Bunb.) Feistm.)

Middle Gondwana (Trias.): *Danaeopsis hughesi* Feistm.

Coll. Obr. Nr. 489c"

And on page 6 of this paper, Krasser stated: "Die Abdrücke von San-schi-li-pu sind von besonderem Interesse, weil sie auf das Vorhandensein von Schichten, welche dem Gondwana-System angehören, schliessen lassen. Geologische Alter: 1. "Middle Gondwana", (Trias) bestimmt durch *Danaeopsis hughesii* Feistm.; 2. unterer Theil der *Glossopteris*-Facies (wohl Perm): bestimmt durch Cordaitaceenblätter."

These two forms were described by Krasser on page 7 of his account, and the plant locality was mentioned on page 6: "China, Schen-si, Schlucht unterhalb des Dorfes San-schi-li-pu. Dieser Fundort befindet sich im nördlichen Theile der Provinz Schen-si am Wege von der Stadt-U-pao (am Gelben Flusse) nach Sui-te-tschou, etwa 12—15 km. nordöstlich von der letzteren Stadt; die Schlucht eines kleinen Baches, längs welcher der Weg führt, ist in eine mächtige Folge von grünlichen Sandsteinen und graugrünen Schieferthonen und Mergeln eingeschnitten, die den obengenannten (in Nr. 430) Ueberkohlenschichten angehören. Die Handstücke mit den Pflanzenabdrücken stammen von einigen grossen Blöcken, die lose am Grunde der Schlucht lagen, aber das Gestein ist dem an den Abhängen anstehenden sehr ähnlich und die Grosse der Blöcke deutet darauf, dass sie nicht aus grosser Entfehrung stammen können. Die Ueberkohlenschichten in Nord-Schen-si sind schwach dislociert und sind zweifellos jünger als Carbon, wahrscheinlich mesozoisch; sie erstrecken sich weit nach Westen, wo immer jüngere Horizonte erscheinen und gehen nach Osten über den Gelben Fluss nach Schan-si, wo die älteren Horizonte vorwalten und bei der Stadt Liu-ling-tschönn unter denselben carbonische kohlenführende Ablagerungen hervorkommen."

It is of interest to note that the stratigraphical observations made by Prof. Obrutschew more than sixty years ago are in complete agreement with the results of the more detailed field investigations of today. It is evident that the "mächtige Folge von grünlichen Sandsteinen und graugrünen Schieferthonen" belong to the Yenchang Formation and that the so-called "Ueberkohlenschichten" belong to the Wayaopu Coal Series (sen. restr.) and its overlying Ishihtsun Coal Series. Of special interest is the fact that Prof. Obrutschew's determination of the geological age of these formations is on the whole quite correct. He believed these formations to be undoubtedly younger than Carboniferous, belonging probably to the Mesozoic. The field observations of Prof. Obrutschew that the sedimentations "erstrecken sich weit nach Westen, wo immer jüngere Horizonte erscheinen und gehen nach Osten über den Gelben Fluss nach Schansi, wo die älteren Horizonte vorwalten und bei der Stadt Liu-ling-tschönn unter denselben carbonische kohlenführende Ablagerungen hervorkommen" are also perfectly right. According to the 'Geological Map of the Oil Field of North Shensi' given by Dr. P'an (1936, Plate 1), the geological formations which overlie the "Ueberkohlenschichten" (=Wayaopu Coal Series & Ishihtsun Coal Series) and extend to the west are now known to be the Anting Formation of the latter part of the Jurassic and the Paoan Series of the Cretaceous. Still younger formations are exposed to the farther west, e.g. the Red clay and Loess of the Pliocene and the Pleistocene. And from the outcrops of the Yenchang Formation to the east, we find the older formations, i.e. the Shihchienfeng Series of the Upper Permian or Permo-Triassic age, which underlies the Yenchang Formation disconformably. And from the outcrops of the Shihchienfeng Series still farther to the east, we find the underlying Shihhotze Series (Permian, probably Middle Permian) and the Yuehmenkou coal-bearing Series (Upper Carboniferous). The recent field investigations of Shensi and Shansi tend to confirm Prof. Obrutschew's view almost in every respect.

It is also to be noted that Krasser was at the very beginning of the opinion that the above mentioned two fossil forms (i.e. Nr. 489c, Coll. Obr.) might have been derived from one and the same formation and that they might belong to one and the same geological age. Afterwards, he was inclined to believe that it was not impossible that the specimen of *Cordaites* (i.e. his ?*Noeggerathiopsis hislopi*) was found from an older formation and that the specimens were brought together by change from a certain distance to the locality by the native peoples in handling building works. He said for instance (1900 p. 6): "Es scheint mir wahrscheinlicher, dass die Pflanzenabdrücke 489c einem Horizonte angehören und also ein und dasselbe Alter haben; aber es ist nicht ausgeschlossen, dass der Block mit *Cordaites* aus älteren Schichten stammt und dass die Blöcke z. B. zu Bauzwecken von Menschen aus einiger Entfernung transportiert wurden und zufällig an diesem Fundorte zusammenkamen und liegen blieben. Obr.—Coll. Obr. Nr. 489c."

It is of special interest to point out that Krasser determined, at first, his specimens of *Danaeopsis hughesi* as ?*Danaeopsis marantacea* (Presl) Heer and designated the geological formation in question accordingly as ?Keuper. He said in a footnote published on page 6 of his paper as follows: "Vor der Kenntnis näheren Angaben Obrutschew's über die Fundstätte und bevor ich *Danaeopsis hughesi* Feistm. erkannt hatte, konnte ich natürlich die Cordaitaceenblätter führenden Schichten lediglich als paläozoisch bezeichnen. *Danaeopsis hughesi* sah ich anfänglich als ?*Danaeopsis marantacea* (Presl) Heer an und bezeichnete die betreffenden Schichten demagemäss als ?Keuper."

Recent field investigations have shown that the two fossil species collected by Prof. Obrutschew (Coll. No. 489c) and studied by Krasser must have been derived from one and the same formation and that the geological age of the formation is evidently of the Keuper i.e. Upper Triassic age, as believed by Krasser at the commencement of his study. The first form Cordaitaceenblätter (?*Noeggerathiopsis hislopi*) has been found out to be identical with *Glossophyllum*? *shensiense* Sze sp. nov. described in the present memoir and the second form *Danaeopsis hughesi* has been changed in it to ?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.). Krasser's identification in 1900 of these specimens has been the cause of too much speculation on the occurrence of a Gondwana flora in North China, but these specimens are, in fact, too imperfect for accurate determination, as repeatedly discussed by many authors (e.g. Gothan 1915, p. 270; Halle, p. 138; Sze 1931, p. 7; Sze 1933c, p. 77; P'an 1936, p. 23, p. 38). The problem of relations of the Gondwana flora to the Yenchang flora will be dealt with at some length in a special chapter of the conclusion of this memoir.

The discovery of plant fossils of this formation in Northern Shensi was recorded also in the old Chinese literature. A great man of learning named Sun Kuo (1029—1093) of the Sung Dynasty had already observed the petrification of plants in a region of Yen-An District. He mentioned in his famous book "Mêng-Chi-Pi-T'an", Vol. 21 as follows: "In the recent years, the bank of a river at Yungningkuan, Yenchow (i.e. Yen-An) fell in ruins, the fissures and cracks are about several ten feet deep in the ground and thereby a forest of about 100 stems of bamboo was discovered. The stems are connected with the roots and are all petrified to stones. A certain person picked up some of them and said that he would bring and offer them to the Emperor. There are no bamboos growing in Yenchow today, and it is difficult to image the exact age of these bamboos found in a petrified state in the deep ground. It is however highly possible that in the remote ancient time, this region was lower than today and that the climate at that time was moist enough for growing the bamboos."

In a paper written in Chinese entitled "The Roots of the Chinese Palaeontology" published in 1947, Dr. T. H. Yin pointed out the great significance of the aforesaid discovery, he said for instance: "The so-called fossil bamboos of Sun Kuo are probably *Neocalamites* or *Schizoneura* of the Mesozoic strata of Northern Shensi. The fossil remains of these plants are very much like bamboos and could be easily mistaken as belonging to bamboos." Dr. Yin further pointed out that it was of special interest that Sun Kuo had already known the importance of fossil plants for expressing the facts of Palaeogeography and Palaeo-climatology, and this has been vividly indicated by his sentence "in the remote ancient time, this region was lower than today and the climate at that time was moist enough for growing the bamboos." The writer is in agreement with Dr. Yin that the socalled fossil bamboos of Sun Kuo should be the fossil remains of *Neocalamites*. The stems and pith-casts of *Neocalamites* are indeed very much like the stems of bamboos. These fossils occur in great abundance in the Yenchang Formation of Northern Shensi, and many of them have been described and figured in this memoir. (see Pl. II, fig. 2; Pl. IV, figs. 1, 2; Pl. VI, figs. 6—8; Pl. VII, figs. 1, 2). The district Yenchow (now called Yen-An) is now known to be one of the most important type-localities of the Yenchang Formation, and it is quite possible that the petrified remains observed by Sun Kuo were derived from this formation. The important fact worthy of note is that Sun Kuo in the eleventh century, nearly 900 years ago, already knew the plant fossils to be good climate-indicator for judging the climate of the geological times. In connection herewith, it should be pointed out that in Europe, in the fifteenth century, more than 400 years later than the time of Sun Kuo, the great Italian philosopher, Leonardo da Vinci (1452—1519) happened first to know that the fossils are actually remains of organic lives and that they have nothing to do with "lusus naturae".

Since the publication of Dr. C. H. Pan's important memoir entitled "Older Mesozoic Plants from North Shensi" in 1936 in Palaeontologia Sinica, the Yenchang flora of Northern China has received a share of the attention it deserves, because this formation is older than the Mesozoic coal-bearing formations of Northern China on the basis of both geological sequence and floral evidence. The age and correlation of this flora will be set forth in a special chapter in this memoir. The species described by P'an may be mentioned below (at the right are the revised names accepted in the present memoir):

?*Schizoneura gondwanensis* Feistm. = *Neocalamites carcinoides* Harris
Cladophlebis cf. *roesserti* Zeiller = ***Cl. shensiensis*** P'an
Cladophlebis cf. *gigantea* Ôishi
Cladophlebis grabauiana P'an
Cladophlebis szeiana P'an
Bernoullia zeilleri P'an
Danaeopsis hallei P'an = *Danaeopsis fecunda* Halle
"*Danaeopsis*" *hughesi* Feistm. = ?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)
Thinnfeldia nordenskioldi Nathorst
Thinnfeldia rhomboidalis Ettingshausen
Ginkgo magnifolia (Fontaine) = *Ginkgoites magnifolia* (Fontaine)
?*Noeggerathiopsis hislopi* (Bunb.) = *Glossophyllum*? *shensiense* sp. nov.
Podozamites lanceolatus (L. & H.) Braun
Problematicum . . . . . . = *Conites* sp.

In 1951, Sze and Lee described a typical fertile specimen of *Danaeopsis fecunda* Halle collected by Mr. S. H. Li from the Yenchang Formation of Wuwei District in Western Kansu. The characteristic forms collected from the Yenchang Formation of Eastern and Western Kansu discriminated by Sze and Lee (1951, p. 89—90) are as follows:—

Danaeopsis fecunda Halle
Cladophlebis shensiensis P'an
Cladophlebis grabauiana P'an
Cladophlebis cf. *roesserti* Zeiller = *Cl. shensiensis* P'an
Cladophlebis szeiana P'an
Neocalamites carrerei (Zeiller)
Equisetites sp.
Taeniopteris sp.
Desmiophyllum sp.

Of special importance is the fact that the geological sequence of Eastern Kansu is exactly similar to that of Northern Shensi. A geological profile of the locality Hwating in E. Kansu has been published by Sze and Lee in 1951 (1951, p. 90). In this section, the continuous succession of the overlying coal series and the underlying plant-bearing formation is clearly illustrated. The Keuper-Rhaetic Yenchang Formation of Eastern Kansu is almost conformably overlain by the Liassic Ankouyao Coal Series (i.e. the Huating Coal Series) which is the equivalent of the Wayaopu Coal Series of Northern Shansi. One looks forward with the expectancy, as has been stated by Sze and Lee in 1951, assured by the presence of some elements of the Keuper-Rhaetic age in the Yenchang Formation of Northern Shensi and Eastern and Western Kansu, to the discovery of more material from other localities that may shed light on the question whether the relationship between the Keuper-Rhaetic and Lower Jurassic formations so clearly illustrated in North and Northwest China, might also be found to prevail in other parts of Eastern Asia.

The greater part of material described in the memoir was collected by the writer in a field trip to Northern Shensi in the winter of 1951. Mr. J. S. T'ang of the China Petroleum Administration, and Mr. T. S. Kuan of the Geological Bureau of Northwest China were allowed to accompany the writer on this collecting tour of Northern Shensi. The other large part of material was brought together by the geologists of the same Administration and was sent to the writer for examination by Mr. S. Chang, the director of the Administration. A small part of the material was collected by Mr. C. S. Huang and his colleagues of the Geological Bureau of Northwest China, and another small part of fossil plants was found by Mr. S. Wang of the Institute of Palaeontology, Academia Sinica. A few specimens were sent to the writer by Messrs. F. H. Chia and C. L. Kao of the Ministry of Geology. To all of them, the writer wishes to express his sincere thanks for the valuable support they have given to the palaeobotanical work.

DESCRIPTION OF SPECIES

BRYOPHYTA

Genus *Thallites* Walton

Thallites sp.

Pl. LVI, Figs. 1, 1a, 2.

The fragments of a thalloid remain shown in Pl. LVI, figs. 1, 1a, 2 are too imperfectly preserved for determination, but seem to represent a very characteristic type. In regard to the shape and size, the present specimens are undoubtedly identical with the form described by the writer in 1933 as Problematicum from the Rhaeto-Liassic beds of the district Changting, Fukien. Although the characteristic rhizoids and air-pores have not been observed on our specimens, we have a good reason to believe that these specimens belong evidently to the Hepaticae of Bryophyta, based on the shape of the Thallus.

Thallus branched dichotomously, margins of segments slightly uneven. Shape of apex of lobes probably ± roundish.

Segments showing distinct median channels from center of thallus to marginal lobes. Thallus dichotomizing about three times. The ultimate two segments forming an angle of about 45°. Rhizoids and air-pores not preserved.

The specimens found from Fukien are more fragmentary preserved than the present specimens. The writer described these specimens in 1933 with some reservation under the name of Problematicum, but at the same time he pointed out that these specimens might possibly represent remains of a thalloid Liverwort. The writer stated at that time for instance: "Viel eher könnte es um ein thalloides Lebermoos handeln. Eine zum Vergleich in Frage kommende Form ist die in dem Yorkshire Lower Oolite gefundene *Marchantites erectus* (Leck.) Seward (Leckenby 1864, S. 81, T. 11, F. 3; Seward 1898, S. 233, F. 49), die sich aber durch die mehrfachen Verzweigungen von unserer Form unterscheidet. Ueber die Artgleichheit, lässt sich bei der mangelhaften Erhaltung und der Schwierigkeit der Bestimmung von ähnlichen Reste nichts sagen."

That these specimens belong to the form-genus *Thallites* of Walton has also been pointed out by Lundblad in her recent publications (e.g. Lundblad 1955, p. 32).

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Formation: Upper part of the Yenchang Formation.

PTERIDOPHYTA

1. ARTICULATAE

EQUISETALES

EQUISETACEAE

Genus *Equisetites* v. Sternberg

Equisetites sarrani Zeiller

Pl. II, fig. 5; Pl. IV, figs. 4, 5, 5a; Pl. VI, figs. 3—5, 5a.

This well-known species is represented by a number of nodal diaphragmas and stems. In regard to the shape of the leaf-sheath and nodal diaphragms, the present specimens are identical in all respects with the type-specimens of this species described by Zeiller from the Tonking Coal Field in Indo-China. There are also several characteristic cones (Pl. VII, figs. 7, 7a) preserved on the same slabs with the stems and diaphragms. The shape and size of the cones agree also fairly well with those found from Tonking. The present status of this species is somewhat unsatisfactory and its relation to several other Asiatic fossils species is not well defined. The same has been said by Sze and Lee in a memoir dealing with the Jurassic Plants from the Szechuan Province (Sze and Lee 1952, p. 20—21).

Locality: Ch'ilitsun, Yenchang District, Shensi; Ihochen, Suite District, Shensi.

Formation: The upper part of the Yenchang Formation.

Equisetites brevidentatus sp. nov.

Pl. V, figs. 1, 1a.

The single specimen was collected by Messrs. F. H. Chia and C. L. Kao from the basal part of the Yenchang Formation. From the same horizon a few well preserved specimens of *Danaeopsis fecunda* Halle have been found.

An Equisetaceous stem of unknown length, stem very large, more than 11 cm. in breadth. Length of internodes unknown. Surface of the stem quite smooth, showing very indistinct longitudinal ridges. Sheath very short, about 6—7 mm. in height above the node, with fringed margin. Teeth very short about 6—7 mm in length and 5—6 mm in breadth with rounded apex.

The most important character of this species is the great number of very short and rounded teeth of the leaf-sheath in each whorl. There are ca. 14 teeth still preserved on the leaf-sheath. This new species of *Equisetites* is closely comparable to the following species *E. sthenodon,* but the teeth of the sheath is comparatively shorter and rounded. The characteristic branch-scars of the latter species are also not to be observed in this species.

Locality: T'ipapao, Linhsien District, Shansi.

Horizon: The lower part of the Yenchang Formation.

Equisetites sthenodon sp. nov.

Pl. II, fig. 4; Pl. VI, figs. 1, 1a, 2.

This new species was represented by two specimens of leaf-sheath (part & counterpart) figured in Pl. VI, figs. 1, 2 and one specimen of stem figured in Pl. II, fig. 4. The leaf-sheath is very fragmentary, but the teeth of the sheath are very characteristic.

Stem probably very large. Length and breadth of the stem unknown. Length of the internodes also unknown. Surface of the stem very smooth, showing neither ridges nor grooves. Sheath about 14 mm. in height above the node, with fringed margin. Teeth about 14—15 mm in length and 6.5 mm in breadth with pointed apex. Branch-scars rounded.

In regard to the shape and size of the teeth, this new species is closely related to *Equisetites platyodon* Brongniart from the Schilfsandstein of Southern Germany and Northern Switzerland, but in this European species the teeth of the leaf-sheath are more connected and are more acute. There are no other known species which could be closely compared with our species.

Locality: Fangerhshang, Yaohsien District, Shensi.

Horizon: The exact stratigraphical horizon is unknown.

Equisetites acanthodon sp. nov.

Pl. V, figs. 2, 2a.

Pl. V, figs. 2, 2a show a fragmental specimen of a part of leaf-sheath of an *Equisetites* which belongs to a species different from those described above. The fragment of sheath still shows 9 teeth. The teeth seem to be very short, with rounded apex. A curious feature of this species is the occurrence of a long and acute "lamina" of very thin texture attached to the apex of each teeth. These thin and acute "lamina" represent of course the upper part of the teeth. The broadest part of the "lamina" is at the base, gradually narrowing to the acute apex. Under the lens the "lamina" shows very fine longitudinal striations. The length and breadth of the stem are unknown.

There is no doubt in view of these features that the species occupies an isolated position in the genus. This species is therefore described as a new species.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Equisetites deltodon sp. nov.

Pl. IV, figs. 3, 3a.

Pl. IV, figs. 3, 3a show another fragmentary specimen of a part of leaf-sheath of an *Equisetites* which belongs to a new species and which is different from those described above. The leaf-sheath seems to be also very rigid. The teeth seem to be also very strong, and are of the elongated-deltoid shape. The length of the teeth is about 5 mm, the broadest part of the teeth is at the base, measured about 4 mm. The apex of the teeth is obtuse or subacute. The teeth are generally distant. The surface of the sheath and the teeth is generally very smooth; occasionally the teeth have an inconspicuous depressed "midrib". Length and breadth of the stem unknown.

Locality: Kiaochiaping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

***Equisetites?* sp. (cf. *E. rogersi* Schimper)**

Pl. VII, figs. 3, 4, 4a.

In Pl. VII, figs. 3, 4, 4a are shown a part of leaf-sheath of an Equisetaceous plant which probably belongs to the genus above cited, though its specific determination is not possible. It shows a certain resemblance, however, to the leaf-sheath of *Equisetites rogersi* Schimper described by Fontaine (1883, p. 10; Pl. 2, figs. 1, 2) from the Virginia-Keuper of North America, but the specimens are too fragmentary preserved for accurate determinations.

Locality: Kaoyenti, Ichün District, Shensi.

Horizon: The basal part of the Yenchang Formation.

***Equisetites* sp. (Strobili of *Equisetites*)**

Pl. V, fig. 4; Pl. VII, figs. 5—7, 7a

The Equisetaceous cones represented by the impressions in Pl. V, fig. 4, and Pl. VII, figs. 5—7, 7a have been found in a few of the plant-bearing beds of the Yenchang Formation. They are generally not very well preserved, and in view of the lack of distinctive characters in cones of this type, an attempt at specific determination would serve no useful purpose. The specimens are therefore described under the name *Equisetites* sp. (Strobili of *Equisetites*). The cones in Pl. V, fig. 4, and in Pl. VII, figs. 5—6 are all preserved by flattened impressions, obovate-lanceolate or ellipsoid in shape, about 15 mm long and 10 mm broad, consisting of peltate hexagonal sporaphylles. The shape of the cones agrees with the specimens described and figured by many authors from the Palaeozoic and Mesozoic formations.

The specimen figured in Pl. VII, figs. 7, 7a might belong to the species *Equisetites sarrani* Zeiller, as has been mentioned on page 117. It is impossible to decide whether the other specimens belong also to this species. These specimens are preserved on the matrix of gray greenish sandy shale, so characteristic of the Yenchang Formation and are often in close association with the impressions of *Neocalamites carcinoides* Harris.

Locality: Chi'litsun, Yenchang District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Locality: Lichiayao, Hsinghsien District, Shansi.

Horizon: The lower part of the Yenchang Formation.

Ggenus *Neocalamltes* Halle

***Neocalamites carrerei* (Zeiller) Halle**

Pl. IV, fig. 2; Pl. VI, fig. 6.

As has been stated by Sze and Lee in the memoir published in 1952 (Sze & Lee, 1952, p. 20), this characteristic species of the Tonking Coal Field is by no means easy to distinguish from many of those referred to *Neocalamites hoerensis* (Schimper) Halle and *Neocalamites ferganensis* Kryshtofovich. The same has been pointed out by Harris (1937, p. 11). In *N. hoerensis*, the internodes of the stem are comparatively narrow and slender, but this feature is hardly sufficient for separating the species. As remarked by Harris, the specimens with very wide stems and short internodes can be recognized as *N. carrerei*, but the range of the two overlap to such an extent that many specimens are indeterminable. The most important feature of distinguishing these two species is the relation of leaf-traces with the longitudinal ribs, but even based on this feature *N. carrerei* is hardly distinguishable from *N. hoerensis*. It would seem, therefore, that the best course to follow is to unite these two species. The figured two specimens from the Yenchang Formation are identical in all respects with the type specimens described by Zeiller from the Tonking Coal Field.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation

Neocalamites carcinoides Harris

Pl. I, figs. 1, 1a; Pl. II, figs. 1, 1a, 2; Pl. III, figs. 1—3;
Pl. IV, fig. 1; Pl. VI, figs. 7, 8; Pl. IX, figs. 1, 2, 2a.

This important Greenland species is evidently one of the most characteristic elements of the Yenchang flora of Northern Shensi. All our specimens are very well preserved and are identical in all respects with the type-specimens described by Harris. The specimen figured in Pl. IV, fig. 1, represents the external feature of the stem measured at least 8–8.5 cm in breadth. The length of the stem and the internodes is unknown. The specimen figured in Pl. II, fig. 2, shows an internode of about 14 cm in length and 5.5 cm in breadth. The surface of the stem is marked with fine longitudinal ribs which are interrupted at the node, sometimes opposite, sometimes alternating with those of the next internode. All the specimens are very characteristic. There are very distinct leaf-scars preserved on the node. The leaf-scars are circular, about 1.5 mm wide with a small central boss representing the leaf-trace. The leaf-traces are separated, in large stems by about 5–6 ribs occasionally by 7 ribs, and in smaller ones by 4 ribs. The specimen shown in Pl. I, figs. 1, 1a is a branch of the stem. The internode of the branch is very slender, about 5 mm in breadth and about 4–5 cm in length. The node of the branch is slightly projecting. The leaf-whorls are attached to the nodes. Each whorl has 10 leaves. The whorl is divided into two groups on each side of the node, and the leaves are pointing forwards, outwards, or slightly backwards, but never directly backwards. The whorl of leaves are probably flattened into plane of stem by twisting of petiole during the life of the plant. The leaves are usually free to near their bases. The leaves are measured about 5–6 mm wide at the widest part, the length of which is unknown. The broadest point of the leaf seems to be near its middle. The midrib of leaf is generally not very conspicuous on some specimens. Occasionally, the midrib can be more or less distinguished from the lamina, occupying about one-fifth of width of leaf at its middle and the whorl width at the base. The margins of the leaves are usually straight, sometimes slightly sinuous. Very rarely the leaves are fused together to their apices (Pl. III, fig. 1). The length of individual leaves may exceed 20 cm. without being complete. The branch scars are preserved on some specimens (Pl. II, fig. 3; Pl. VI, fig. 7). There are about 8–10 branch scars on the stem (4–5 on each side of the specimen). The branch scars are situated almost on the same level with the leaf-scars, and are indicated by a circular area about 5–9 mm wide with indefinite markings. The specimen shown in Pl. II, fig. 3 is described here as *N.* sp.

The specimens figured by Harris in his Pl. V, fig. 5 and Pl. VI, fig. 5 (1931) are, in the writer's opinion, probably the stems of *N. carrerei*. These specimens resemble very much those figured by Harris as *N. hoerensis* (1926, Pl. IX, fig. 5) and are characterized by the leaf-scars which are separated generally by 2–3, or only occasionally by 4 ribs. These specimens can not therefore be regarded as belonging to *N. carcinoides*.

It is of interest to point out that Prof. Harris determined his specimens at first in 1926 as *Neocalamites* cf. *inopinata* Zeiller and in 1931 he regarded these specimens as a new species and named them *Neocalamites carcinoides*. In 1937, he referred his new species to the genus *Lobatannularia*: *L. carcinoides* (Harris) n. comb. The present writer is not quite prepared to agree with the view that the Greenland species should be a form of *Lobatannularia* or *Annulariopsis*. Harris stated in 1931 that the Greenland species is distinct from the species from Tonking, he said for instance (1931, p. 29): "*N. carcinoides* is certainly distinct from *Annulariopsis inopinnata* Zeiller with which Harris (1926b) compared it. The leaves prove to be slender and with acute apices, instead of being obtuse." The present writer agrees with him that this species should be placed in the genus *Neocalamites*, as has been explained by Harris himself. In the paper published in 1931 (p. 22), Harris pointed out as follows: "The leafy shoots of *Neocalamites* differ from those belonging to the genera *Annulariopsis* Zeiller and *Lobatannularia* Kawasaki (=*Annularites* Halle) in having all the leaves of a node of equal length, while in these genera, the forward pointing ones are longer than the backward pointing ones. In *N. carcinoides*, however, the leaves are occasionally slightly unequal as in these genera." And on the same page, he again remarked: "The species *N. carcinoides* is remarkable because while the commonest type of stem agrees fairly well with *N. hoerensis*, specimens occur with leaves fused in two groups as in typical species of *Schizoneura,* and others which have certain leaves in each whorl shorter than the rest as in *Lobatannularia.* The characters of three genera are thus included in the form range of this species. It is placed in *Neocalamites* because the commonest type of specimen agrees best with this genus." The present writer is in complete accord with the above views, for if we determined the specimens of leafy shoots found from the Mesozoic strata as *Annulariopsis* or *Lobatannularia* etc., how can we determine the commonest type of stem occurring in the same bed and from the same locality, which agree fairly well with those of *N. hoerensis, N. carrerei* and other species of *Neocalamites.* Can we on the one hand determine the specimens figured in Pl. 1, fig. 1; Pl. II, fig. 1 and Pl. IX, fig. 1 in this memoir as *Lobatannularia carcinoides* and on the other hand determine the specimens figured in Pl. II, fig. 2; Pl. IV, fig. 1, Pl. VI, fig. 7 and Pl. IX, fig. 2 as *Neocalamites carcinoides?*

In the paper published in 1937, Harris referred this Greenland species to the genus *Lobatannularia,* he named it: *Lobatannularia carcinoides* (Harris) n. Comb. He said on page 11 of this paper: "*Lobatannularia* is a characteristic genus of the uppermost Palaeozoic and Older Mesozoic* of E. Asia, where it is represented by many species from all of which it is fairly readily distinguished by its longer and differently shaped leaves. The occurrence of this genus in the basal Lias of Greenland and probably Sweden is obviously of considerable interest." It appears clear that Prof. Harris has been inclined to the view already expressed by many authors (e.g. Gothan, Yabe, Koiwai, Ôishi) that this type of plants might be regarded as a relic or a residual remain of the Palaeozoic forms persisting in the Mesozoic strata. And the same has been said by the late Prof. Ôishi regarding the occurrence of *L. nampoensis* Kawasaki from the Liassic of Korea. He said for instance (1940, p. 186): "The occurrence of this specimen in the lower Daido Formation (Daido Series) in Korea is of special interest as it is the youngest representative of this genus." The present writer is of the opinion that the species of Greenland i. e. *N. carcinoides* Harris belongs evidently to the genus *Neocalamites,* it has nothing to do with the Palaeozoic forms of E. Asia. And this has been explained by Harris himself that the Greenland species can be readily distinguished from all species of *Lobatannularia* by its longer and differently shaped leaves. In this connection, it should be pointed out that the most important feature of the Palaeozoic genus is the character of leaf-mosaic described so fully by Prof. Halle in his later publication. This important feature cannot be observed on the specimens of the Greenland Mesozoic species. Furthermore, the writer is firmly convinced that the Mesozoic specimens of leafy shoots are attached certainly to the stems of the *Neocalamites* type similar to those of *N. hoerensis, N. carrerei* and many other species, and that all the characteristic forms of leafy shoots of the Palaeozoic e. g. *Annularia, Asterophyllites, Lobatannularia* etc. are attached to the stems of definitely *Calamites*-type. For this reason, the writer would prefer to name the Greenland species as *Neocalamites carcinoides* Harris, and the same can be said for the Liassic species of Korea which was first determined by Kawasaki as *Schizoneura nampoensis* (Kawasaki 1927, Pl. VII, fig. 29; see also Ôishi 1940, p. 186). This single specimen found from Korea is certainly also attached to the stem of definitely *Neocalamites* type. It is highly possible that this single specimen of Korea might also belong to the form-range of the species *N. carcinoides* and the same can be said for the single specimen described by Dr. P'an from the Yenchang Formation as ?*Schizoneura gondwanensis* Feistm. (P'an 1936, p. 13, Pl. IV, figs. 7, 7a). Finally, it should be of special interest to point out that even the specimens found from the Rhaeto-Liassic beds of Tonking should be, in the writer's opinion, placed in the genus *Neocalamites,* for these specimens are certainly attached to the stem of the *Neocalamites* type. There seem to be hitherto no indubitable specimens of the stems of the *Calamites* type found in the Mesozoic formations of the whole world, and this is the reason why the present writer does not on the whole agree with the view repeatedly expressed by the late Prof. Gothan that the specimens found from the Tonking Coal Field in Indo-China should be regarded as a relic or a residual remain of the Palaeozoic forms.

Localities: Ch'ilitsun, Yenchang District, Shensi; T'anhokou, near Shihlangmiao, Ichün District, Shensi.

*In connection herewith, it should be pointed out that the *Lobatannularia*-bearing formations in E. Asia is apparently of the Lower or Middle Permian age and that the only species of the Older Mesozoic is the single specimens determined by Kawasaki from the Liassic of Korea as *L. nampoensis,* which in the writer's opinion is also a form of *Neocalamites.*

Horizon: The upper part of the Yenchang Formation.

Locality: Huailingping, Yenchang District, Shensi.

Horizon: The middle part of the Yenchang Formation.

***Neocalamites brevifolius* sp. nov.**

Pl. V, Fig. 3.

This new species of *Neocalamites* is represented by a single but characteristic specimen. The stem is about 3 cm wide with rather smooth surface. The leaf-scars are strongly projecting on the nodes. Internodes very short, about 8–11 mm in length. There are about 14 leaf-scars on each whorl of the stem (7 on each side of the specimen). The leaf scars are comparatively rather strong, each leaf scar is about 1.5–2 mm wide. The leaves are very short and strong, about 2 cm in length and 2 mm in width, pointing strongly forwards, with obtuse or subacute apex. The midrib of the leaves is very indistinct. All the leaves are not fused together at the base.

There are no known species of *Neocalamites* which could be closely comparable to this form and for the purpose of reference, it has been thought best to create a new specific name for this specimen: *Neocalamites brevifolius* sp. nov.

Locality: Ch'ilitsun, Yenchang District, Shensi.

Horizon: The upper part of the Yenchang Formation.

***Neocalamites rugosus* sp. nov.**

Pl. VIII, figs. 1, 1a, 2, 3, 3a; Pl. XL, figs. 4—6.

The curious specimens described here as *Neocalamites rugosus* can not be referred to any existing species of this genus. A new species has to be created for this form, and the writer has named it *Neocalamites rugosus* sp. nov., based on the zigzag feature of the stem. The best specimen is figured in Pl. VIII, figs. 1, 1a. On this specimen, one can clearly notice a characteristic node of an Equisetaceous plant and on the right side of the stem, one can clearly observe the longitudinal ribs of the *Neocalamites* type. The breadth of the stem is about 8 cm., the length of which is unknown. The surface of the stem is characterized by numerous horizontal rather irregularly zigzag furrows or ribs. These zigzag lines represent evidently the character of the outer surface of the cortex of the stem. On the nodes, one can still see a whorl of leaf-scars. Many detached leaves of the *Neocalamites* type are found on the same slabs with these curious impressions (Pl. VIII, figs. 2, 3, 3a).

It is not at all certain whether all the other known species of *Neocalamites* are characterized by the same zigzag ornamentation of the outer surface of the cortex of the stem, and the writer has placed the specimens in a new species of *Neocalamites,* pending the discovery of additional material that may clear up these curious structures.

Since the Chinese text of this memoir has been written, the writer received a great number of reprints from Prof. Jongmans published by him in recent years. In a memoir entitled "Les Bassins Houillers du Sud-Oranais" published in 1951, the writer has found a more or less similar specimen of the Westphalian age determined as *Calamites rugosus* Jongmans* (1. c. Pl. 1, fig. 1). It has been the writer's greatest pleasure of knowing that Prof. Jongmans has placed his specimens in *Calamites*. The close resemblance of the zigzag feature of both Palaeozoic and Mesozoic forms is indeed of considerable interest.

Localities: T'anhokou, near Shihlangmiao, Ichün District, Shensi; Huhgchiakutsun, Yenchang District, Ichün District.

*In the meantime, the writer wrote to Prof. Jongmans asking for information regarding the zigzag lines of the *Calamites* stem and he sent the writer the important memoir dealing with the *Calamites* of Western Europe published in 1915—1917. In this memoir, the writer found a form named *C. carinatus* Sternb. var *rugosus* K. et J. (1915, Pl. 41, figs. 1—3; Pl. 155, fig. 1). In the text (1917, p. 149), Prof. Jongmans pointed out: "The pith casts and branch scars of this variety are identical those of *C. carinatus* and the variety only differs from the type in its ornamentation of the outer surface of the cortex." In a letter dated on Dec. 6, 1955. Prof. Jongmans informed the writer that the best illustrations of *Calamites rugous* can be found in: Die Calamariaceen des Rhein-Westphälischen Kohlenbeckens, Med. v. Rijks Herbarium 20, 1913, pl. 13, f. 1, 2, 3, and that he cannot send a copy of this paper to the writer, for they are out of print.

Neocalamites sp.

Pl. II, fig. 3.

The single, very fragmentary *Neocalamites*-stem in Pl. II, fig. 3 cannot be determined specifically, but has been figured to illustrate the distribution of the genus. The impression of the stem are characterized by very fine longitudinal ribs and furrows of the *Neocalamites* type and by a whorl of large and rounded branch scars on the node. The branch scars are five in number on one side of the stem. They are about 9 mm wide, with characteristic, radiary markings. It is highly possible that this specimen belongs also to the species *Neocalamites carcinoides* Harris.

Locality: Hsükoutsun, Yenchang District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Neocalamites? sp.

Pl. VII, figs. 1, 1a, 2, 2a

The specimens shown in Pl. VII, figs. 1–2, 1a, 2a, are the pith-casts of an Equisetaceous plant. It is possible that these pith-casts belong to the genus *Neocalamites* and to the species *N. carcinoides* Harris in view of the fact that a more or less similar specimen of pith-cast has been figured by Harris from the *Thaumatopteris* zone of Eastern Greenland (Harris 1931, Pl. V, fig. 1) in close association with the stems and leafy shoots of *N. carcinoides*.

The diameter of the cast is about 7.5 cm. The internodes are very short, about 16 mm in length. The longitudinal ribs and furrows are very distinct, and are interrupted at the node, sometimes opposite, sometimes alternating with those of the next internode.

Locality: Tánhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

II. FILICINAE

1. EUFILICALES

OSMUNDACEAE

Genus *Cladophlebis* Brongniart

Cladophlebis (*Todites*) *shensiensis* P'an

Pl. X, figs. 1—3; Pl. XI, figs. 1—3; Pl. XII, figs. 1—5; Pl. XIII, figs. 1—4; Pl. XIV, figs. 1—5; Pl. XV, figs. 1—17; Pl. XVI, fig. 5; Pl. XVIII, figs. 1—5; Pl. XIX, figs. 3—4; Pl. XXI, fig. 5; Pl. XXVII, fig. 6.

The very large meterial collected from Tânhokou, near Shihlangmiao of the Ichün District gives a good idea of the size and variation of the fronds of this species. The writer has been in much doubt whether to identify the specimens shown in Pl. X, fig. 2; Pl. XI, figs. 1–3; Pl. XII, figs. 1–4 and Pl. XIII, figs. 1–3 with this species, or describe them as new, but has finally decided in favor of the former course. The original diagnosis given by Dr. P'an for this species is reprinted here with some alternations due to the study of a larger meterial.

Frond very large, at least bipinnate to tripinnate. Penultimate pinnae large, attaining a maximum breadth of at least 30–40 cm; rachis smooth, with rather indistinct longitudinal striations, attaining a breadth of at least 13 mm, tapering gradually towards the apex, attaining a breadth of about 4.5 cm and a length of at least 15–20 cm, suboppositely or alternately attached to the mother rachis at an angle of about 60–80° in the lower part of the frond and about 45° near the apex of the frond. Pinnules forming an angle of generally 90°, occasionally 55–65° with the pinna rachis, and becoming more oblique near the apex of the frond, closely set, occasionally distant, margin entire, distal margin strongly concave, proximal margin strongly convex. Shape of pinnules strongly variated, most typical pinnules subquadrate to triangular and slightly falcate with rounded apex, generally attaining a length of 10 mm and a breadth of 9 mm, broadest at the base. Well-developed pinnules obliquely oblong, blunt or subacute, strongly falcated, attaining a breadth of 1 cm and a length of 2 cm. Venation distinct, the midrib of almost equal strength with the secondary veins, decurrent and dissolving in the middle course. Secondary veins slightly arching, occasionally slightly flexuous, bifurcating thrice or twice, the first catadrome vein given off from the decurrent part of the midrib, strongly arching outwards and backwards, bifurcating three times or even four times (Pl. X, fig. 1a). Fertile pinnae are of the *Todites* type, the pinnules are very small and round with indistinct bifurcating radiary veins. Sporangian indistinct. (Pl. XV, figs. 1–17).

A most typical specimen is shown in Pl. X, figs. 1, 1a. This specimens shows slightly falcate, triangular and occasionally more or less quadrate pinnules which are closely set, and are slightly overlapping laterally. This specimen is identical in all respects with the type-specimens figured by P'an in his Pl. VI, figs. 4, 4a and 5, 5a. Another typical specimen is shown in Pl. XXI, fig. 5 which was found from the Yenchang Formation of Kansu Province and is identical in shape and size of the pinnae and pinnules with the specimen figured by P'an in his Pl. V, figs. 4, 5 and Pl. VI, fig. 6. Another less typical specimens are shown in Pl. XII, fig. 5 and Pl. IX, fig. 3. The length of the pinnules of these specimens is slightly greater than the breadth. These specimens agree fairly well with the specimen figured by P'an in his PI. V, figs. 6, 6a. The most abundant specimens of this species are shown in Pl. X, fig. 2; Pl. XI, figs. 1–3; Pl. XII, figs. 1–4 and Pl. XIII, figs. 1–3. The size and shape of the pinnules of these specimens are less typical than the specimens first described by P'an from the Yenchang Formation. All these specimens are with well-developed pinnules which are much larger than Pan's type-specimens and are obliquely oblong, blunt or subacute, strongly falcate, attaining a breadth of 1 cm and a length of 2 cm, occasionally more than 2 cm. The pattern of the venation agrees in all respects with this species. Some specimens (Pl. XI, fig. 2; Pl. XII, fig. 3; Pl. XIII, fig. 4; Pl. X, figs. 2, 2a) in the material placed at the writer's hand are intermediate in size and form of the pinnules between these two extremities, (i. e. between the most typical specimens and the specimens with larger and obliquely oblong and strongly falcate pinnules) and provide a fairly complete series of stages between the larger and smaller types. The pattern of the venation of all these specimens is essentially similar, so that the writer believes that we are quite justified in regarding all of them as belonging to one species.

The specimens figured in Pl. XIV, figs. 3–5; Pl. XVI, fig. 5 and Pl. XXVII, fig. 6 give an idea of varying shape of pinnules with more dense venations. These specimens are identical with the type-specimens described and figured by P'an as ***Cladophlebis*** (***Todites***) cf. ***roesserti*** Zeiller (non Presl) (see P'an 1936, p. 14, Pl. IV, figs. 11–15; Pl. V, figs. 1–3) In the writer's opinion, these specimens belong evidently also to ***Cladophlebis shensiensis,*** the reason for adopting this step will be set forth below. According to Dr. P'an (1936, p. 16), the species ***Cl shensiensis*** bears a close resemblance to ***Cladophlebis*** (***Todites***) ***roesserti*** Zeiller (non Presl) from the Tonking Coal Field and ***Cl.*** (***Todites***) ***goeppertianus*** (Münster) Krasser (Harris 1931, p. 31; Pl. XI, figs. 3, 8, Textfigs. 6, 7) from East Greenland, but differs by the broader pinnule, and the less crowded and more arching secondary veins. Based on the conclusion of the study of the present material, the writer, however, cannot find sufficient reason for separating the species ***Cl. shensiensis*** from the specimens described by P'an as ***Cl.*** (***Todites***) ***roesserti*** Zeiller (non Presl) from the same formation and from the same localities. Firstly, there is a considerable variation in shape and size displayed in the species ***Cl. shensiensis*** in the present material. In the abundant specimens the ratio of the length to breadth is about 2:1. Secondly, there are also specimens in the Tonking Coal Field, which show a more loose venation similar to that of ***Cl. shensiensis*** (e. g. Zeiller's Pl. II, figs. 3, 3a, 1903). Thirdly, many specimens of the Tonking Coal Field are also characterized by the much more arching secondary veins resembling those of ***Cl. shensiensis*** (e. g. Zeiller's Pl. II, figs. 5, 5a; 6, 6a). Judging on these three reasons, the writer is inclined to the view that all the specimens described by P'an as ***Cl.*** (***Todites***) ***roesserti*** Zeiller (non Presl) belong actually to his ***Cl. shensiensis.***

Prof. Harris states (1926, p. 59) that Zeiller's specimens from Tonking (1903, Pls. II and III) are indistinguishable from *Todites williamsoni* (=*Cl. whitbyensis*) from the Middle Jurassic of Yorkshire, England. The same has been said by the writer in 1931, but the writer pointed out at the same time (Sze 1931, p. 50): "Ich halte eine Identität dieser beiden Arten für möglich; jedoch ist diese Frage ohne Untersuchung eines grösseren Materials aus Franken nicht möglich, das mir zur Verfügung nicht steht. Dass andere Authoren ähnlicher Meinung sind, geht aus den Discussionen von verschiedenen Autoren hervor, und bei Yokoyama finden wir (1891, p. 242, Pl. 32, figs. 3, 3a, 4) ein *Asplenium Roesserti* var. *whithyensis*." P'an pointed out also that Zeiller's *Cladophlebis* (*Todea*) *roesserti* of Tonking is much different from those which are generally regarded as *Cladophlebis roesserti* (Presl), as the secondary veins of Zeiller's species and those of our specimens are more crowded, more arching and more frequently bifurcating, and the midrib generally dissolves at a short distance from its origin. It seems to the present writer therefore that even the specimens described by Zeiller as *Cl. roesserti* from Tonking might be identical with *Cl. shensiensis*. The two specimens figured by Zeiller in his Pl. II, figs. 3, 3a and figs. 6, 6a are all but indistinguishable from the typical specimens of *Cl. shensiensis*.

In short, it should be remarked that there are much confusions in the species *Cl. roesserti*. The great majority of specimens under this specific name of various authors are almost entirely different from the specimens from Tonking, e. g. the specimens of E. Greenland (Harris 1926, p. 57, Textfigs. 3A–D).

Of special interest is the fact that in the present material, there are a great amount of fertile pinnae belonging possibly to *Cl. shensiensis*. The pinnules of these specimens are small, rounded in shape, with indistinct more or less radiary veins and are covered with the sporangia (Pl. XV, figs. 1–16). These specimens agree indeed in all respects with the fertile examples described by Zeiller from Tonking. It is therefore highly possible that the Tonking specimens are actually identical with those from the Yenchang Formation described under the name *Cladophlebis shensiensis*. More or less similar fertile examples have also been found from the Nariwa flora of Japan (Ôishi 1940, p. 194, Pl. III, figs. 1, 1a). The Japanese specimens have been referred to *Todites goeppertianus*. (Münster) Krasser by Ôishi. Like Harris, Ôishi believes also that Zeiller's specimens from Tonking belong to *Todites goeppertianus* Münster sp. Ôishi (1932, p. 275; 1940, p. 195) further pointed out that the specimens from Tonking are different from the specimens under the same designation or *Todites roesserti* from Sweden, Germany and East Greenland in respect to the more crowded, arching, more frequently forking secondary nerves into which the midnerve dissolves at a short distance from its origin, that Presl's type-specimen of *Todites roesserti* (*Alethopteris roesserti* Presl) is an indeterminable fragment, and that the specimens identical with Presl's species by different authors represent ferns quite different from *Todites goeppertianus*. Like Harris (1926, p. 59) and Seward (1910, p. 341), Ôishi is of the opinion that *Todites goeppertianus* is a fern very similar to or in some cases hardly distinguishable from *Cl. whitbyensis* (=*Cl. williamsoni*). But he further remarked that Brongniart's type-specimen of *Cl. williamsoni* differs at least in its sterile specimens from the type-specimens of *Cl. goeppertianus*, the nervation of the former being simpler and less crowed; the midnerve persists nearly to the apex and the secondary nerves do not arch so strongly as those of the latter. With this view one can well agree. The important point is that the fertile specimens of *Cl. shensiansis* belong also to *Todites* and represent the same general type of Osmundaceous fern.

In regarding to the size and shape of the fertile pinnules, the present specimens agree fairly well with those described by Fontaine (1883, Pl. IX, figs. 1, 1a) from the Virginia-Keuper of North America. Dr. P'an pointed out also the close resemblance between his *Cl. roesserti* (=*Cl. shensiensis*) and *Cl. rütimeyer* Heer described by Leuthardt (1904, p. 34, Pl. XIV; Pl. XV, figs. 1, 2) from the Basler Keuper of Switzerland. It appears clear that this characteristic Middle Keuper species is indeed closely related to our species. The specimen figured in Pl. XIV of Leuthardt's paper is especially hardly distinguishable from the most typical specimens of *Cl. shensiensis* (Pl. X, figs. 1, 1a) in regard to the sub-quadrate to triangular pinnules with the strongly convexed posterior margin and in regard to the pattern of venation. But this Middle Keuper species is probably not identical with our species, since some specimens figured by Leuthardt (e.g. his Pl. XV, figs. 1, 2, 1904) show the pinnules which are contracted at the base and some specimens are char acterized by an abnormal basal pinnule at the catadrome side of the pinna (e.g. Leuthardt 1904, Pl. XV, fig. 1). Both features are very much similar to the sterile specimens of *Cl. lobifolia.*

The specimens figured by Brick (1952, p. 22, Pl. VI, figs. 16, 3–7; Pl. VII, figs. 1–7 etc., 1953, p. 15, Pl. XXI, figs. 1–3) from the Upper Triassic of Western Kazakstan and from the Jurassic of Eastern Ферганского Basin as *Todites roesserti* Zeiller might belong also to our species.

Finally, it should be remarked that Dr. P'an had also compared his specimens of *Cl. shensiensis* with those described by Harris from East Greenland as *Cl.* (*Todites*) *goeppertianus.* The present large material of *Cl. shensiensis* shows however that the sterile pinnae of these two species are quite different.

Localities: T'anhokou, near Shihlangmiao, Ichün District, Shensi; Ch'ilitsun, Yenchang District, Shensi; Yenwukou, Yenchang District, Shensi; Ch'imochiao, near Hsinshüping, Ichün, Shensi; Yehchiaping, Suite District, Shensi; Chienkouho, Huating District, Kansu.

Horizon: The upper part of the Yenchang Formation.

Localities: Shihchiakou, Yenchang District, Shensi; Shataiping, Yenchang District, Shensi.

Horizon: The middle part of the Yenchang Formation.

Localities: Kaochiaan, Suite District, Shensi; Chiaoshang, Suite District, Shensi.

Horizon: The lower part of the Yenchang Formation.

MATONIACEAE

Genus *Phlebopteris* Brongniart

Phlebopteris? *linearifolia* sp. nov.

Pl. XXVII, figs. 7, 7a.

The frond is of unknown shape. The rachis is comparatively slender, about 1 mm wide. The pinnae form an angle of about 45° with the rachis and are opposite, very closely set, almost touching each other laterally; they are very slender and linear, with parallel sides and broadly rounded apex, about 3.5 mm in breadth and more than 5 cm in length and are confluent and slightly decurrent at the base. The midrib is fine but distinct, but in the smaller pinnae not much thicker than the lateral veins, decurrent, bending slightly forward, persisting almost to the apex. The secondary veins are not very dense, slightly arching, forming an angle of about 35°—45° with the midrib, bifurcating generally twice. Fertile pinnae unknown.

The fragment shown in Pl. XXVII, figs. 7, 7a is the only specimen known. It differs from all other known species through the very narrow and slender pinnae confluent and slightly decurrent at the base. While there is no doubt that this form is a new and very well defined species, it is not equally clear to which genus it should be referred. In regard to the slender shape of the pinnae and in regard to the general pattern of the venation, there is a possibility that this form may belong to a species of *Phlebopteris,* formerly generally known as *Laccopteris;* but as the characteristic fertile examples are unknown, it is impossible to form any opinion regarding its possible relation to our species.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

2. FILICALES INCERTAE SEDIS

Cladophlebis cf. *gigantea* Ôishi

Pl. IX, figs. 3, 4; Pl. XXIII, figs. 3, 3a.

This characteristic species has been fully described by Dr. P'an in 1936. One of his best specimens is reproduced here in Pl. XXIII, figs. 3, 3a. In the material placed at the writer's hand, there are only two fragmentary specimens which seem to belong to this species. The most typical specimen was found from the upper part of Yenchang

Formation at the locality Ch'ilitsun, Yenchang District. This specimen (Pl. IX, fig. 3) recalls more closely the type-specimens described by Ôishi from the Nariwa flora of Japan. It is a fragment of a ultimate pinna. The pinna-rachis is about 2 mm wide. The pinnules are with lamina of delicate texture, subopposite, broadest at the base, thence attenuating gradually towards the apex which is probably bluntly rounded. They are straight, closely set, and are attached to the pinna-rachis by their whole base. The nervation is delicate and very crowded; from the well-defined midrib which is straight and persistent to the apex of pinnule is sent off secondary veins which are slightly arching, and forked three times, first close to the midrib; secondly midway and lastly near the margin of pinnules, thus making a bundle of nervelets. Margin of the pinnules are shallowly crenulated. Another less typical specimen was found from the Ichün District. This specimen agrees well with those described by P'an from the Yenchang Formation. The rachis is less than 2 mm. The pinnules are smaller, about 5–6 mm broad and 17 mm long, obliquely oblong more or less ellipsoid, falcate, with bluntly rounded apex, and are slightly contracted at the base; they are closely set, subopposite, forming rather wide angles with the rachis. Margin of the pinnules is only slightly crenulated. The midrib is distinct, arising at a very acute angle but bending abruptly outward and pursuing a straight course at an angle of 70° to 90° to the rachis. The secondary veins very fine, dichotomosing three times.

There is a considerable variation in the shape of the pinnae and pinnules of this species in the material first described by P'an in 1936. Some specimens show the very small pinnules of about 3 mm in breadth and less than 5 mm in length (e.g. P'an's Pl. VII, figs. 6–8) and are triangular in shape. Some specimens show the secondary veins of the pinnules bifurcating only two times (e.g. P'an's Pl. VII, figs. 3–5). Dr. P'an believes that these specimens probably represent the upper part of fronds. A few other specimens show the strongly falcate and acute pinnules with secondary veins which are bifurcating mostly only twice (e.g. P'an Pl. VII, figs. 4, 4a). The writer agrees with Dr. P'an that all these specimens seem to belong to the Japanese species *Cladophlebis gigantea* Ôishi, but at the same time he is inclined to believe that the Chinese specimens should not be unreservedly referred to this pecies, because the shape and size of the pinnules and even the venation are so greatly variated than those of the Japanese species. The present writer is in complete accord with the view expressed by Prof. Ôishi, he says for instance (1940, p. 265–266): " . . . . the pinnules of the Chinese specimens are decidedly smaller than those of both the Japanese species mentioned above. Moreover, the writer thinks that it is somewhat questionable whether the limit of variation in respect to the size of the pinnules of *C. gigantea* should be extended to such smaller pinnules as in the Chinese specimens. Therefore, the writer wishes to hold provisionally the Chinese specimens as Cfr. *Cladophlebis gigantea* Ôishi, until better specimens which show more satisfactory evidences proving them conspecific may be obtained in either of the localities."

Dr. P'an is of the opinion that the species *Cladophlebis bitchuensis* Ôishi which occurs in the same locality with *Cl. gigantea* with also thrice bifurcated secondary veins, is most probably not specifically distinct from *Cl. gigantea,* though it possesses an entire margin instead of lobed. It seems that Prof. Ôishi is not quite in agreement with this view. He mentioned these two species separately in his important memoir "The Mesozoic Plants of Japan" published in 1940. And on page 254 in this memoir Ôishi pointed out: "P'an regarded the specific identity of *Cl. bitchuensis* and *Cl. gigantea.* But the two may be distinguished because the pinnules in the former have entire margin less rounded at their apices." It seems indeed almost impossible to draw any distinct line between these two Japanese species. As a rule, the pinnules of *Cl. bitchuensis* have more entire margin and with less rounded apex, but it is quite conceivable that the discovery of more specimens from the type-localities may compel us to recognize more definitely the close agreement between the two forms. Furthermore, the shape of the pinnules, though worthy of notice is not in itself a feature of much value for separating the species.

Localities Ch'ilitsun, Yenchang District, Shensi; T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Locality: Shataiping, Suite District, Shensi.

Horizon: The middle part of the Yenchang Formation.

Cladophlebis raciborskii Zeiller

Pl. XXI, fig. 7; Pl. XXII, figs. 3, 3a; Pl. XXVI, figs. 1—7; Pl. XXVII, figs. 1—5; Pl. LIII, fig. 3.

This species is represented by many specimens, most of which are shown in Pl. XXVI, figs. 1–7 and Pl. XXVI, figs. 1–5. The specimens are all fragmentary but sufficient to give a good idea of the shape of pinnules and the pattern of venation. The breadth of the ultimate pinnae is about 7 cm, the pinna-rachis is smooth and is of moderate thickness, the pinnules are alternate to subopposite, closely set, slightly falcate with a slight auriculate distal expansion at the base, and are narrowing gradually to an acuminate apex. The upper half of the margin of the pinnules is finely dentate. The midrib is comparatively strong, straight, slightly decurrent, bending forward, persisting almost to the apex. The secondary veins are rather loose, forming an angle of about 45° with the midrib, arching, bifurcating close to the midrib, both branches generally dividing once more. At the apex of the pinnules, each tooth receives a set of branches of a secondary vein.

The specimens are too fragmentary for a definite determination; but this species is so characteristic and so easily recognized that even these imperfect fragments can be assigned to it with great probability. The best specimen of this species is up to now still the type-specimen figured by Zeiller in 1903 (Zeiller 1903, Pl. V, fig. 1). The original diagnosis of this species will be given below:

"Frondes apparemment bipinnées, atteignant probablement de grandes dimensions, à rachis primaire lisse ou très faiblement strié en long. Pennes primaires assez étalées, opposées ou subopposées, espacées d'un même côté de 25 à 40 millimètres et davantage, empiétant les unes sur les autres à bords parallèles sur une portion importante de leur longueur, puis effilées en pointe aiguë vers le sommet, larges de 25 à 60 millimètres, atteignant au moins 20 centimètres de longueur.

Pinnules assez étalées, contiguës, droites ou légèrement arquées en avant, à bords parallèles sur la moitié environ de leur longueur, puis effilées en pointe aiguë, à bords dentelés dans leur moitié ou leur tiers supérieur, a base légèrement dilatée en avant et contractée en arrière, faiblement soudées entre elles, larges de 5 à 8 millimètres sur 15 à 35 millimètres de longueur. Pinnule basilaire de chaque penne du côté supérieur (anadrome) de longueur à peu près égale aux suivantes, contiguë ou presque contiguë au rachis primaire.

Nervare médiane nette, se suivant jusqu'au sommet des pinnules, légèrement décurrente à la base; nervures secondaires plus ou moins dressées, bifurquées, presque dès leur base, en deux branches bifurquées elles-mêmes à peu de distance de leur origine, assez rapprochées les unes des autres."

From what has been said above regarding the original diagnosis of this species, it is evident that our specimens, although very fragmentary, are identical almost in all respects with the type-specimens found from the Tonking Coal Field. Of special interest is the fact that in our specimens the posterior margin of the pinnules is at the base slightly expanded. This very characteristic feature agrees fairly well with that of the type-specimens found from Tonking. Zeiller described this feature as follows: "a base légèrement dilatée en avant et contractée en arrière, faiblement sondées entre elles." The feature failblement sondées entre elles can be well observed on our specimens. All the pinnules of our specimens seem to be also very slightly confluent at the base.

The species *Cl. raciborskii* Zeiller has also been described by Ôishi from the Nariwa flora in Japan (1932b, p. 298, Pl. 28, fig. 2; 1940, p. 282) and by Kawasaki from Korea (1925, p. 15, Pl. 7, figs. 25–29; Pl. 34, fig. 94; 1926, Pl. 4, fig. 11). The specimens described by Kawasaki are all not typical in view of the fact that the margin of the pinnules is almost entire and the secondary veins are generally dividing only once. It is possible that these specimens may belong to *Cl. raciborskii* forma *integra* described by Ôishi and Takahasi. Among the specimens described by Ôishi, there are also specimens which show the pinnules with entire margin. Ôishi determined these specimens in 1932 as *Cladophlebis* cfr. *raciborskii* (Ôishi, 1932, Pl. XXVI, fig. 3; Pl. XXVIII, figs. 3–4) and latter in 1936, 1938 and 1940, he referred them to *Cladophlebis raciborskii* Zeiller forma *integra* Ôishi et Takahasi (Ôishi et Takahasi 1936, p. 119; 1938, p. 73; Ôishi 1940, p. 283). Prof. Ôishi further pointed out that the specimens described by Thomas as *Cl. kamenkensis* Thomas

(Thomas 1911, p. 66, Pl. III, figs. 1–3) and the specimens described by Sze from Szechwan as *Cladophlebis* sp. (Sze, 1933a, p. 13, Pl. VI, fig. 8) belong also to this new forma. With this view one can well agree. In studying the material found from Szechwan in 1933, the present writer had also compared his specimen with *Cladophlebis kamenkensis* Thomas and *Cl. raciborskii* Zeiller, and had pointed out that "die von den Japanishon Autoren als *Cl. haiburensis* (L. u H.) bezeichneten Stücke z. T. oder sogar zum grössten Teil von unserem Typus sind (z. B. Kawasaki 1925, T. 5, F. 16, 17, 19; T. 2, F. 4–6; Ôishi 1932, T. 26, F. 1)." (see Sze 1933a, p. 13–14). All these specimens are characterized by the broadly linear and strongly falcate pinnules with entire margin and with subacute apex, the length being generally as much as 1.5 to 2 times the breadth. It appears clear that all these specimens belong to the new forma of *Cl. raciborskii* created by Ôishi and Takahasi; they have certainly nothing to do with the English species *Cladophlebis haiburnensis*. In connection herewith, it should be pointed out that the specimen described by Brick from Eastern Ферганского Coal Field as *Cladophlebis suluktensis* Brick (1953, p. 43, Pl. 18, 19, fig. 2) might also belong to this type. Brick also compared her specimen with *Cl. kamenkensis* Thomas and *Cl. raciborskii* Zeiller.

There remains the question whether the new forma *integra* of this species given by Ôishi and Takahasi is valid or not. It seems to the present writer that the margin of pinnules is not in itself a feature of great importance for separating different forms or species in the genus of *Cladophlebis*. In the species *Cl. denticulata* Brongniart published by different authors, there are many specimens which are characterized by the characteristic pinnules of dentate margin, and there are also many specimens which are characterized by the pinnules of entire margin. And one can clearly see these two forms even in Brongniart's type-specimens. The new forma of *Cl. raciborskii* given by the two Japanese authors is in the opinion of the present writer quite untenable.

The species *Cl. raciborskii* has been recently recorded by Mr. H. H. Lee from the Yunkang Series in the Tatung Coal Field, N. Shansi (Lee 1955, p. 44). Lee believes that the age of the Yunkang Series is Middle Jurassic (see also the table given on page 193 of this memoir).

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis kaoiana sp. nov.

Pl. XIX, figs. 1, 1a, 2; Pl. XX, figs. 1—3; Pl. XXII, figs. 1, 1a.

This species is represented by many well preserved specimens, the best one is figured in Pl. XIX, figs. 1, 1a. Frond at least bipinnate. Penultimate pinnae large, attaining a maximum breadth of at least 20 cm, rachis comparatively slender, about 3 mm wide, with very fine longitudinal striations. Ultimate pinnae opposite to subopposite forming an angle of generally 45° with the mother rachis, linear to linear-lanceolate, maximum length 10 cm, maximum breadth 24 mm, rapidly contracting to an obtuse or subacute apex. Rachis of ultimate pinnae smooth or with very fine longitudinal striations, gradually narrowing to the apex. Pinnules alternate just touching each other, forming an angle of generally 45° with the rachis, very slightly decurrent, and very slightly falcate, oblong to oblong-lanceolate, with obtuse and more or less subacute apex, attaining a maximum breadth of 5–6 mm and a maximum length of about 15 mm. Venation not dense, midrib distinct but not thick, very slightly decurrent, and very slightly arching forward, forming an angle of about 45° with the pinna-rachis, gradually narrowing to the apex of the pinnules; secondary veins arising at an angle of about 40°–45°, bending outwards and reaching the margin at angle of generally about 50°, bifurcating, the distal or both branches generally dividing once more. Margin of pinnules entire, pinnules with lamina of delicate texture and slightly confluent at the base. Pinnules at the top portion of the ultimate pinnae almost fused one another at the base. The first anadromc basal pinnule is slightly longer, more oblong in shape and almost parallel with the mother rachis; the first catadrome basal pinnule is slightly shorter, more round or ovate in shape, forming an angle of generally 35°–45° with the mother rachis. Fertile pinnae unknown.

This new species is distinguished by its delicate texture of the pinnules, its comparative narrow and slender rachis and its not very dense but fine and distinct venation. The whole frond gives an impression of a graceful habit. In spite of the fact that several more or less similar types of *Cladophlebis* have been described by previous authors, the writer is inclined to believe that the present specimens represent a new specific form of this genus. In naming this species, the writer follows the principle of Prof. Halle that "It is lesser evil to keep forms separated which are identical than to identify such as are distinct" (1913, Grahamland flora, p. 3).

The writer has ventured to name this new species after his friend Mr. C. S. Kao, the Curator of the Geological Museum of the Ministry of Geology, China.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis graciles sp. nov.

Pl. XXIV, figs. 1, 1a, 2, 2a; Pl. XXV, figs. 1—4.

This very graceful species is represented also by many well preserved specimens. Frond at least bipinnate. Rachis comparatively broad and strong, smooth, occasionally with a median ridge. Rachis about 3 mm wide narrowing gradually to the upper portion of the frond. Ultimate pinnae opposite, occasionally subopposite, linear-lanceolate, attaining a maximum breadth of about 15 mm and a length of at least 7 cm gradually narrowing from the base to the narrow, acute apex and forming an angle of 45° with the mother rachis, just touching or more distant. Pinna-rachis also very strong, arising from the mother rachis at an angle of about 45°, gradually narrowing to the apex of the pinna. Pinnules very small, about 4 mm in breadth and 5 mm in length; rhomboidal to subquadrate with generally obtuse to subacute apex; very slightly falcate, margin entire, alternate to subopposite, closely set, generally touching at their margins, a little decurrent and sometimes confluent, and becoming more and more confluent towards the apex of the pinna, with a slight contraction or upward bulging of the proximal margin at the base; upper side often slightly convex; distal margin straight or often very slightly concave. Midrib fine but distinct, decurrent, often bending slightly forward in the upper half of the pinnule, and persisting almost to the apex; secondary veins much finer than the midrib, but also very distinct, not very dense, straight or arching, dividing generally in the proximal half of the pinnule twice, and in the distal half of the pinnule the secondary veins dividing once, with the anterior branch dividing once more; generally the first secondary vein in the basal part of the distal half of the pinnule after dividing once, the anterior branch dividing once more, then the posterior branchlet of of which dividing again. The secondary veins at the apex or the uppermost half of the pinnule generally dividing only once. The first catadromous pinnule at the base of the ultimate pinnae is more round in shape and forming an angle of about 45° with the rachis of penultimate pinnae. Fertile pinnae unknown.

Most of the numerous specimens of this species are fragmentary; those shown in Pl. XXIV, figs. 1, 2 (Part and counterpart) are more nearly complete than the others. In spite of the fact that the specimens are preserved on the matrix of coarse sandstone, the venation of the pinnules is very distinct. The only known species which could be closely comparable to ours is *Cladophlebis microphylla* described by Fontaine (1883, p. 51, Pl. XXVII, fig. 2) from the Virginia-Keuper of North America. This North American species is as implied by its specific name, characterized by the very small pinnules. In regard to the size and shape of the pinnules, *Cl. microphylla* Fontaine bears a strong resemblance to our species. As described by Fontaine, the pinnules of this American species are united at the lowest part of the base, subquadrate and falcate, rather thick in consistency and alternate. The most important difference between these two species is in the venation. The secondary veins of *Cl. microphylla* are more simple than our species, they are all only dividing once from near their insertions. *Cladophlebis graciles* is also a good deal like *Cladophlebis ovata* Fontaine (1883, p. 50, Pl. XXVI, fig. 5; Pl. XXVII, fig. 3) from the same formation of North America. This species is distinguished by the pinnules which are alternate, dense and thick in consistency, ovate, obtuse, and slightly falcate, separate to the base. The venation is not well shown, being slender and immersed in the thick leaf-substances of the pinnules. The secondary veins seem to be delicate, the lowest twice forked, the upper once forked. According to above descriptions, this American species seems to be less closely related with our species.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis ichünensis sp. nov.

Pl. XVIII, figs. 10—11; Pl. XXVIII, figs. 1, 1a, 2; Pl. LIII, fig. 4.

Frond of unknown shape, at least bipinnate. Penultimate pinna probably linear or lanceolate. Rachis smooth, stout, about 3 mm broad. Ultimate pinnae closely set, generally touching laterally, forming at very wide angles with the rachis, linear or linear-lanceolate with almost parallel sides, maximum breadth about 18 mm, maximum length unknown, at least 8–10 cm, Pinna-rachis also strong, almost perpendicular to the mother-rachis. Pinnules closely set, generally touching, forming an angle of about 70° with the rachis, broadly oblong, maximum breadth about 4 mm, maximum length about 11 mm. Slightly decurrent with broadly rounded apex. Venation not very dense, midrib distinct, straight, decurrent, bending forwards, persisting almost to the apex; secondary veins not dense, comparatively fine, but very distinct, arising at an angle of about 40°, bending outwards and reaching the margin at an angle of generally about 50°, bifurcating generally only once, very rarely the distal branch dividing once more. The first secondary vein at the proximal half of the pinnule giving off from the decurrent part of the midrib, strongly arching outwards, bifurcating once, occasionally the posterior branch dividing once more. Fertile pinnae unknown.

Through the pecopteroid shape of the pinnules with its characteristic venation, *P. ichünensis* is well distinguished from all other forms in the Yenchang flora. It is highly probable that a part of the specimens described by previous authors as *Cl. nebbensis* may belong to this species.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis stenophylla sp. nov.

Pl. XXI, Figs. 1—4.

Frond at least bipinnate; penultimate pinnae more or less linear, with a maximum breadth of about 7–8 cm. Rachis strong. Ultimate pinnae forming an angle of about 45° with the rachis, closely set, generally slightly overlapping, with strong rachis, opposite or alternate, attaining a length of 5–6 cm or more and a breadth of about 10–11 mm, linear or linear-lanceolate, their sides parallel almost to the upper half of the pinna, then gradually narrowing to the obtuse or subacute apex. Pinnules alternate to subopposite, closely set, generally touching each other laterally, forming an angle of about 70° with the pinna-rachis, oblong, with broadly rounded apex, attaining a length of 6 mm and a breadth of 2.5 mm. Midrib of pinnules slender, secondary veins forming an angle of about 60°–70° with the midrib, straight or slightly arching, bifurcating generally only once.

The numerous specimens of this characteristic species are preserved somewhat indistinct; they are all not very suitable for photographic reproduction. The species is also chiefly characterized by its small, oblong and pecopteroid pinnules. The length to breadth ratio of the pinnules varies considerably, the pinnules of the smaller specimens and those towards the apex of the pinnae being shorter than the others. The venation is generally indistinct on account of the preservation. The secondary veins dichotomize generally or almost constantly only once close to the midrib. In regard to the shape and size of the pinnae and pinnules, this species is very similar to some species of *Pecopteris* of the Palaeozoic, e.g. *Pecopteris arborescens P. cyathea* Brongn., *P. hirta* Halle, *P. norinii* Halle etc. Among the Mesozoic species of *Cladophlebis*, *Cladophlebis arguta* (L. et H.) Halle (see Sze 1933b, p. 24, Pl. 4, figs. 1—4) from Inner Mongolia (formerly Suiyuan Province) seems to come near to the present form. The shape of the pinnules of this species appears to be slightly different, some pinnules are very slightly contracted at the base, and the margins of the pinnules are slightly crenulated. The secondary veins are arising almost at right angle from the midrib and dividing generally once, the first secondary veins at the base of the pinnules generally dividing twice.

Locality: Ch'imochiao, Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis paralobifolia sp. nov.

Pl. XXII, figs. 2, 2a; Pl. XXIII, fig. 1.

There is only one specimen of this species. Frond at least bipinnate. Rachis comparatively broad, smooth, its impression showing a marked contract between a median ridge and flat, wing-like franks (Pl. XXII, fig. 2). Penultimate pinnae linear, attaining a breadth of at least 10 cm probably much broader. Ultimate pinnae rather distant almost opposite, forming angles from 45° to almost 90° with the rachis, linear or linear-lanceolate, generally 15 mm broad, rapidly contracted at the apex. Pinna-rachis also rather strong, straight and smooth, about 1–1.5 mm in breadth. Pinnules closely set, ovate-deltoid, tapering from the base, with generally rounded, occasionally subacute apex, attaining a length of about 6–10 mm and a maximum breadth of 4–4.5 mm at the base. Pinnules confluent at the base, the distal margin slightly contracted and the posterior margin slightly decurrent. Venation very fine but distinct. Midrib distinct, but slender, arising at an acute angle from the rachis and bending forwards, dissolving at some distance below the apex of the pinnules; secondary veins of nearly same strength as the midrib, not dense, arising with an acute angle from the midrib, dividing generally once, especially those of the upper half of the pinnules, occasionally the distal branch dividing once more, the first secondary veins at the base of the pinnules generally dividing twice. The basal pinnule on the lower side of the ultimate pinnae shows the characteristic broad lamina provided with a rather inconspicuous basal lobe. Fertile pinnae unknown.

The present writer has determined, after some hesitation, this single, very characteristic specimen as a new species *Cladophlebis paralobifolia* sp. nov. As implied by the specific name, this new species bears a resemblance to the species *Cladophlebis lobifolia* (Phillips). In the form of the pinnules and in the possession of a slightly larger and slightly lobed basal pinnules, our species is more or less like the specimen figured by Raciborski (1894, Pl. XI) and those from the Yorkshire coast (England). The pinnules of *Cl. lobifolia* are generally smaller, more ovate-deltoid in shape, and less confluent at the base; the distal margin of the pinnules is more strongly contracted. The basal pinnules of both the anadromous and catadromous sides of the pinnae are more abnormal in form and larger. The texture of the lamina of pinnules of our species seems to be very delicate while the pinnules of *Cl. lobifolia* are generally of a thick and leather-like consistency. Furthermore, the fertile pinnae of *Cl. lobifolia* is of *Eboracia* type; the sori and spores exhibit a close agreement with those of *Coniopteris* and recent Cyatheceae, so far as can be determined in the absence of well preserved sporangia. In regard to the fact that the fertile pinnae of our species are unknown, it seems premature to express the affinities of the two forms at present.

Locality: Yenan District, Shensi (Exact locality unknown).

Horizon: The exact horizon from which this specimen was derived is unknown. According to the character of the matrix, this specimen may belong to the Yenchang Formation.

Cladophlebis suniana sp. nov.

Pl. XVIII, figs. 7—9.

This new species is a good deal like Pan's *Cladophlebis grabauiana*, and also resembles *Cl. ichünensis* sp. nov. described in this memoir, but the pattern of venation will distinguish this plant.

Frond at least bipinnate. Rachis slender but strong. Ultimate pinnae linear or linear to lanceolate, with probably obtuse apex, attaining a maximum breadth of 13 mm and a length of at least 5–6 cm, alternate, forming an angle of about 45° with the rachis. Pinnules closely set, touching each other laterally, opposite to subopposite, decurrent and confluent at the base, ovate to oblong with broadly rounded apex, attaining a maximum breadth of 5 mm and a maximum length of about 7 mm. Venation fine but not dense. Midrib strongly decurrent, arising from an acute angle with the rachis, bending forwards, dissolving a short distance from the apex of the pinnules, secondary veins slightly finer than the midrib, arising from an angle of 45° with the midrib, arching and bending outwards, some of them undivided, some of them dividing once either in the middle course or at the margin of the pinnules. The first secondary vein at the base of the proximal half of the pinnules is arising from the decurrent part of midrib, strongly arching, dividing generally once, occasionally undivided; the first secondary vein at the base of the anterior half of the pinnules is arising with an acute angle from the midrib, very slightly arching outwards and forwards to the margin, generally or almost without exception undivided. Fertile pinnae unknown.

The species is strikingly like the plant described by P'an as *Cl. grabauiana* (Pl. XXIII, figs. 2, 2a) from the same formation of Northern Shensi. The only difference is that the secondary veins of *Cl. grabauiana* are all bifurcating twice, very occasionally the distal branch dividing once more, and there is no secondary vein arising from the decurrent part of the midrib. *Cladophlebis suniana* resemble also *Cl. ichünensis* described in this memoir, the latter species is however distinguished by its longer pinnules which are more oblong in shape and by its secondary veins which are more dense and are dividing almost constantly twice.

The present writer finds himself compelled to place the specimens in a distinct species, as the features are so different from those of all previously described species that they cannot be well placed in any existing ones, and has named it after the late Mr. C. C. Sun, the distinguished geologist of the China Petroleum Administration.

Locality: Ch'imcchiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis sp. a

Pl. XVIII, fig. 6.

Only a very small fragment of this form was found, but enough to show that it is clearly a *Cladophlebis*. It is a part of an ultimate pinna without base and apex, measuring a little over 1.5 cm in length. The pinnules are ovate in shape, attaining a length of 10 mm and a breadth of 6–7 mm. The apex of the pinnules is broadly rounded, with a very short "mucro", which however is very indistinct. The nerves are fine and dense, but sharply distinct, dividing from two to three times. The midrib is indistinct, dissolving almost at the beginning of its arising.

The specimen is indeterminable, but it has been figured because it does not appear to belong to any of the other species described in this memoir. It is however highly possible that the specimen may also belong to a variated form of the species *Cladophlebis shensiensis*, since this species is known, as remarked above, to have a considerable variation of the shape and venation of the pinnules. The material consists only of a very fragmentary specimen and some points are not clear, it seems better not to identify it with *Cl. shensiensis* for the present.

Locality: Tánhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis sp. b.

Pl. XXVIII, figs. 4, 4a.

After considerable hesitation, the writer has decided to place the single and very fragmentary specimen shown in Pl. XXVIII, figs. 4. 4a in the genus *Cladophlebis*. It is marked by the large deltoid pinnules with subacute apex and contracted base, and by the closely placed veins which fork at long intervals. All veins seem to be arising from the contracted base of the pinnules, and very obliquely ascending; one vein in the middle of the pinnule sometimes appears as a midrib, scarcely stronger than the other veins. The most striking feature of this specimen is that there is a very fragmentary normal ultimate pinna (with one or two normal pinnules) still attached to the right side of the main rachis. The specimen is too imperfect for a comparison with any particular species.

Locality: Tánhokou, near Shihlangmiao, Ichün District Shensi.

Horizon: The upper part of the Yenchang Formation.

Genus *Sphenopteris* Brongniart

Sphenopteris sp. (cf. *Sph. arizonica* Daugherty)

Pl. XXVII, figs. 8, 8a.

The fragment of a sphenopteroid frond shown in Pl. XXVII, figs. 8, 8a is too imperfectly preserved for determination, but seem to represent a very characteristic type. It consists of the upper part of a bipinnate frond or a pinna of a tripinnate frond. The rachis is slender, about 1 mm wide. The ultimate pinnae are closely set, alternate to subopposite, ovate, linear or linear lanceolate, and attain a breadth of 6–7 mm and a length of 2–2.5 cm gradually tapering towards the subacute apex, arising at an acute angle, very rapidly bending outwards and assuming a course almost perpendicular to the rachis. The pinnules are ovate or round in shape, alternate or subopposite, attached to the rachis with a broad base, and slightly decurrent. The distal margin at the base is slightly contracted. The venation is very indistinct, probably due to the state of preservation. The midrib is fine, strongly decurrent, scarcely stronger than the other veins, bending outwards, giving off simple or forked, strongly arching secondary veins ascending at very narrow angles.

There is some resemblance between the present specimen and some American specimens of *Sphenopteris arizonica* described and figured by Daugherty (1941, p. 99, Pl. 19, figs. 3, 4) from the upper Triassic flora of Arizona, but the American form has a broader and stronger rachis of the frond and of the pinnae which is slightly flexuous, finely striate and with a marked median ridge, bordered by narrow membranaceous laminae. The pinnules of the American form are ovate to obicular and occasionally lobed. In regard to the shape and size of the pinnules and their manner of attachment, the present specimen recalls somewhat *Microphyllopteris gleichenoides* O. & M. (Walkom 1919, Pl. 2, fig. 6) of the Lower Cretaceous Burrum flora in Australia, but this Lower Cretaceous species is evidently not identical with our form in view of the fact that the ultimate pinnae are more linear-lanceolate in shape, very closely set and forming much smaller angles with the rachis.

Like *Sph. arizonica,* the fertile pinnae of the present from are also not known. It seems premature to express the affinity of the plant. It is not certain whether our form belongs to the ferns or to the pteridosperms. Seward (1931, p. 269) stated that all Mesozoic and later species of *Sphenopteris* are ferns. Daugherty (1941, p. 99) is of the opinion that there is not impossible that some Pteridosperms with a *Sphenopteris* foliage survived until Triassic times. The present writer however, is quite prepared to agree with the view of Prof. Seward, that all Mesozoic and later species of *Sphenopteris* are not Pteridosperms. The present form as well as *Sph. arizonica* might therefore most probably belong to the ferns.

Locality: Ch'ilitsun, Yenchang District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Sphenopteris? *chowkiawanensis* sp. nov.

Pl. XXVIII, figs. 3, 3a.

The material on which this species was founded consists of only one small but very well preserved fragment. Frond at least bipinnate. Rachis comparatively broad and strong, with rather smooth surface. Ultimate pinnae closely set, alternate, forming an angle of 45° or more with the main rachis, linear, with probably parallel sides, attaining a breadth of about 9 mm. Pinnules closely set, almost round in shape attaining a maximum length of about 5 mm and a maximum breadth of about 4 mm, contracted very slightly and attached with a considerable portion with the base. Venation very characteristic. Each pinnule consists of at first one vein, arising with an acute angle from the pinna-rachis, rapidly bifurcating, each branch again dividing twice to thrice, the margin of the pinnule thus may receive generally 8 veins, occasionally as much as 14 veins.

This is a well marked species. The present writer knows of no previously described species with which this could be identified, or indeed which closely resembles it. Since there is no distinct midrib in the pinnules, even the generic determination of this form is somewhat doubtful. It should be however pointed out that in regard to the shape of the pinnules and in regard to the pattern of venation, the present form strongly recalls a textfigure reproduced by Harris as *Todites* cf. *princips* (1926, p. 55 textfig. 2a) from E. Greenland, but the size of the pinnules of our species is almost three times larger than that of the pinnules of the species of E. Greenland. These two forms are therefore not identical, inasmuch as the fertile pinnae of our species is still unknown.

Locality: Chowkiawan, Yenchang District, Shensi.

Horizon: unkown.

Undetermined Sterile Pinnae

Pl. XXVIII, figs. 5, 6.

The specimens of the fern-pinnae shown in Pl. XXVIII, figs. 5, 6 are too fragmentary and too badly preserved to be determined, but they have been figured becouse they do not seem to be identical with any other species found from the Yenchang Formation of Northern Shensi. The pinnules are almost oppositely attached to the rachis and generally forming a right angle with the rachis. In regard to the shape and size of the pinnules, the present form resembles more or less the species of *Cladophlebis*. The pinnules are attached also with a broad base to the rachis. The pattern of venation is almost like that of *Cladophlebis*. Midrib distinct; secondary vein generally bifurcating twice, occasionally thrice.

Locality: Taweiping, Chiahsien District, Shensi.

Horizon: The lower part of the Yenchang Formation.

3. MARATTIALES

MARATTIACEAE

Genus *Danaeopsis* Heer

Danaeopsis fecunda Halle

Pl. XXX, figs. 1—4; Pl. XXIX, figs. 1—2; Pl. XXXI, figs. 1, 1a—1f;
Pl. XXXV, fig. 5; Pl. XLIII, fig. 1; Pl. LII, fig. 4.

This very characteristic species is hitherto only known from the Rhaetic of Scania, Sweden and from the Yenchang Formation of North and Northwest China. Very recently this species seems to occur in the Upper Triassic beds from Eastern Kazakstan (see Synonym in the Chinese text). In Northern China, this species is distributed in many localities ranging from the lower to the middle and upper parts of the Yenchang Formation. According to a recent report of Dr. P'an, it occurs also in the basal part of the overlying Wayaopu Coal Series in Northern Shensi.

This species is therefore one of the most common species in the Yenchang Formation in North and Northwest China. The sterile fronds of this species were described by P'an as *Danaeopsis* (*Pseudo-danaeopsis*) *hallei* P'an in 1936. The discovery of a very characteristic fertile specimen in association with the sterile ones in the Yenchang Formation of Western Kansu in 1950 affords evidence in favor of identifying the species with the well-known Rhaetic species *Danaeopsis fecunda* Halle of Scania, Sweden. The fertile pinna of this species found from Western Kansu has been fully described by Sze and Lee in 1951. In a recent report (written in Chinese) published in 1954, Dr. P'an expressed the view that he is in complete agreement with the writer's determination (P'an 1954, p. 211). A new diagnosis is therefore given below, based on the new material collected from the Yenchang Formation in recent years. The fertile specimen of Western Kansu is reproduced in Pl. XXXI, figs. 1 and 1a—1f.

Frond very large, pinnate; rachis very thick with a maximum breadth of about 2.5 cm; pinnae closely set or distant, broadly lanceolate-linear, given off from the rachis at rather wide angles, attaining a maximum breadth of about 6 cm and a maximum length of about 17.5–18 cm, slightly narrowed at the basal part and more gradually narrowing towards the broadly rounded apex. At the basal part, the upper margin of the pinnae bending slightly downward and the lower margin being slightly decurrent on the rachis, occasionally both the upper and lower margins are slightly contracted at the base; margin entire; surface not thick. Venation very distinct, midrib strong, attaining a maximum breadth of 7 mm at the base of some pinnae, gradually narrowing and persisting almost to the apex, smooth, occasionally with three more or less marked longitudinal striations; secondary veins not very dense, given off from the midrib at an acute angle, bending outwards, bifurcating generally close to the midrib or at a little distance from the origin, dividing occasionally once more at the middle course and anastomosing near the margin. In the decurrent part of the pinnae, the secondary veins are given off directly from the rachis. Fertile pinnae resembling more or less the shape of the sterile pinnae, completely covered, except the midrib, with contiguous sporangia on the lower side. Each sorus consisting of a double row of free, ellipsoidal sporangia which have a faint longitudinal furrow marking the line of dehiscence and a slight rounded depression at the apex; sporangia and spores are unknown in the Chinese specimen; in the Swedish specimen, the dimensions of sporangia are 0.80–0.90 $\times$ 0.65–0.75 mm and the spores are of the tetrahedral type, globular, with the usual triradiate marking, surface smooth without any papillae or other sculpture, the diameter is usually 0.06–0.07 mm.

The fertile pinnae of this species are fully described by Prof. Halle in a paper published in 1921 entitled "On the Sporangia of some Mesozoic Ferns," and by Sze and Lee in a paper published in 1951 in Science Record, Vol. 4, No. 1 of Academia Sinica.

The sterile pinnae of this species described and figured by P'an in 1936 (1936, Pl. X, fig. 3; Pl. XI, figs. 1—2), and by Sze and Lee in 1951 (1951, Pl. I, figs. 1—4) are identical almost in every respect with the type-specimen found from Scania and described by Prof. Halle in 1921 (1921, Pl. I, fig. 1). Especially the specimens figured by P'an in his Pl. X, fig. 3 and by Sze and Lee in their Pl. I, fig. 4 agree fairly well with the type-specimen of Sweden. The pinnae of these specimens are narrowly lanceolate-linear in shape and both the anterior and posterior margins of the pinnae are slightly contracted at the base. This feature agrees well with the pinnae of the type-specimen of Sweden, which Prof. Halle described as being characterized by "narrowly, lanceolate-linear, with a rounded non-decurrent base." The Chinese species are therefore identical perfectly well with the Swedish species. The identification is all the more ascertained by the fact that a very similar and identical fertile specimen of this species has also been found from the Yenchang Formation of Kansu Province. There are several specimens in the material, which show the pinnae characterized by a decurrent base, and agree in this respect not quite well with type-specimen described by Halle. But the single specimen of the sterile frond of Scania (Halle Pl. I, fig. 1, 1921) is very imperfectly preserved, and it is quite possible that future search of the type localities of Scania may reveal the presence of specimens of the sterile frond of *Danaeopsis fecunda* that may have some pinnae showing the somewhat decurrent base. The same has been pointed out by Sze and Lee in 1951 (Sze and Lee 1951, p. 88). Of special importance is the fact that in our material there are many specimens of the sterile frond, which are characterized by the rather larger pinnae e.g. the specimens figured in Pl. XXIX, figs. 1, 2. The pinna shown in Pl. XXIX, figs. 1, 1a-b attains a maximum breadth of 6 cm and a length of 18 cm without being complete. These fronds must have attained a very long size. In regard to the size and shape, the pinnae of these specimens agree very well with the European Upper Triassic species *Danaeopsis marantacea* Presl and especially with the specimens described by Leuthardt (1904, Pl. XIII, figs. 1—3) from the Basler Keuper of Switzerland. In those specimens, however, the anastomoses of the secondary veins at the margin of the pinnae are quite different from the type-specimen of *Danaeopsis fecunda* Halle of Sweden and from our specimen found from the Yenchang Formation. It is not quite improbable that future investigations may show the sterile pinnae of *D. marantacea* to have a venation similar to that of our specimens and may show the fertile pinnae similar to that of *D. fecunda,* which name will then have to be rejected in favor of *D. marantacea.* The original figure given by Leuthardt (1904, Pl. XIII, figs. 1—3) has been reproduced by Seward (1910, p. 358, fig. 265B) and Hirmer (1927, p. 593, fig. 713A) in their important works. It seems evident that those two great authors have been strongly inclined to the view that the original figure of Leuthardt is correctly illustrated. Seward (1910, p. 408) described the character of secondary veins of *M. marantacea* as follows: "A specimen of *M. marantacea* described by Leuthardt as *Danaeopsis marantacea* from the Upper Trias of Basel shows a peculiarity in the venation; the lateral veins often fork near their origin, as noticed by other authors, but each vein forks a second time near the edge of the lamina and the two arms converge, forming a series of intra-marginal loops." If the observation of Leuthardt and the description of Seward of the so-called intra-marginal loops formed by the secondary veins of this species were correct, the sterile pinnae of *D. marantacea* should be quite distinct from our species. But according to the figure given by Schimper (1874, Pl. 37, fig. 1), there are no anastomoses of the secondary veins at the margin of *D. marantacea,* and the same can be seen from the figures given by Gothan (1921, p. 60, fig. 46; 1954, Pl. 114, fig. 92) in his Lehrbücher. The present writer is rather inclined to believe that the original figure of this species given by Leuthardt, described by Seward, and reproduced by Hirmer (1927, p. 593, fig. 713A) is not correctly drawn, and that the anastomoses of the secondary veins at the margin of the pinnae of this species may probably be similar to those of the present specimens and to those of the type-specimen of *D. fecunda* Halle of Sweden. The fertile pinnae of *D. marantacea* are at any rate slightly different from those of our species, as has been fully discussed by Prof. Halle in 1921 (1921, pp. 4, 8; Pl. 2, figs. 27–30). Under these circumstances, an identification of these two species is not possible and the better course is to retain *D. fecunda* and *D. marantacea* in the genus *Danaeopsis* at least for the present.

It may be questioned whether the specimens described by Brick as *Danaeopsis marantacea* (Presl) Heer and *D. emarginata* Brick (1952, p. 15—16; Pl. 1, figs. 1—3, 6; Pl. IV, fig. 7) from the Upper Triassic of Western Kazakstan are identical with our species or not. In the shape and size of the pinnae and in venation, the specimens from Kazakstan are indeed closely comparable to the present specimen. A careful study of the illustrations published by Brick led the writer to believe that the Kazakstan specimens might probably be identical with ours. Some secondary veins of the pinnae figured by Brick are also slightly anastomosing at the margin, resembling more or less the present specimens. It is of course highly possible that the specimens of Brick belong to *Danaeopsis marantacea.* Since no characteristic fertile specimens are hitherto found from Kazakstan, it seems premature to express the close affinities of the sterile pinnae found from this region. It should be however pointed out that the new species *D. emarginata* found from Kazakstan is apparently not valid. In the absence of fertile pinnae, it is better not to create different new species of the genus *Danaeopsis,* based solely on the very slightly variations of the shape of the sterile pinnae and its venations. It seems to the present writer that in regard to the shape and size of the sterile pinnae and in regard to the pattern of venation, *D. emarginatum* is all but indistinguishable from the specimens described by the same author as *D. marantacea* from the same region. In determining the species of *Danaeopsis,* we should more rely on the difference of the fertile pinnae, and if the shape of the sporangia and their orientations of *D. marantacea* are slightly different from those of *D. fecunda,* even these two species may be identical. It therefore follows that the specimens described by Brick as *Danaeopsis angustipinnata* and *D. bipinnata* (1952, p. 17—18; Pl. II, figs. 3—4; Pl. III, figs. 1—10) are also not valid, because these new species are based solely on the somewhat different shape of the sterile pinnae which are more closely set and more narrow and slender in form. It seems to the present writer that these specimens might even possibly belong to the genus *Bernoullia* in view of the fact that several characteristic fertile specimens of *Bernoullia* have been found from the same formation of Western Kazakstan. The question will be more fully discussed later.

The generic name *Pseudodanaeopsis* Fontaine proposed by Krasser has been rejected by Halle for several reasons. Lundblad is of the opinion that in the light of evidence brought forward in the last decades even the filicinean affinities of the type of Fontaine's genus seem very doubtful, on account of the features of the rather thick and coriaceous leaf-substance. The generic designation given by Dr. P'an as *Danaeopsis* (*Pseudodanaeopsis*) for the Yenchang specimens does not therefore appear to rest on adequate grounds. The anastomosing feature of the secondary veins of some specimens of the American species is indeed very closely comparable to our specimens.

Localities: T'anhokou, near Shihlangmiao, Ichün District, Shensi; Yenchiaping, Suite District, Shensi; Nanyung-erh, Wuwei District, W. Kansu.

Horizon: The upper part of the Yenchang Formation.

Localities: Taweiping, Chiahsien District; Kaochiaan, Suite District, Shansi; Wumeng, Yungho District, Shansi; Lichiayao, Hsinhsien District, Shansi; Yenhokou, Huating District, W. Kansu.

Horizon: The lower part of the Yenchang Formation.

Localities: Hsiaomaho, Yaohsien District, Shensi; Fangêrhshang, Yaohsien District, Shensi; Pemafang, Linyü District, Shensi; Pingti, Shünhwa Distriict, Shensi.

Horizon: Unknown.

Danaeopsis? sp.

Pl. XXXIII, fig. 4; Pl. LIII, fig. 7.

The small fragments shown in Pl. XXXIII, fig. 4 and Pl. LIII, fig. 7, though naturally indeterminable are of some interest, because they seem to represent the young fronds of *Danaeopsis*. The rachis is comparatively strong, about 5 mm in broadth, with smooth surface. The leaflets (or pinnae) are ovate to ellipsoid in shape, with broadly round apex and with a contracted base both above and below, occasionally the proximal margin is slightly decurrent (Pl. XXXIII, fig. 4). The pinnae are almost oppositely attached to the rachis. The whole shape of the frond is very similar to the young form of the pinnate "*Taeniopteris*." The midrib of the pinnae is also comparatively strong, attached to the rachis with very wide angles and not decurrent. The secondary veins are very indistinct due to the state of preservation; they seem not very dense and seem to be arising with an acute angle from the midrib and bending rapidly outwards, generally simple, occasionally bifurcating once close to the margin.

The specimens are evidently insufficient for determination and do not seem to be closely comparable to any known species.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

4. MARATTIALES?

Genus *Bernoullia* Heer

Bernoullia zeilleri P'an

Pl. XXIX, figs. 3, 3a; Pl. XXXII, figs. 1—3;
Pl. XXXIII, figs. 1—3; Pl. XXXIV, figs. 1—4; Pl. XXXVII, fig. 9;
Pl. XLIII, fig. 2; Pl. XLIV, figs. 5—6; Pl. LII, fig. 3; Pl. LIII, fig. 2.

One of the most characteristic plants in the Yenchang Formation is a *Bernoullia* which has already been described by P'an as a new species, *B. zeilleri* P'an. This species is represented by many well preserved specimens, both fertile and sterile, in the present material. A more complete diagnosis of this species will be given here, based on the study of a large material.

Frond pinnate (or bipinnate); rachis stout, attaining a breadth of 4–4.5 mm with indistinct longitudinal striations, its impression showing a marked contrast between a median ridge and flat, wing-like flanks. Pinnae with entire margin, closely set or distant, linear to linear-lanceolate, with more or less parallel sides, gradually tapering from the base to the obtuse or subacute apex, attaining generally a length of 7.5 cm and a breadth of 8–15 mm, subopposite to alternate, forming an angle of 45–80° with the rachis often even perpendicular, attached by a contracted base. Smaller pinnae ellipsoid to ovate, occasionally round (Pl. XXXII, fig. 3; Pl. XLIV, fig. 6). Pinnae-rachis (or midrib) also comparatively stout, about 2 mm in breadth at the base, gradually narrowing to the apex, often with a fine but distinct longitudinal, middle striation; secondary veins fine and dense, departing at a narrow angle, arching and reaching the margin at an angle of 50–60°, repeatedly dichotomising between the midrib and the margin, forming more or less separated fascicles of veins. Fertile pinnae more distant than the sterile ones, alternately attached to the rachis; rachis stout, about 4–4.5 mm in breadth, often showing a distinct median ridge, bordered by narrow membranaceous laminae; pinnae comparatively shorter and slender, attaining a breadth of about 5 mm or more and a maximum length of 3 cm, forming comparatively wider angles with the rachis, more or less perpendicular, generally ellipsoid to oblong in shape, with broadly rounded apex and slightly contracted base; covered completely with contiguous sporangia on the lower side; the distal margin of the pinna seems to be rolling up at the lower side of the pinnae with the result that there seem to be no sporangia on this narrow part (i.e. a narrow and slender part of about 2/5 of the entire lower side of the pinnae). Sporangia appearing in several regularly longitudinal rows attached to the lower side of the pinnae. Shape of sporangia unknown. Spores unknown.

This splendid fern stands second in the abundance of its individuals and the area over which it is diffused. Most of the specimens of this species were collected by the writer, the material is very rich, more than 30 well preserved specimens of the sterile fronds have been placed at the writer's hand for study. Some sterile fronds in the collection attain a length of 20 cm without being complete. The original frond of the plant must have been very large. In our collection, there are no specimens which show a bipinnae frond, but this does not of course mean that the plant is always only simply pinnate. Dr. P'an pointed out (1936, p. 27) that the general habit of the pinna and venation of our species agree with Zeiller's *Pecopteris* (*Bernoullia*?) sp. and that the characteristic base and venation of the pinna show a closer resemblance to *Bernoullia* than to any other known genera; therefore he would prefer to keep the species provisionally in that genus. And with this view, the writer is in complete accord. In the writer's opinion, our specimens can be assigned, without hesitation, to the genus *Bernoullia* created by Heer in 1877. The general shape of the pinnae of *Bernoullia* may be compared with *Marattiopsis,* but neither the venation nor the fructification agree with this genus, as has been remarked also by Dr. P'an. *Bernoullia* has been described from the Basler Keuper of Switzerland and from the Lunzer Keuper of Austria, both belonging to the Middle Keuper age. The genus has also been recorded in the Lettenkohle Formation (Lower Keuper) of Franconia (Franken) in Germany. Dr. P'an did not point out the difference between our species and the European species *Bernoullia helvetica* Heer. It seems to the present writer that in the species *B. helvetica,* the size of the pinnae is smaller and shorter with slightly crenulate margin, occasionally lobed; the lobes of the pinnae even show a distinct midrib, given off simple or bifurcating secondary veins. The pattern of the venation in the lobes agrees more or less with the types of some Palaeozoic species of *Pecopteris,* e.g. *P. unita* and *P. arcuata* (see Leuthardt 1904, Pl. XIX, fig. 3). Moreover, the fertile pinnae of this European species are also different from those of our species. Both the upper and lower margins of the fertile pinnae of *B. helvetica* are rolling up at the lower side of the pinnae with the result that the sporangia appear to be concentrated to a narrow median zone parallel to the pinna-rachis (or midrib), generally about 4 longitudinal rows of rounded sporangia along either side of the pinnae-rachis (see Leuthardt 1904, Pl. XIX, fig. 4). The individual sporangia seem to be round in shape (see Leuthardt 1904, p. 39), whose exact structure is unfortunately not known. It seems that the sporangia are not fused together to form synangia and do not appear by pores. The secondary veins at the upper portion of the pinnae of the European species are also characterized by separated fascicles of veins and the main rachis is also characterized by a median ridge bordered with flat and wing-like flanks.

It is of interest to point out that from the Upper Triassic of Kazakstan, Dr. Brick has also described some specimens under the name of *Bernoullia aktiubensis* (1952, p. 20; Pl. V, figs. 1—12). Judging solely from the illustrations, it seems that the fertile specimens of Kazakstan belong certainly to *Bernoullia,* but the sterile fronds figured by Brick from the same basin are probably not correctly determined; a part of them might possibly belong to *Cladophlebis* (e.g. Brick 1952, Pl. V, figs. 1, 3—4). The specimen shown in Pl. V, fig. 5 of the same paper is an indeterminable fragment and the specimens shown in figs. 2, 6—7 on the same plate are characterized by a venation quite different from that of *Bernoullia*. On the other hand, the writer thinks that the specimens described by Brick as *Danaeopsis angustipinnata* (1952, Pl. III, figs. 8–10) and *Danaeopsis bipinnata* (1952, Pl. II, fig. 4) might belong to *Bernoullia* in regard to the shape and size of the pinnae as well as the pattern of venation. Judging solely on the figures, the secondary veins of these specimens tend also to form separate fascicles. At any rate, these specimens of Kazakstan belong evidently not to *Danaeopsis*.

According to Prof. Seward (1910, p. 410), the Upper Triassic ferns described by Heer, Krasser and Leuthardt as *Bernoullia* have been referred to the Marattiaceae, but there is no trustworthy evidence in favor of this affinity. It is however not improbable that this peculiar fern might have belonged to this family. Without further evidence, these discussions are rather futile.

Localities: T'anhokou, near Shihlangmiao, Ichün District, Shensi; Ch'imochiao, near Hsinshüping, Ichün, District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Locality: In the vicinity of the Chinchien city, Chinchien District, Shensi.

Horizon: The middle part of the Yenchang Formation.

Locality: Yenhokou, Huating District, Kansu.

Horizon: The lower part of the Yenchang Formation.

Cladophlebis (*Asterotheca*?) *szeiana* P'an

Pl. XVI, figs. 1—4; Pl. XVII, figs. 1—5; Pl. XXI, fig. 6.

This interesting Upper Triassic species of China is represented by a fairly large number of specimens of both fertile and sterile fronds. The material is larger and better preserved than the type-specimens described by P'an in 1936. A more complete description of this species, which seems to come fairly near to some known forms, will be given below.

Frond at least bipinnate or tripinnate. Main rachis comparatively very broad and stout, measuring at least 8–9 mm in breadth at the base of the frond, gradually tapering to the apex, and with a smooth surface, occasionally ornamented with very faint and indistinct longitudinal striations. Ultimate pinnae linear or linear-lanceolate; closely set, usually touching each other laterally or even overlapping one another, rachis also comparatively stout, with indistinct longitudinal striations. Ultimate pinnae in the lower part of the frond usually deeply dissected into pinnules, while those near the apex and the upper portion of the frond generally entire very much resembling single pinnules. Intermediate types between these two extremes present. Pinnules, when well developed, oblong with almost parallel sides and a broadly round apex, contiguous and almost confluent at the base, attaining a length of 6–7 mm and a maximum breadth of about 3 mm; distal margin almost straight, proximal margin more rapidly contracted at the upper part and slightly decurrent at the base. Undeveloped pinnules almost confluent one another into a long, narrow and slender pinna with entire or crenualted margins in the type of *Pecopteris unita* and *P. arcuata* (Pl. XVI, fig. 1; Pl. XVII, fig. 1). Venation distinct; in the well-developed pinnules, midrib comparatively stout, strongly decurrent at the base, bending rapidly forwards, dissolving into lateral veins near the apex; secondary veins not very dense, thick, with almost the same strength as the midrib, their branches retaining almost the same thickness the whole way to the margin, where they appear rapidly cut off, or even widen a little toward the margin (Pl. XVII, figs. 2, 2a), arising at an acute angle with the midrib, arching outwards, usually bifurcating once, occasionally simple; the first proximal secondary vein arising at the decurrent part of the midrib, strongly arching to the margin, bifurcating constantly once; the first distal secondary vein attached obliquely to the decurrent part of the midrib. Venation of the undivided, crenate or entire pinnae similar to that of the pinnate ones, one vein arising from the pinna-rachis corresponding to the midrib of the pinnule and giving off lateral veins which are simple very rarely bifurcating once, and in the entire pinnae all reach the margin. The ultimate pinnae at the apex of the penultimate pinnae or fronds very similar to the pinnules of the well-developed ultimate pinnae and with the same type of venation (Pl. XVI, fig. 1). Fertile pinnae not well preserved. Pinnules similar to the sterile ones, bearing synangia of probably *Asterotheca* type, which attain a height of 1 mm or slightly more. The nature and the shape of synangia not well defined. Spores unknown.

This species is one of the finest and most interesting in the Yenchang Formation, the writer has been enable to obtain a large number of well preserved specimens of it, which show its very polymorphous nature and the many peculiarities presented by it. In the first place, the shape of the sterile specimens displays, like the characteristic species *Pecopteris arcuata* Halle of the Shihhotze Series of China, a quite unusual degree of variation. The frond of this species was probably also very large and was dissected in a different manner in its upper and lower parts. Many of the specimens here referred to the same species are so different as to appear at first to have nothing in common; but on a closer examination, some features of the venation are found to connect these apparently different specimens with each other, and like *P. arcuata* this Mesozoic species is also characterized by a complete series of transitional forms between the extremes. Dr. P'an also pointed out the close similarity of these two species. He said for instance: "In the general habit of the frond and venation, *Cladophlebis szeiana* recalls *Pecopteris arcuata* (Halle 1927, p. 80; Pl. 19; Pl. 20, figs. 1—3, 8—14, 4—1) from the Shihhotze Series of Shansi, but differs through the thicker midrib and secondary veins. In *Pecopteris arcuata* there are fine striations between the veins, which are a characteristic feature of that species, but in ours no fine striations between the veins have been observed." One of the most important point of difference between these two species is, in the writer's opinion, in the fertile specimens. The fertile pinnae of the Palaeozoic species *Pecopteris arcuata* Halle have been found in the 11th coal seam (11^e couch) of the Kaiping Basin of Hopei Province and have been studied by Stockmans and Mathieu (1939, Pl. XVIII, figs. 4, 4a) as belonging to the *Ptychocarpus*-type, more or less similar to the other Palaeozoic species *Pecopteris* (*Ptychocarpus*) *unita*. The two Belgian authors named this species *Ptychocarpus* (*Pecopteris*)*arcuatus* nov. Comb. (1939, p. 81). As stated above, the exact nature and shape of the synangia of our Mesozoic species can not be defined, but the synangia of this species is certainly not of the *Ptychocarpus* type; they probably belong to the *Asterotheca* type.

The only Mesozoic species which could be closely comparable to ours is probably *Asterocarpus virginiensis* Fontaine from the Virginia-Keuper of North America. Dr. P'an stated that *Cladophlebis szeiana* closely resembles *Asterocarpus virginiensis* var. *obtusilobus* (Fontaine 1883, p. 45; Pl. XXI, figs. 3—4; Pl. XXIV, figs. 3—5; Pl. XXV, fig. 1), but the American species does not have so thick lateral veins as ours. He further pointed out that the first lateral veins in the proximal half of the pinnules of our species appear to arise from the decurrent part of the midrib, but those in the American species are reported to arise directly from the pinna-rachis. In the writer's opinion, however, the description by Fontaine of this feature cannot be regarded as correct, and it is highly possible that the first proximal secondary vein is arising, similar to that of our species, from the decurrent part of the midrib and not directly, as Fontaine believed, given off from the pinna-rachis. At any rate, in regard to the shape of sterile pinnae and pinnules, the American species belongs evidently to the genus *Cladophlebis*. According to Krasser (1909, p. 108), this American species is identical with *Asterotheca meriani* (Brongn.) Stur from the Lunzer Keuper of Austria. He further remarked that the generic name *Asterotheca* of Presl has a priority over *Asterocarpus* of Goeppert ("...... Prioritätsname gegenüber *Asterocarpus* Goeppert"). If the fertile pinnae of our species belong actually to the *Asterotheca*-type, the close affinity between this European and American Middle Keuper species and the species *Cladophlebis szeiana* P'an from the Yenchang Formation of North China can be really established, and it is highly possible that these two Mesozoic species of *Cladophlebis* belong to the Marattiales. Without further evidence, this question cannot of course be regarded as conclusive.

Finally, it should be pointed out that the species *Cladophlebis szeiana* P'an has been described by Dr. Brick from the Upper Triassic flora of Western Kazakstan (1952, p. 27; Pl. VIII, figs. 1—9). Judging solely from the illustrations, the specimens from Kazakstan are not identical with our species, in regard to the shape of the pinnules and in regard to the pattern of venation. The secondary veins of the Kazakstan's specimens are also comparatively much finer. On the other hand, it seems to the present writer that specimenns figured by Brick as *Cladophlebis simplicinervis* in her Pl. II, figs. 1, 2 of the same paper might belong to our species. As implied by its specific name, this Kazakstan species is characterized by the simple secondary veins of the pinnules. This feature agrees well with some specimens in our material. As stated above, in the undeveloped pinnae of our species, the secondary veins arise at an acute angle from the midrib and retain almost the same thickness as the midrib and almost simple. Futhermore, the manner of dissection of the pinnae of this Kazakstan species is similar to that of our species and to that of the Chinese Palaezoic species *Pecopteris arcuata*. The upper portion of the pinnae of *Cl. simplicinervis* is not dissected, exactly like those of our species. In regard to the shape and size of the well-developed pinnules, this two species are almost identical.

Localities: T'anhokou, near Shihlangmiao, Ichün District, Shensi; Ch'ilitsun, Yenchang District, Shensi; Yenchiaping, Suite District, Shensi; Chienkouho, Huating District, Kansu.

Horizon: The upper part of the Yenchang Formation.

Locality: Huailingping, Suite District, Shensi.

Horizon: The middle part of the Yenchang Formation.

Locality: Yenhokou, Huating District, Kansu.

Horizon: The lower part of the Yenchang Formation.

GYMNOSPERMAE

I. PTERIDOSPERMAE?

Genus *Thinnfeldia* Ettingshausen

Thinnfeldia rhomboidalis Ettingshausen

Pl. XXXIV, figs. 5, 5a.

Thinnfeldia rhomboidalis Ettingshausen seems to be a rare plant in the Mesozoic strata of Eastern Asia. Up to the present, the species has been described by Sze from the Rhaeto-Liassic beds of Changting District, Fukien and by P'an from the Yenchang Formation of Suite District, Shensi. In the present material, only a small fragment of this species has been found, but enough to show the typical shape of the pinnae. The rachis is comparatively stout, about 3 mm wide, with very fine longitudinal striations. The pinnae is rhomboidal in shape, contracted both at the apex and at the base, attaining a length of 4.5 cm and a breadth of 7 mm, broadest at the middle part of the frond and forming an angle of about 45° with the rachis. The midrib is very distinct and strong at the base, arising at an acute angle from the rachis, bending rapidly outwards, and appears to be vanished in the middle course of the pinnae. The secondary veins are very fine and very dense, given off from the midrib, bifurcating several times and arching outwards to the margin. There are many "Nebenadern" giving off directly from the pinna-rachis. The present specimen, though very fragmentary, is identical in all respects with Ettingshausen's species.

It is long known that there is a considerable variation in the shape of the frond and pinnae of this species. In the memoir published in 1933 (Sze 1933b, p. 47), the writer pointed out that he agrees with Prof. Gothan to regard the different species of Schenk, namely *Th. decurrens, Th. obtusa* and some other species as synonyms of the *rhomboidalis*. He said: "Ich stimme deshalb Gothan bei, der Formen wie Schenks *Th. decurrens, Th. obtusa* und einige andere Arten als Synonyme von *Th. rhomboidalis* betrachtet hat (1914, S. 118), obwohl Antevs diese beide Arten Schenks von *Th. rhomboidalis* getrennt hält (1914, S. 27, S. 30)". The writer is still inclined to support such a course today.

Localities: Ch'imochiao, near Hsinshüping, Ichün District, Shensi; Yehchiaping, Suite District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Thinnfeldia major Raciborski

Pl. XLII, fig. 3; ?Pl. XXXII, fig. 4.

The fragment shown in Pl. XLII, fig. 3, agrees perfectly well with the specimen figured by Raciborski in his Pl. 19, fig. 5 (1894) as *Thinnfeldia rhomboidalis Ett.* from Krakau, in regard to the size and the shape of the pinna and its segments, and in regard to the pattern of venation. There is almost no slight difference between these two specimens. The specimen of Raciborski was reproduced by Gothan in the paper of 1912 (Gothan, l. c. Pl. 15, fig. 2) Prof. Gothan pointed out in the Explanation of Plates as follows: "*Thinnfeldia rhomboidalis* Ettingsh. nach Raciborski, worl aber besondere Art." Antevs (1914, p. 35) described many specimens of similar type under the name of *Thinnfeldia major* (Raciborski) and placed Raciborski's specimen and other specimens of Krakau in the same synonym. The new diagnosis given by Antevs (1914, p. 35) for this form is as follow: "Wedel einmal gefiedert, lanzettlich, Spindel kräftig. Fiederchen dicht, mehr oder weniger alternierend, mit der ganzen breit der Basis befestigt, breit linear, bis 35 mm lang and 12 mm breit, mit stumpfer oder gerundeter Spitze. Mitelader feine, dichte gegabelts Seitenadern aussehend. Konsistenz dick und fest."

According to the diagnosis of the species given above, it is highly possible that the specimen figured in Pl. XXXII, fig. 4 may also belong to this species. The segments (or pinnules) of this specimen are almost acute at the apex. This feature agrees not well with the specimen of Raciborski (1894, Pl. 19, fig. 5), but is identical in all respects with the specimens figured by Antevs (1914, Pl. 2, figs. 6—9).

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Locality: Yenan District, Shensi (exact locality unknown).

Horizon: Unknown.

? *Thinnfeldia nordenskiöldi* Nathorst

Pl. XXXVII, figs. 6—8.

In Pl. XXXVII, figs. 6—7 are shown two specimens which are too imperfect to be definitely determined but seem to be closely comparable with the form described by P'an as *Thinnfeldia nordenskiöldi* Nathorst. The specimens may represent probably a terminal segment of this species and convey no idea of the shape of the frond. Terminal pinna or segment is spatulate to lanceolate, with a narrowly rounded or subacute apex, attaining a length of 9 cm and a maximum breadth of 3.4 cm, the broadest part is at the portion more or less about two third from the base. The margin of the lower portion about 2/3 from the base of the pinna is almost entire; the margin of the upper portion of the pinna is more or less dissected, occasionally even lobed. The midrib is indistinct and appears in the impressions to be a shallow groove in the middle of the pinna. The secondary veins arise at the base of the pinnae directly from the rachis which are not preserved in our specimens; the other veins are given off at a very acute angle from the midrib, obliquely ascending and strongly arching forwards and outwards, repeatedly bifurcating to the lateral margins of the pinna.

The characteristic feature of the present few specimens agrees fairly well with that of Pan's specimens and agrees with the specific diagnosis (1936, p. 28) given by him. The only point of difference is that some of our specimens are much broader than the specimens described and figured by P'an. In the writer's opinion, there is some differences between Pan's specimens and the type-specimens of Sweden described by Nathorst and Antevs. In the species of Sweden, the pinnae are more lanceolate in shape and are more distantly attached to the rachis (see Antevs 1914, Pl. 1, fig. 2; Pl. 2, fig. 4). The specific identity of the Chinese specimens with the Swedish species appears to be somewhat doubtful. At any rate, the Chinese specimens are too incomplete to be referred to that type with any degree of certainty. This imperfect nature of the material is the only reason why the present specimens have not here been actually included in *Thinnfeldia nordenskiöldi.*

According to Antevs (1914, p. 33), this species can not be readily distinguished from *Th. speciosa* Ettingshausen. It is possible that future search in the field may reveal intermediate forms which may prove that these two species are identical. An identification does not seem justified at least for the present in view of the fact that the size of fronds of *Th. nordenskiöldi* is much greater than *Th. speciosa.* Furthermore, the venation of the former is much denser than the latter species, and the epidermal structure of these two species is also slightly different. According to Schenk (1867, p. 15) the stomata of *Th. speciosa* are confined to the lower side of the segments.

Th. nordenskiöldi is a very rare plant, it has been hitherto only found in the uppermost horizons of Rhaetic of Pälsjo (Zone mit *Nilssonia polymorpha*) in Schonen. According to Dr. P'an, the Chinese form is persisted from the upper part of the Yenchang Formation to the basal part of Wayaopu Coal Series.

Localities: Ch'imochiao, near Hsinshüping, Ichün District, Shensi; Yehchiaping, Suite District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Thinnfeldia rigida sp. nov.

Pl. XLI, figs. 1—3; Pl. XLII, figs. 1, 2, 2a; Pl. XLIII, figs. 3, 4; Pl. LII, fig. 2.

Frond probably bipinnate. Rachis very stout, attaining a breadth of 6—10 mm (Pl. LII, fig. 2), with irregular markings. Shape of ultimate pinnae (or leaves) unknown; probably lanceolate; pinna-rachis also stout, about 3 mm wide, gradually tapering to the apex with irregularly longitudinal striations. Ultimate pinnae attaining a maximum breadth of at least 9—10 cm gradually narrowing to the apex; terminal pinna (or terminal segment) not well preserved, probably long and slender with obtuse apex; segments (or pinnules) closely set, almost touching each other laterally, occasionally even overlapping, contiguous and confluent at the base, slightly decurrent, oppositely to alternately attached to the rachis, attaining a maximum breadth of 2 cm at the base and a length of about 5—6 cm, very gradually narrowing to the obtuse or rounded occasionally subacute apex, slightly falcate at the upper portion of the pinnae. Those pinnae at the uppermost portion of the ultimate pinnae very short about 1.2—2 cm in length and 1 cm in breadth, with broadly rounded apex. Margin of the pinnae entire, occasionally very slightly crenulated. Pinnae rather thick in consistency and coriaceous, with a slightly folding surface. Midrib comparatively strong, arising from the rachis at wide angles, straight or slightly arching, persisting almost to the apex; secondary veins comparatively finer, departing at an acute angle from the midrib, bending and arching outwards and reaching the margin at an angle of about 50—60° in the margin, dichotomosing generally thrice, branching once very close to the midrib and often immediately once more, further branching of the veins, at a distance of about 2—3 mm near the margin. Secondary veins of the upper portion of the pinnae usually dividing twice. Many secondary veins are apparently given off from the rachis, repeatedly dividing and strongly arching outwards.

This new species is represented by many large fragments, but the shape and the size of the fronds and the pinnae are very characteristic. There are no known fossil plants which could be closely comparable to our species. The only specimen which tends to show a bipinnate frond is that figured in Pl. LII, fig. 2. The present writer is convinced that future search of the fossils in different type-localities of the Yenchang Formation may reveal better preserved specimens which may show bipinnate fronds and which may be characterized by the presence of "Zwischenfiedern" attached to the main rachis.

This species of *Thinnfeldia* must have had magnificent proportions. The only specimen figured in the old literature which could be more or less comparable to our species is that described by Gothan from the basal part of Liassic (Rhaetic) of Nürnberg, Germany. This specimen was determined by Gothan as "*Thinnfeldia rhomboidalis* Ettingsh., grosse Form ("*Th. decurrens* Schenk")" (Gothan 1914, Pl. XXI, fig. 1). In regard to the length and breadth of the fronds and the size of the closely attached pinnae, this Nürnberg specimen resembles more or less our species; the midrib of this German specimen is given off also at an acute angle from the midrib and the secondary veins are also very fine, but more straight. According to Gothan, the rachis of the German specimen is characterized by the presence of cross striations.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Thinnfeldia alethopteroides sp. nov.

Pl. XXXIV, fig. 6; Pl. XLV, figs. 1, 1a, 2.

Frond probably bipinnate. Ultimate pinnae (or leaves) linear-lanceolate attaining a maximum breadth of at least 5 cm and a length of at least 12.5 cm gradually narrowing to the apex which is probably obtuse or subacute. Rachis about 2 mm broad without regular markings. Segments (or pinnules) slightly distant, their borders rarely touching, confluent at the top of the ultimate pinnae, narrow and slender, linear or linear-lanceolate, attaining a maximum breadth of 5—6 mm and a maximum length of about 3.5 cm with blunt apex; margin entire, straight or slightly falcate and decurrent on the rachis, distal margin slightly contracted at the base, opposite to subopposite; obliquely attached, generally forming an angle of about 45° with the rachis. Midrib distinct, arising at an angle of 45° from the rachis and persisting almost to the apex. Secondary veins fine and dense, arising at angles of about 45° to the midrib, dividing usually twice at the basal portion of the segments, dividing once with the distal branch dividing once more at the middle portion, and at the top portion of the segments, the secondary veins generally dividing only once. Many secondary veins ("Nebenadern") given off directly from the pinna-rachis. Fertile specimens unknown.

The only species of the Older Mesozoic formations that could be comparable with ours, is *Thinnfeldia speciosa* Ett. (see Gothan 1912, Pl. XIII, fig. 1; Antevs 1914, Pl. IV, fig. 2), but this European species is characterized by the segments which are more lanceolate in shape with the broadest portion at the middle of the segments and with a more acute apex. The segments are also more remotely placed. Among the specimens described by Sze as *Th. rhomboidalis* from the Rhaeto-Liassic of Changting District, Fukien, there is one specimen which might belong probably to the present species, i.e. his Pl. VI, fig. 2 (1933b). This specimen is slightly different from others discovered from that locality, and in regard to the size and shape of the segments and in the pattern of venation, it comes nearer to our species. The only difference is that the distal margin of the segments of the specimen found from Changting is strongly contracted at the base and the posterior margin of the segments is strongly decurrent on the rachis. The shape of the segments of that specimen is therefore more similar to the Ettingshausen's species.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Thinnfeldia laxusa sp. nov.

Pl. XLIV, figs. 1—4; Pl. XLV, figs. 3—4.

Frond probably bipinnate. Ultimate pinnae (or leaves) linear-lanceolate attaining a maximum breadth of 3 cm and a length of at least 13 cm gradually narrowing to the base and gradually narrowing to the obtuse apex. Rachis about 2 mm thick, with very fine longitudinal striations. Segments (or pinnules) distant, their borders never touching, those on the middle portion of the pinnae, linear or linear-lanceolate in shape with rounded, or obtuse apex, attaining a maximum breadth of 3 mm and a maximum length of 2 cm, those on the basal portion of the pinnae ovate, oblong or oblong-ellipsoid in shape, with broadly rounded apex, attaining a maximum breadth of 4 mm and a length of 9–13 mm, margin entire, straight, never falcate and strongly decurrent on the rachis, distal margin strongly contracted at the base, subopposite to alternate, obliquely attached, forming an angle of about 45° with the rachis. Midrib distinct, decurrent and bending outwards, straight, breaking up some distance below the apex. Secondary veins fine and dense, forming an angles of about 45° with the midrib, dichotomosing, either the distal branch or the proximal branch dividing once more. Several veins entering the base of the segments direct from the pinna-rachis. Terminal segment comparatively large with obtuse apex, the broadest part measuring about 8 mm in breadth (Pl. XLIV, fig. 2). Fertile specimens unknown.

The figures in Pl. XLIV, figs. 1—4 and in Pl. XLV, figs. 3—4 give an idea of the varying aspect of different parts of the frond. Pl. XLIV, figs. 1, 1a show a typical pinna with well-developed segments, which are more linear-lanceolate in shape, attaining a breadth of only 3 mm and a length of more than 2 cm, with the distal margin strongly contracted at the base and a proximal margin strongly and distinctly decurrent on the rachis. Pl. XLV, figs. 3, 4 show two pinnae with segments of slightly different shape, which are oblong-ellipsoid with more rounded apex and are contracted both above and below at the base. The segments are still distinctly decurrent. Pl. XLIV, fig. 1 shows a pinna of the basal portion of the frond. The segments are more ovate-oblong, with broadly rounded apex and attaining a breadth of about 5 mm and a length of about 1—2 cm. Pl. XLIV, fig. 2 shows a pinna of the upper portion of the frond, which consists of a terminal segment of rather larger size and more rhomboidal in shape with the broadest part at the middle, measuring about 8 mm in breadth. The most typical pinnae of this species are strikingly like the specimens described by Ettingshausen (1852, p. 5; Pl. II, figs. 1, 2) as *Thinnfeldia muensteriana*. The segments or pinnules of this species are also more linear-lanceolate in shape, the distal margin of which is also strongly contracted at the base and the proximal margin is strongly decurrent on the rachis. The midrib is also very distinct. Furthermore, the segments are also distantly attached like our species. But a part of segments of Ettingshausen's species are slender with more acute apex and the secondary veins, according to Ettingshausen, are given off at a very acute angle from the midrib and are generally simple, very rarely only dividing once. The secondary veins of this species are not so dense as in our species. The species was originally described by Presl as *Taxodites muensterianus* (1838 in Sternb. II, Fasc. VII, VIII, p. 204; Pl. XXXIII, fig. 3). In 1852, Ettingshausen referred this species to the genus *Thinnfeldia,* and in 1867, Schenk described this species as *Selanocarpus muensterianus* (1862, p. 89; Pl. XXII, figs. 1, 2, 5, 6). This designation has been followed by Hirmer and Hörhammer. The two German authors described this from as *Selanocarpus muensterianus* (Presl) Schenk (1936, p. 38—41; Pl. VIII; IX, figs. 1—3). According to them, the other specimen described by Ettingshausen as *Th. parvifolia* (1852, Pl. II, fig. 3) belongs evidently also to this species. Based on the conclusions of study of Hirmer and Hörhammer, the whole frond of this species is known to be closely related to *Phlebopteris* (formerly known as *Laccopteris*) and the species may therefore belong to Matoniaceae. The characteristic fertile fronds with sporangia of this species have also been proved and described fully by the German authors. This species therefore belongs evidently to ferns. The whole habit of our specimens of Yenchang Formation is in the writer's opinion, gymnopermous or pteridospermous. The dissection of the frond of our species is probably different from the European species. It is a plant probably of bipinnate frond. The writer is of the opinion that further search of fossils in our localities may even reveal intermediate forms between the present species and the specimens described in this memoir as *Thinnfeldia alethopteroides* sp. nov. The writer keeps the two forms separate at present, pending the discovery of more complete materials.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Torizon: The upper part of the Yenchang Formation.

Genus *Ctenopteris* Brongniart

Ctenopteris sarrani Zeiller

Pl. XXXV, figs. 3, 3a, 4.

Only two small fragments of this plant were found, but enough to show that they are identical with the specimens described by Zeiller as *Ctenopteris sarrani* from the Tonking Coal Field of Indo-China. The original diagnosis of this species (Zeiller, 1903, p. 53) may be given below:

"Frondes bipinnées, de grande taille, atteignant au moins 2 ou 3 mètres de longueur sur 1 mètre de largeur, à rachis primaire strié longitudinalement, large de 15 à 30 millimètres dans la région inférieure de la fronde. Pennes primaires alternes ou subopposées, étalées-dressées, légèrement arquées et décurrentes à la base, espacées d'un même côté de 5 à 13 centimètres, se touchant à peine par leurs bords, à contour longuement linéaire, légèrement rétrécies vers la base, effilées au sommet en pointe obtuse, larges de 4 à 8 centimètres, atteignant au moins 50 centimètres de longueur, à rachis large de 2 à 5 millimètres, strié longitudinalement.

Pinnules étalées-dressées, contiquës à la base, à bords latéraux parallèles ou faiblement convergents, souvent un peu décurrentes vers le bas, arrondies au sommet en arc elliptique, larges de 15 à 30 millimètres sur 2 à 4 centimètres de hauteur.

Nervures toutes égales, partant du rachis parallèlement aux bords des pinnules, souvent un peu arquées en dehors et légèrement divergentes, assez rapprochées, simples ou une seule fois bifurquées, en général assez peu apparentes."

According to the foregoing descriptions and according to the illustrations (Zeiller 1903, Pl. VI-VII, fig. 2) of the specimens published by Zeiller, it is evident that this plant must have had magnificent proportions. Our specimens represent only a terminal portion of the fronds of the Tonking species. In regard to the shape of the pinnules and in regard to the pattern of venation, our specimens can also be assigned to the genus *Ptilozamites,* the frond of *Ptilozamites* is forked at the base, and this feature is quite different from *Ctenopteris* the frond of which is evidently pinnate. In view of the fact that many well-preserved specimens of *Ctenopteris* have been found from Tonking and that there are no typical specimens of *Ptilozamites* (e.g. *Pt. nilssoni* Nathorst) hitherto known in the Mesozoic formations of E. Asia, the writer would prefer to determine the present specimens as *Ctenopteris.* Moreover, in *Pt. nilssoni* the rachis is characterized by cross striations (see Johansson 1922, Pl. VI, figs. 9—13), and the pinnae of this species are rather asymmetrical, with pinnules on the outer side longer and larger than those on the inner side (see Harris 1936, textfigs. 29, 30). In our specimens, the rachis is characterized by longitudinal striations and the shape of pinnae are symmetrical with the pinnules on both sides of the same shape and size. In this respect, our specimens, though rather fragmentary, are identical perfectly well with Zeiller's species.

The genera *Ptilozamites* and *Ctenopteris* were brought together as a "special group" by Nathorst in 1911. In Fossil Plants Vol. III, p. 511 (1917), the three genera *Ctenis, Nilssonia* and *Ctenopteris* have been placed in the Nilssoniales. In the same volume p. 12, Seward said: "Until definite evidence is obtained as to the nature of the reproductive organs of *Nilssonia, Ctenis* and *Ctenopteris,* it is impossible to say how closely these genera agree in essential characters with existing members of the Cycadales." And on the same page, he further pointed out: "........the genera *Ptilozamites* and *Ctenopteris* probably Cycadean, and the structure of the epidermal cells in the latter species lends support to this view." Antevs (1914, p. 6) is of the opinion that the genus *Ptilozamites* holds an intermediate position between *Ctenopteris* and *Anomozamites* (1914, p. 6). And in the opposite page of the same paper, he further stated: "The reasons for which Zeiller placed *Ctenopteris* among the ferns are accordingly rather vague, and it may be confidently stated that several circumstances speak against the opinion of the genus belonging to this group. I have dwelt somewhat on Zeiller's discussion, as it is highly probable that *Ctenopteris* not only closely agrees externally but is also really nearly related to *Ptilozamites.* Finally, I will once more point out that it is not easy to give a definite place in the system to either one or the other genus for the present. It is, however, most likely that both belong to the Cycadophytes or an extinct plant-group closely related to these." In his important memoir published in 1932, Prof. Harris pointed out the close relationships of *Thinnfeldia, Ctenopteris Ctenis, Lepidopteris* and *Ptilozamites.* He said for instance (1932, p. 71): "Rather similar stomata occur in *Thinnfeldia, Ctenopteris* and *Ctenis,* but the most similar stomata known are certain abnormal ones which occur occasionally on the upper side of the leaf of *Lepidopteris* (p. 61, textfig. 27c). These stomata are indistinguishable from those of *Ptilozamites;* this suggests that these two plants may be related."

The present writer is inclined to believe that *Ptilozamites* together with *Thinnfeldia* and *Lepidopteris* may possibly belong to the "Mesozoic Pteridosperms", and the same may be said for the genus *Ctenopteris.*

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Genus *Protoblechnum* Lesquerx

? *Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)

Pl. XLVI, figs. 1—6.

The fragments shown in Pl. XLVI, figs. 4—6 may be provisionally referred to this species, but they can not be generically and specifically identified with any degree of certainty. Several better preserved specimens have been described by P'an as *"Danaeopsis" hughesi* Feistm. in 1936. For the purpose of comparison, three specimens are refigured here in Pl. XLVI, figs. 1—3.

It may be questioned whether the specimens found from the Yenchang Formation are actually identical with Feistmanetel's species. In describing his specimens in 1936, P'an evidently believed that these specimens, though rather fragmentary, belong to the Gondwana species. Dr. Hsü told the writer that the determination of Dr. P'an cannot be regarded as correct, and that the Yenchang specimens may not be identical with the species found from the Gondwana-Land. It seems to the present writer that the specimens described by P'an are indeed too fragmentary to permit of any further conclusion and convey no idea of the shape of the frond. But the question arises, if many similar fragmentary specimens had been found in India, they would be determined by most palaeobotanists without any slight hesitation as *"Danaeopsis" hughesi* Feistm. The writer therefore described the present specimens under the name of ?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.), pending the discovery of better preserved and more complete material from the localities.

The Indian species *Danaeopsis hughesi* was first described by Feistmantel in 1882 (1882, Vol. 4, Pt. I, p. 25; Pls. 4—7; Pl. 8, figs. 1—5; Pl. 9, fig. 4; Pl. 10, Pl. 17, fig. 1; Pl. 18, fig. 2; Pl. 19). Many authors have expressed the opinion that this plant has nothing to do with the genus *Danaeopsis* because of the dichotomous branching of the frond and that it may probably not be a fern (see Gothan 1921 p. 60). This species has been referred to *Protoblechnum* by Halle in 1927 (Halle 1927, p. 134). Halle believed that the Indian species agrees very closely with the Chinese species *Protoblechnum wongii*, and with this view the writer is in complete accord. Of special interest is the fact that a number of bifurcating fronds of *Protoblechnum wongii* have been discovered from the Shihhotze Series of North China during recent years, which proves that the opinion of Prof. Halle is well founded (Sze 1955a, p. 201—209, Pl. I—IV, textfigs. 1, 2; Chow, Chang and Chang 1955, p. 167—171, textfig. 1)

The discovery of this form in the Yenchang Formation has a special historical significance, because it was Prof. Obrutschew who first found a similar specimen from this formation of Northern Shensi, and because his specimen was described by Krasser in 1900 under the name of *Danaeoposis hughesi* Feistm. (Krasser 1900, Pl. 1, fig. 4) which has been the course of too much speculation on the occurrence of a Gondwana flora in North China. The problem has been repeatedly discussed by many authors. Prof. Halle believed that the specimen found by Prof. Obrutschew in 1893-1894 from the Mesozoic formation of Northern Shensi seems to be indeed more similar to the Indian species *Protoblechnum hughesi* than to the Chinese species *Protoblechnum wongii*, and he further pointed out that Prof. Obrutschew's specimen differs both from *Pr. wongii* and from *Pr. hughesi* in the broad expansion of the pinna-base on the distal side of the midrib and may belong to yet another species of this or some other genus. In connection herewith, it should be pointed out that the specimen of Prof. Obrutschew has been determined by the writer as ?*Protoblechnum* sp. in 1933 (Sze 1933c, p. 77). Dr. P'an believed that this fragment is evidently identical with the better preserved specimens found by him from the Yenchang Formation (P'an 1936, p. 22).

Finally, it should be pointed out that the specimen unreservedly described by Brick as *Danaeopsis hughesii* Feistm. from the Upper Triassic of W. Kazakstan (Brick 1952, p. 19, Pl. IV, fig. 7) is, in the writer's opinion, certainly identical with the present form. This specimen of Kazakstan should be determined also under the name of ?*Protoblechnum hughesi* (Feistm.) Halle (? sp. nov.) at least for the present. Other specimens figured by Brick under the same specific name (1952, Pl. IV, figs. 1—6) from Kazakstan are too poorly preserved for determination; these fragments cannot even provisionally be referred to the Indian species.

The new generic name *Diplasiophyllum* proposed by Frenguelli in 1943 for the Indian species must be discarded, as has been remarked by the present writer (Sze 1955a, p. 207).

Locality: Yaoping, Anting District.

Horizon: The basal part of the Wayaopu Coal Series.

Localities: Tánhokou, near Shihlangmiao, Ichün District, Shensi; Yehchiaping, Suite District, Shensi; "Schlucht beim Dorfe San-schi-li-pu", Suite District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Locality: Kaochian, Suite District, Shensi.

Horizon: The lower part of the Yenchang Formation.

II CYCADOPHYTA

Genus *Sphenozamites* Brongniart

Sphenozamites changi sp. nov.

Pl. XXXVI, figs. 1—2; Pl. XXXVII, figs. 1—5; Pl. XXXVIII, figs. 1—3.

Although *Sphenozamites* ranges from Lower Permian to Jurassic rocks, the genus has rarely been found from different formations. In Eastern Asia, it is only known from the Hsiangchi Coal Series in Western Hupei(Sze 1949, p. 25), and from the Rhaeto-Liassic beds of Indo-China (Counillon 1914, p. 7). The genus is represented by several beautiful specimens in the present material, the largest specimen reaches a length of 22 cm without being complete. This specimen is preserved in such a state that the two sets of lateral pinnae are stretched deeply in a matrix of hard sandstone, forming with each other an angle of about 35°. Pl. XXXVI, fig. la shows the pinnae at the right side of this specimen, and Pl. XXXVI, fig. 1b shows those at the left side.

Frond very large, pinnate. Rachis probably broad, appearing in impressions with a narrow aspect, smooth, ornamented with very fine longitudinal striations. Pinnae opposite, subopposite to alternate attached to the rachis, probably not inserted exactly on the side of the rachis, but a little within its upper surface, very closely set, occasionally even imbricate, very large and broad, attaining a breadth of at least 5–7 cm and a length of 8–10 cm without being complete (Pl. XXXVIII, fig. 2), generally rhombic with strongly contracted base and a broadly rounded often somewhat oblique apex, distal margin strongly arching to the apex. Margin entire. Venation very fine and dense, giving off from the rachis, and diverging from the narrow base; they divide by repeated dichotomies, the first of which occur very near the base and are very dense in the upper part of the pinnae, numbering about 50 or even more per centimetre; the veins at the proximal margin of the pinnae are more or less parallel to the margin and those at the distal margin are forming angles of about 45–50° with the margin.

There are no known species which could be closely comparable to our species. In size of the pinnae, the Chinese species comes nearest to the form described by Fontaine as *Sphenozamites rogersianus* from the Virginia-Keuper of North America (Fontaine 1883, p. 80, Pl. XLIII, fig. 1; Pl. XLIV, figs. 1, 2; Pl. XIV, figs. 1, 2). There can be no doubt of their generic identity, but the specific determination is more uncertain because the American species is characterized by the globular prominences or dot-like elevations drawn out into little bars which extend from vein to vein and look like transerverse veins. In all the figures given by Fontaine, the veins of this species are much more distant than in our specimens.

This new species is named in honor of the late Prof. H. T. Chang, the founder and the first director of the former Geological survey of China, who died a few years ago at the age of 75, and to whom the writer is greatly indebted for the constant encouragement of studying palaeobotany.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

CYCADOPHYTA?

Genus *Drepanozamites* Harris

1832. *Drepanozamites* Harris, 1832b, p. 83

Drepanozamites? *p'ani* sp. nov.

Pl. XL, figs. 1, 1a, 2.

Only two small fragments of this plant have been found, so that its true character cannot be made out. Length of the leaf unknown, estimated at 40–50 cm; rachis comparatively broad, smooth, about 5 mm in breadth, bearing pinnae on its lateral margins. Pinnae about 10–15 mm wide, broadest at the base, attached at basal corner, tapering to the apex which is probably blunt, usually curved forward and thus probably falcate. Length of the pinnae unknown, estimated at 4 cm. Margins of adjacent pinnae often overlapping to some extent. Venation fine but not very dense; midrib vaguely defined, breaking up either at its origin of arising or at the middle portion of the pinnae; secondary veins diverging from point of attachment of pinna or arising from the midrib.

This form is quite different from other species in the present collection. While there is no doubt that this form is a new and well difined species,it is not equally clear to which genus it should be referred. It was only with a considerable hesitation that the writer decided to place this species with a question mark in the genus *Drepanozamites*. The specimens can be compared with those found from E. Greenland described by Harris under the name of *Drepanozamites nilssoni*, but our species is characterized by the presence of a vaguely defined midrib in the pinnae. As remarked by Harris, all the veins of the Greenland species are diverging from point of attachment of pinna, there is apparently no midrib in the pinnae of this species. The two species are therefore kept separate at least for the present, and the writer has thought it safer to describe the present form as a new species and has named it after Dr. C. H. P'an, the author of the memoir of "Older Mesozoic Plants from North Shensi".

According to Prof. Harris, the specimens described by the writer as *Rhacopteris? gothani* from the Pinghsiang Coal Field of Kiangsi is identical with *Drepinozamites nilssoni*. He said for instance (1937, p. 28): "Sze (1933b, p. 42) has recently described some Chinese specimens under the name *Rhacopteris? gothani* which agree exactly both in form and venation with the Greenland specimens and are probably identical with them." It seems to the writer that the characteristic pinnae of our Pinghsiang specimens, which are broadest at the base and are attached at basal corner to the rachis and their more or less fan-shaped veins prove that this species is a typical *Drepanozamites*. It differs from the genotype *D. nilssoni* through the margin of the pinnae being more or less dissected distally, crenated and occasionally even lobed. It is therefore somewhat doubtful whether the Pinghsiang specimens should be referred to the Greenland and Swedish species or not. The writer prefers to postpone identification, because of the much more falcate shape of the Greenland pinnae and the fact that the distal margin of the pinnae of the Pinghsiang specimens is crenated or even lobed, while the margin of pinnae of the Greenland specimens is entire, without any dissections. The writer proposes to place our Pinghsiang specimens in the same genus under the name *Drepanozamites gothani* (Sze) Sze n. Comb.

Locality: Tânhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Genus *Sinozamites* gen. nov.

The writer finds himself compelled to place the splended plant described below in a distinct genus, as its features are so constantly different from those of all previously described genera that they cannot be well placed in any existing ones. The shape of the fronds and many of their details are clearly like the fossil genus *Zamites* and the recent genus

Zamia, and from this resemblance the writer derives the name for the genus. As only one species is known, the diagnosis given below of *Sinozamites leeiana* may serve for the present as generic diagnosis.

Sinozamites leeiana sp. nov.

Pl. XXXIX, figs. 1—3; Pl. L, fig. 4; Pl. LIII, fig. 5.

Long shoots with laterally disposed leaves, separated by long internodes in almost opposite position. Axis straight, comparatively very thin and slender, measuring a breadth on the impression of only 2 mm, ornamented with very fine longitudinal striations. Leaves long and linear, with almost parallel sides, attaining a maximum breadth of 15 mm and a length of at least 12.5 cm, and forming an angle of about 80–90° with the axis. Leaves with more or less truncated apex and very abruptly contracted at the base, which is narrow and somewhat stalk-like. The top and the upper portion of the leaves strongly and deeply dissected through sharp and narrow incisions into sharply pointed teeth, almost parallel to the margin and corresponding each to one vein. Several veins entering the leaf-base, bifurcating close to the base; first diverging and then almost parallel to the margin, repeatedly dichotomising at various points to the apex; some veins reaching the margin very near the leaf-base; number of veins about one–fourth from the apex 20–22 to the centimeter. Epidermis-structure unknown. Fertile specimens unknown.

This form has several characters by which it may be recognized at a glance. Through its thin and slender axis and the almost oppositely attached long and linear leaves with stalk-like base, *Sinozamites* is well distinguished from all other fossil genera of the Cycadophyta. In size and shape of the leaves, the present form is strikingly like some Palaeozoic species of *Tingia* e. g. *T. carbonia* and *T. crassinervis,* but the leaves of *Tingia* are characterized by a base which is not abruptly contracted into a stalk and the venation is much more coarse and loose than in our species, and the shoots of *Tingia* are characterized by a very broad and thick axis, with leaves in short internodes and arranged in four rows, two on the upper and two on the lower side of the axis.

There is some resemblance between our form and a peculiar fossil species described by Du Toit as *Moltenia dentata* (1927, Pt. II, p. 380) from the upper Karoo Beds of S. Africa. The shape and size of the leaves of this form can be more or less compared with our species, but the lateral margin of the leaves of *M. dentata* is characterized by sharp teeth, reaching almost to the base of the leaf, which is contracted but distinctly decurrent on the axis. Moreover, the type of venation of this South African species is quite different from that of our form, it is of the *Pseudoctenis* type. Du Toit believed that his plant may belong possibly to the Bennettitales.

Among the recent forms of Cycadophyta, the genus *Endocephalartus* is somewhat like our species, but the shape of the leaves of this recent plant is more lanceolate, with acute apex and with a contracted base which is not stalk-like. The venation is also not so dense as in our species and the texture of the leaves is also thick in consistency. The marginal teeth of the leaves are more stronger and rigid, arranged more regularly and reaching almost to the base of the leaf. There are also some species of *Endocephalartus* which are characterized by the marginal teeth confined only to the apex of the leaf, but the form of the leaves of these species is quite distinct from our species, the leaves are broadest at the middle tapering gradually to the apex and gradually to the base. Like the South African species *Moltenia dentata,* our species might probably also belong to the Bennettitales.

The writer has ventured to name this new plant in honor of his highly estimated teacher Prof. Li Szu-Kuang (J. S. Lee), the author of the Geology of China.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

III GINKGOPHYTA

Genus *Ginkgoites* Seward

1919. *Ginkgoites* Seward, Fossil Plants IV, p. 10

Ginkgoites chowi sp. nov.

Pl. XL, fig. 3; Pl. XLVII, fig. 2.

This new species is distinguished by the shape of the leaves which resemble more or less the Chinese shovels.

Leaf more or less shovel-shaped, attaining a breadth of about 6.5 cm and a length of at least 5 cm, with a strong and rigid (4 mm) petiole of unknown length. Leaf-base more or less truncate, lamina rather broad, and thick in consistency, coriaceous with a folding surface. Margin almost entire, probably slightly dissected distally. Venation not well shown, being slender, and immersed in the thick leaf-substances of the leaf, but apparently as follows: Vein fine and delicate, not very dense, given off from the top of the petiole, radiating and bifurcating to the margin, the number of bifurcations cannot be settled, because of the unsatisfactory preservation.

The most typical specimen of this species is figured in Pl. XL, fig. 3. In the general shape of the leaf, this species is strikingly like the Chinese shovels or spades. Our species recalls the specimens figured by P'an (1936, p. 29, Pl. XII, figs. 9—10; Pl. XIV, fig. 4) from the same formation as *Ginkgo magnifolia* (Fontaine), but differs from it through the more shovel-like leaves with more entire margin. The leaf-base of Pan's specimens is more wedge-shaped, and the leaves are divided into four segments, traversed by the strong and distant and repeatedly bifurcated veins. The slightly dissected feature of the leaves of our species recalls also the figure published by Du Toit (1927, Pt. II, p. 368, 16A) under the name *G. antarctica* (Saporta), and the specimen from Kamenka described by Thomas (1911, p. 74; Pl. IV, fig. 8) as *G. polaris* Nathorst. The leaf of Kamenka is characterized, however, by a more wedge-shaped base and the preservation is too poor to permit of further comparisons.

A comparison of the specimens suggests that the leaf of this species was very large and probably undivided or only slightly dissected. It is probably similar in habit to the leaves described by Kräusel as *Ginkgoites lunzensis* (Stur) Florin from the Lunzer Keuper of Austria, and especially to the specimen figured in his Pl. I, fig. 7 (1943). The resemblance is so close that the two forms might suspect to be identical, but the distal margin of the leaves found from Lunz is like many other species of this genus generally deeply dissected and there is no adequent ground for specific identification with the present form from the Yenchang Formation.

This species is named after the writer's friend Mr. T. C. Chow, the first palaeobotanist of China and the author of 'The Lower Liassic Flora of Sofiero and Dompäng in Scania' (Arkiv för Botanik Bd. 19, 4, 1924).

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Ginkgoites sp.

Pl. XLVII, figs. 3, 4.

The small leaves figured in Pl. XLVII, figs. 3, 4 are indeterminable but have been figured because they show a fairly close resemblance to a specimen from the Tetori Series of Japan (Ôishi 1940, p. 377, Pl. XXXVIII, fig. 9) which Ôishi thinks may be a leaf of *Ginkgoites digitata* (Brongn.) Seward. It is however quite doubtful whether the Japanese specimen really belongs to this species. The preservation of our specimens is very incomplete, the base of the leaves seems to be wedge-shaped and the distal margin seems to be shallowly dissected into four lobes with broadly rounded apex.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Genus *Glossophyllum* Kräusel

Glossophyllum? *shensiense* sp. nov.

Pl. XXXVIII, figs. 4, 4a: Pl. XLVIII, figs. 1—3; Pl. XLIX, figs. 1—6; Pl. L, figs. 1—3; Pl. LIII, fig. 7b; Pl. LV, fig. 5.

This species stands third in the abundance of its individuals and the area over which it is diffused. It is often found with *Cladophlebis shensiensis, Bernoullia zeilleri, Danaeopsis fecunda* etc. The great numbers of imprints of this plant, and the good preservation of many of them, enabled the writer to make a very satisfactory study of it. It will be seen that the size of the leaves shows a considerable variation, but all the specimens in our material belong certainly to one and the same species. The species was originally described by Krasser as Cordaitaceenblätter, *Noeggerathiopsis hislopi* (Bunb.) and by P'an as *?N. hislopi* (Bunburg). P'an (1936, p. 32) goes on to say: "Numerous detached leaves have been found from Shataiping, west of Suite. They seem to be identical with the Gondwana species *Noeggerathiopsis hislopi* (Bunburg). Some detached leaves figured in Pl. XIII, figs. 1—3 are the typical form of our specimens. The lamina attains a length of 8.5–9.5 cm and a breadth of 1.2 cm. It tapers gradually to a narrow base, and is slightly contracted to an obtuse rounded apex. It is characterized by longitudinal veins which are about 17–20 in number to 1 cm and bifurcate several times at various parts of the lamina. The general form and venation agree well with the Indian plant but ours is generally narrow and smaller than the Indian plant, and it is not so abruptly budged in the upper part as in Indian form. Since this species various considerably in shape and size, this slight difference seems to me to be insufficient for specific separation." It is of special interest to point out that in the present material, there are many specimens which are considerably larger than Pan's specimens and some of them even show the upper part of the leaves which are abruptly budged as in the Indian specimens (e. g. Pl. XLIX, fig. 2; Pl. L, fig. 3). In this respect, the present specimens are more in agreement with the Indian species. As stated above, there is a considerable variation of size and shape of this species in our collection. Pl. XLIX, fig. 2 shows a specimen attaining a maximum breadth of 4.5 cm at the top of the leaves which is probably broadly rounded. An unfigured leaf in the collection (Cat. No. PB. 2501) is strongly budged in the upper part with a very broadly rounded apex; it attains a maximum breadth of at least 3.8 cm. The most common type of specimens in the material is those figured in Pl. XLIX, fig. 1 and Pl. XLVIII, figs. 1—3. The specimens generally attain a breadth of about 3–4 cm and a length of 23 cm without being complete. One of the best preserved specimens is figured in Pl. XXXVIII, figs. 4, 4a. This specimen attains a maximum breadth of about 2 cm and a length of at least 12 cm, gradually tapering to the very narrow base which is only 2.5 mm broad. The smallest specimens in our collection are those shown in Pl. L, figs. 2, 2a and Pl. LV, fig. 5. These leaves attain a length of about 5–6.5 cm and a maximum breadth of only 1 cm at the upper part; the top part of the leaves is broadly rounded; the leaves are also gradually narrowing to the narrow base. The size and shape of these smaller specimens agree fairly well with those described by P'an from the same formation. The venation of all our specimens is very characteristic and is essentially of the same type as that described by P'an.

In size and shape of the leaves and in venation, our specimens bear indeed a striking resemblance to the Gondwana species. A close inspection of the literature has led one to believe that our specimens are actually very much like those found from the Gondwana-Land. One has only to compare the original figures published by Feistmantel and other authors (e.g. Seward and Sahni 1920, Palaeont. Indica Ser. Vol. VII, No. 1, Pl. 1, figs. 8—10; Feistmantel 1882, Palaeont. Indica Ser. XII, Vol. IV, Pl. XIV, figs. 1—3, 9; Pl. XX, figs. 6, 10) to be impressed with fact that the Indian species is almost identical with our specimens found from the Yenchang Formation. Our specimens resemble also very much those figured by Prof. Neuburg from the Angara-Land and agree especially well with the specimens shown in Pl 50–54 and in Pl. 59, fig. 61 in the important memoir published by Neuburg in 1948. There is also a considerable variation in the shape and size displayed in the Angara material, and in view of the great variation shown by the present material, the writer thinks it is probable that the different species described in the Angara-Land may be identical. It is obviously impossible to prove definitely that many different species of *Noeggerathiopsis* of Angara-Land are really one, and pratical considerations make it advisable to leave the question open. The important question is whether our present form could be identified with the Gondwana species *N. hislopi* (Bunb.) without any reservations. After a careful study of the subject, the writer has arrived to the conclusion that these two forms are probably not related to each other. As stated by Seward (1917, p. 242), the leaves of *N. hislopi* in some cases may reach a length of 80 cm and this is probably not the case in the present species of the Yenchang Formation. Moreover, the mode of attachment of the leaves of the Indian species is probably different from that of our species. In addition to the leaves, there are some twig remains in the material which are comparatively rather slender, measuring only 5-6 mm in breadth, and are characterized by very densely and spirally arranged, small eye-shaped leaf-scars (see Pl. XLIX, figs. 5, 5a, 6). It is highly probable that the present leaves are attached to such twigs. Smilar twig remains are also found from the Tonking Coal Field in Indo-China (Zeiller 1903, Pl. XL, figs. 7—9) in association with the leaves which were described by Zeiller also as *N. hislopi*, and which were believed by P'an perfectly identical with our specimens (see Zeiller, 1903. Pl. XL, figs. 1—6). Zeiller named these twig or branch remains as "Rameau, appartenant probabement au *Noeggerathiopsis Hislopi*."

In the size, in the general shape of leaves and in venation as well as in the shape and size of the twigs, our species bears also a considerable resemblance to the specimens found from the Middle Keuper of Lunz, which were originally described by Krasser (1910, p. 121) as *Noeggerathiopsis* and later transferred by Kräusel (1943, p. 61—72) to a new genus *Glossophyllum*. After a careful examination of the cuticular structures of the specimens, Prof. Kräusel has come to the conclusion that the species from Lunz, namely *Glossophyllum florini* may belong to the *Ginkgoales*. He said for instance (1943, p. 70). "Ihre systematische Stellung darf danach als eindeutig geklärt angesehen werden. Es sind weder Koniferen noch Cordaiten, sondern Ginkgophyten." According to Kräusel, the shape of leaves, the pattern of venation as well as the structure of epidermis of the Lunz species all support for adopting such a step. On page 62 of the same important memoir, Prof. Kräusel pointed out the resemblance between *Glossophyllum florini* and the specimens found from Tonking. He said (1943, p. 62). "Man sicht aus diesen Angaben, wie gut Krasser's Vergleich mit den Blattern aus der Trias von Tonkin war, die Zeiller (wohl zu unrecht!) zu *Noeggerathiopsis hislopi* gestellt hat." And again on page 72 after detailed discussions of the genus *Glossophyllum*, Prof. Kräusel pointed out: "*Glossophyllum* liegt bisher nur von Lunz vor. Die häufigkeit der Blätter im Verein mit den Beobachtungen Florin's und Harris' an Material aus arktischen Gebieten macht aber wahrscheinlich, dass wir es hier mit dem Vertreter einer Ginkgophytengruppe zu tun haben, die im Mesozoikum eine weite Verbreitung gehabt hat. Bei der Durchsicht älterer Florenwerke stösst man auch immer wieder auf ähnlich gestaltete Blattabdrücke. Auch aus Süddeutschland liegen solche vor. Näher darauf einzugehen hat jedoch wenig Wert, solange es nicht möglich ist, diese Blätter auch anatomisch zu untersuchen." Prof. Kräusel then turned to the problem of the probable affinity between the species of Lunz and Tonking. He said for instance: "Aber wenigstens soll noch einmal auf die Reste aus dem Rhät von Tonkin hingewiesen werden, die Zeiller zu *Noeggerathiopsis hislopi* Bunb. stellt (1903, 149, Taf. 40, Fig. 1—6). Krasser's Vergleich trifft durchaus zu, denn von allen mir bekannten Fossilien kommen sie hinsichtlich der äusseren Gestalt *Glossophyllum* am nächsten. Das darf aber nicht ohne weiteres auf alle unter jenem Namen vereinigte Formen übetragen werden. Diejenigen der indischen Gondwanaschichten z. B. weichen nach Gestalt, Nervenverlauf und anatomischem Bau sehr davon ab und sind bestimmt keine Ginkgophyten (Seward & Sahni 1920, 4, Taf. 1). Wahrscheinlich haben die Blätter von Tonkin damit gar nichts zu tun. Ob es sich bei ihnen wirklich auch um eine *Glossophyllum*-Art handelt, bleibt zu prüfen."

It seems to the present writer, however, that our specimens as well as those found from Tonking are really closely related to the species described by Kräusel from the Lunzer Keuper of Austria. The presence of many similar remains of very slender twigs of the Lunz Keuper supports also this relationship. According to the restoration figure (Kräusel

1943, p. 64, Textfigs. 3, 4) the leaves of Lunz are also very densely and spirally attached to the twigs. The mode of attachment of the leaves of these two forms are therefore essentially similar. And furthermore, the small leaves figured in our Pl. L, fig. 2, and Pl. LV, fig. 5 are all but indistinguishable from those figured by Kräusel in his plates, especially the specimen figured by him in Taf. VIII, Fig. 1. The close resemblance between the specimens found from the Middle Keuper of Lunz in Europe and the Keuper-Rhaetic Yenchang Formation of North and Northwest China is indeed both striking and interesting, and the fact deserves more than passing notice.

The only question is whether or not our plant could with some reservation be identified with the Gondwana species as Dr. P'an advocated. The present writer has been at first indeed somewhat at a loss where to place this plant in the existing fossil genera. It is a good deal like the Gondwana species *Noeggerathiopsis hislopi* in shape and venation, but at the same time it is none the less true that our plant is also very similar to the Middle Keuper species of Lunz *Glossophyllum florini* in shape, in size, in venation, in the mode of attachment of the leaves and in the size of the twigs with the characteristic eye-shaped leaf-scars. In spite of the fact that the epidermal structures of our plant are still unknown, the writer is inclined to believe that our plant is more closely related to the species of Lunz on account of the approximately equivalent geological age of both formations.

The generic name *Glossophyllum* was instituted by Kräusel in 1943 for the sterile leaves from the Lunzer Keuper of Austria believed to be identical with those first described by Krasser as *Noeggerathiopsis* sp. (1910, p. 121) and afterwards named by Kräusel (1923, p. 81, Pl. 3, fig. 1; Pl. 4, fig. 2) as *Baiera lunzensis*. The generic diagnosis defined by Kräusel (1943, p. 71) is as follows:

"*Glossophyllum* nov. gen. Triebe mit spiralig stehenden Blättern; diese steif, lederig, ganzrandig, ± zungenförmig, gerade bis sichelförmig gekrümmt, im mittleren Teil am breitesten, an der Spitze gerundet, im unteren Teil allmählich schmäler werdend und schliesslich fast stielartig verschmälert, am Grunde leicht angeschwollen, hier von zwei Bündeln durchzogen, deren im unteren Teil stattfindende Gabelteilungen schliesslich eine mässige Anzahl ± paralleler Bündel ergeben. Spaltöffnungen auf beiden Blattseiten, auf der Unterseite häufiger, schmale, ± deutlich abgegrenzte Streifen bildend, die durch spaltöffnungsfreie Zonen getrennt werden, in den Streifen zu dichten, unregelmässigen Längsreihen geordnet, regellos gerichtet, oft aber in Richtung der Bündel verlängert, einlippig, von 1–2 Ringen von Nachbarzellen umgeben, Schliesszellen schwach eingesenkt, Nebenzellen 4–7, meist mit je einer über die äussere Atemhöhle geneigten Kutikularpapille. Die Oberseite grundsätzlich gleich gebaut, die Zahl der Spaltöffnungen aber geringer, ihre Streifenbildung undeutlicher, die Spaltöffnungen häufiger in Richtung der Bündel in die Länge gezogen; Epidermiszellen mit geraden Wänden und runden Kutikularpapillen in wechselnd starker Ausbildung."

The original specific diagnosis of *G. florini* may be given below for the purpose of comparison:—

"*Glossophyllum florini* n. sp. Länge der Blätter 6–25 cm, Breite 6–26 mm, Bündelzahl 5–15, meist 6–8 nach der ersten Gabelung der Grundbündel zunächst die mittleren, dann erst die äusseren Bündel sich weiter gabelnd, Dichte der Spaltöffnungen wechselnd (7–32 je mm^2), der äussere Ring der Nachbarzellen meist nur unvollkommen entwickelt, polare und seitliche Nebenzellen von ähnlicher Gestalt, Gesamtumfang des Spaltöffnungsapparates mindestens auf der Blattunterseite daher ± kreisförmig, auf der Oberseite dagegen stärker in die Länge gezogen, die Papillenbildung der Epidermiszellen sehr verschieden stark entwickelt."

The large number of well preserved specimens discovered from Lunz enables Prof. Kräusel to give a very complete account of nearly all parts of the plant. On pages 63–68 of his important and excellent paper, Kräusel has been able to give statistic tables and diagrammatic figures based on very careful study and examination of the length to breadth ratio of the leaves. He mentioned in his specific diagnosis that the leaves of *Glossophyllum florini* may consist of 5–15, generally 6–8 veins. On page 63 of this paper, he pointed out a single specimen found from Lunz which is distinguishable from all other specimens by consisting of 20 veins in the leaf, and according to the result of maceration, he has been able to prove that this specimen may belong to another species of this genus.

There is also a considerable variation in the length to breadth ratio of the present material, but since there are only about 15 specimens placed at the writer's disposal, it is not necessary to give a statistic table or a diagrammatic figure of these specimens. It should however be pointed out that the length as well as the breadth of the present leaves are in fact considerablly larger than those of the Lunz material, and the number of veins of our specimens is also evidently considerably more than that of the Lunz leaves. Moreover, the broadest part of the leaves is generally at the middle part in the Lunz-specimens, while the broadest part of the leaves is mostly at the upper or top part in our specimens. The question whether or not the base of our leaves are characterized by two veins, cannot be settled, because of the unsatisfactory state of preservations. It is therefore highly possible that our species is distinct from that of the Lunzer Keuper and may belong to another species of this or some other genus. One of the most interesting points is that the leaves of *G. florini* are spirally and densely attached to the slender twigs according to restoration-figure given by Kräusel (1943, p. 64, Textfig. 4; Pl. VII, fig. 9), and this must have been the case of the present leaves found from the Yenchang Formation. As stated above, there are also two or three specimens of twigs presented in our collection (Pl. XLIX, figs. 5, 5a, 6). The breadth of the twigs is exactly like that of the Lunz species, and the irregular spirals on the surface are small eye-shaped scars marking the points at which lateral leaves were given off. The feature of the small eye-shaped leaf-scars is also exactly similar to those of the Lunz specimens. It is unfortunate that the present specimens like many others in the material are preserved without carbonaceous films, so that they could not be studied microscopically by the methods of maceration. The stomata and epidermal structures of our species are therefore unknown, and furthermore the base of leaves of all our specimens are preserved very unsatisfactory to show whether or not they are closely related to the Lunz species i.e. whether or not there are only two veins placed side by side entering the leaf-base like the Lunz species. The assignment of our specimens to the *Ginkgoales* must therefore be accepted with a considerable reservation. The writer brings the present specimens for the time being into comparison with the genus of Kräusel and names them *Glossophyllum? shensiense* sp. nov., awaiting better material from the localities.

Diagnosis: Leaves attaining a length of 5–28 cm with the broadest part at the upper portion measuring about 1.1–4 cm in breadth, gradually tapering to the narrow base. Apex of leaves broadly rounded. Veins fine and dense, bifurcating from the base of the leaves dividing several times at various parts of the lamina, running almost parallel to each other and converging more or less at the apex. Number of veins about 14 to the centimeter in the middle portion and about 17–20 to the centimeter near the apex of the leaves. Epidermal structures unknown. Twigs very narrow and slender, attaining a breadth of only 1 cm, with very densely, spirally arranged and transversely elongated small eye-shaped leaf-scars measuring only 0.5 mm high, with a horizontal diameter of 3–4 mm. The breadth of the leaf-scars corresponds to that of the leaf-base of a specimen (see Pl. XXXVIII, fig. 4).

The specimens described by Zeiller from Tonking as *Noeggerathiopsis hislopi* (Bunburg) were believed by P'an to be completely identical with his specimens (see P'an 1936, p. 32, synonym) from the Yenchang Formation. Kräusel expressed the view that the determination of the Tonking specimens by Zeiller is probably not well justified ("Wohl zu Unrecht!"), and that this form might be allied to *Glossophyllum* (1943, p. 62, p. 72). In the writer's opinion, the Tonking specimens can equally well be determined as *Glossophyllum?*. The important question is whether or not the species of Tonking is identical with our form from the Yenchang Formation. After a considerable hesitation, the writer has arrived to the conclusion that the complete identification of these two forms must be accepted with reservation at least for the present. The reason for adopting this course will be set forth below. Firstly, in shape and size of the leaves, the majority of our specimens are different from those found from Tonking. Most of the specimens found from Shensi are much more broad than those found from Tonking, and are often so abruptly budged in the upper part as in the Indian species. Secondly, the Tonking specimens could provisionally be designated as *Glossophyllum? zeilleri* (Seward) n. Comb. for the following reasons: Coggin Brown had collected a small flora from the Yunnan province of Southwestern China similar to that of Tonking. The specimens were determined by Seward and were published by Sahni in 1936. One of the fossil list published in Sahni's paper is a species of *Pelourdea*, named *Pelourdea zeilleri* sp. nov. It is unfortunate that Sahni's important paper is not accessible to the writer, but according to Coggin

Brown (1938, l.c.), it is stated that *Pelourdea zeilleri* is no doubt identical with Zeiller's supposed *Noeggerathiopsis hislopi* from Tonking. "These fossils from Yunnan," as remarked by Coggin Brown, "were taken to Paris by Prof. Sahni and thanks to the courtesy of Prof. Painvain of the Ecoles des Mines, compared with Zeiller's Tonking types with which they are stated to show unmistakable affinities, and none with the Indian Gondwana flora" (see also Sze 1949, p. 52). The final conclusion reached by the writer is that if future investigations definitely prove that our specimens are identical in every respect with those found from Yunnan, the new specific name *shensiense* must be discarded and the plant should be placed under the name of *Glossophyllum? zeilleri* (Seward) nov. Comb.

More or less similar leaves have been recently discovered from the Upper Shihhotze Series of SE Shansi and have been described by the writer as *Pelourdea hallei* sp. nov. (see 1955b, p. 413—419). In this paper, the writer expressed the view that he is in complete accord with the discussions given by Prof. Halle regarding the genus *Pelourdea* and and that he supports fully the "narrow definition" of this genus given by Halle (see Halle 1927, p. 224—225). At the same time, the writer (1955b, p. 416, footnote) pointed out that the relation of *Pelourdea* and *Glossophyllum* is just like that of *Walchia* and *Lebachia* as well as that of *Phoenicopsis* and *Windwardia* etc. *Glossophyllum* is a natural genus and *Pelourdea* is a form-genus or "Sammelgattung". If this tentative proposal could be accepted, the specimens from the Yenchang Formation should more appropriately be designated as *Pelourdea (Glossophyllum?) shensiensis,* and basing on the same reason, it is highly possible that the specimens found from the Lunzer Keuper should also justifiably be named *Glossophyllum* (*Pelourdea*) *florini*. One of the most interesting points is that there are also only two veins placed side by side entering the stalk-like leaf-base of the specimens found from the Shihhotze Series, and in this respect our Permian species is more closely related to the Lunzer species.

A specimen described by Prof. Halle from the Rhaetic of Sweden as *Phyllotenia? hadroclada* (Halle 1910a Arkiv, f. Bot. Bd. 9, No. 14, p. 1—5; Pl. I, figs. 1—6) very closely resembles the present species in the shape of twigs and leaves. The twigs of this Swedish species are also about 1 cm in breadth and are also characterized by the very densely and spirally arranged eye-shaped leaf-scars which are about 0.5 mm high and 3–5 mm broad. This Swedish species seems to have escaped the notice of Prof. Kräusel, because he did not mention it in his important paper published in 1943. It seems to the present writer that this Swedish species might probably be identical with the species of Lunz in regard to the shape and size of the twigs and leaves. As stated by Halle (1910a, p. 2), the veins of *P.* (?) *hadroclada* are parallel, varying in number, 10–12 in the broadest fragment. It appears evident that this feature agrees perfectly well with that of the Lunz species. The only point of difference is that the veins of the Swedish species is stated to be simple and undivided; but this difference is, in the writer's opinion, hardly sufficient for separating these two species, because the leaves of the Swedish species are too fragmentary preserved to permit of a definite conclusion regarding the bifurcation of the veins. Prof. Halle at the same time emphatically pointed out: "They are best seen on the surface of the carbonaceous remains of the leaf, but even here they are not very distinct. Each vein can be followed only a short distance, before it disappears, as if split up into branches." It seems therefore that if a better material from Scania is available, we can probably prove that the veins of this species are bifurcated similar to those of the Lunz species. The important point worthy of notice is that in the leaf-scars of the Swedish species, in a few cases, some small and indistinct dots are seen which probably represent scars of the leaf-traces. According to Halle, the number of small dots and the mode of their arrangement could not be made out with certainty, but they seem however to be at least three, but probably more and arranged horizontally. If this feature proves to be true, the Swedish specimen might belong to a separate distinct species of the genus *Glossophyllum;* but even this feature, in the writer's opinion, may be based on the subjective interpretations of Prof. Halle, because he pointed out the indistinct preservation of these small dots of the leaf-scars and because he said: "Their number and mode of arrangement could not be made out with certainty." It is of interest to point out that this Swedish species was later transferred to *Yuccites hadrocladus* (Halle) Florin, according to Lundblad (1950, p. 50). Dr. Lundblad stated that this species "is clearly differentiated by its cuticular characters which have been investigated by Florin. (1936, p. 48; textfig. 8a)." It seems that the cuticular characters investigated by Prof. Florin in 1936, p. 48; textfig. 8a belong to the species *Sphenobaiera paucinervis* Florin. Lundblad did not mention the cuticular structures of *Yuccites hadrocladus* (Halle) Florin and the relations between this species and *Glossophyllum florini*. If the cuticular structures of the Swedish species closely resemble the Lunz species, the specimens found from Lunz should according to the rule of priority be named *Glossophyllum hadrocladum* (Halle) nov. Comb. Finally, it is of special interest to point out that the Swedish species was once transferred by Seward to the genus *Pelourdea*. Seward (1917, p. 280) named this species *Pelourdea hadroclada* (Halle) Seward.

The specimens described by Brick (1952, Pl. XV, figs. 1—12) from the Upper Triassic of Western Kazakstan as *Yuccites spathulatus* Pryn. might be, based on the above discussions, identical with the present species found from the Yenchang Formation of Northern Shensi.

Localities: Tanhokou, near Shihlangmiao, Ichün District, Shensi; Ch'imochiao, near Hsinshüping, Ichün District, Shensi; Hsükoutsun, Yenchang District, Shensi; "Schlucht beim Dorfe San-schi-li-pu", Suite District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Locality: Shataiping, Yenchang District, Shensi.

Horizon: The middle part of the Yenchang Formation.

Locality: Yenhokou, Wuwei District, Kansu.

Horizon: The lower part of the Yenchang Formation.

Genus *Sphenobaiera* Florin

Sphenobaiera crassinervis sp. nov.

Pl. IX, figs. 5, 5a.

The fragment in Pl. IX, figs. 5, 5a may represent the lower portion of a leaf of *Sphenobaiera*. It is wedge-like with spreading dichotomizing veins and is broken at the upper end. In spite of the fragmentary nature, the identification is fairy certain because of the characteristic features shown by the specimen.

Leaf long wedge-shaped, perhaps bifurcating only once, with long wedge-like segments of comparatively uniform breadth, about 15 mm broad in the upper part or little broader; apices of segments not preserved. Leaf only slightly narrowing downwards, without marked petiole, attached to the axis by the whole of the broad base which measures 5 mm in breadth at the insertion. Two segments forming a very acute angle with each other; margin entire. Veins very thick and irregular, repeatedly dichotomizing, generally about 11–12 per centimeter in the upper part of the segments.

The shape of the leaf and its segments, and the feature of the characteristic leaf-base without marked petiole prove that this species is a typical *Sphenobaiera*. Among species of *Sphenobaiera* described from other floras there is none that shows close resemblance to the present form in regard to the feature of the thick and coarse veins which mark it off from other species.

The generic name *Sphenobaiera* was founded by Prof. Florin in 1936 for the leaves which are characterized by a broad leaf-base without marked petiole. Most of the species which have been transferred by Florin to this genus, were formerly described by various authors as belonging to the genus *Baiera*. Prof. Florin transferred also the species *Baiera digitata* Brongniart from the Kupferschiefer of Europe and the species *Baiera spinosa* Halle and *B. tenuistriata* Halle from the Shihhotze Series of China to this genus. The genus *Sphenobaiera* ranges therefore from the Lower Permian to Lower Cretaceous, and the genus *Baiera* is confined only to the Mesozoic (from the uppermost part of Upper Triassic to the Lower Createaceous). The generic diagnosis of *Sphenobaiera* given by Florin (1936, p. 105) may be mentioned here:—

"Laubblätter onhe deutlich abgesetzten Stiel, gegen den Grund zu Keilförmig verschmälert und in ihrem Umriss ± schmal dreieckig, ferner ± tief in 2 bis 5 Primärlappen geteilt, die in zwei Gruppen angeordnet sein können und ihrerseits wenigstens einmal, aber meist wiederholt tief gelappt sind. Alle Lappen schmal und ± linealisch, nicht mehr als 2–4 parallel Adern in irgend einem Teil einschliessend. Aderung als Ganzes betrachtet fächerfömig."

According to the foregoing generic diagnosis, the species described here belongs undeniably to this genus. The leaf shows one bifurcation: and as the specimen is preserved in a fragmentary condition, it is difficult to decide whether it is divided only once or probably twice: in any case the leaf was long and narrow and probably not much divided.

Among the species in the very complete table published by Florin (1936 p. 108; this table is reprinted in the Chinese text of this memoir p. 53), the only form which could be more or less comparable in size and shape of the leaf to our species is *Sphenobaiera multifida* (Fontaine) Florin from the Virginia-Keuper of North America (Fontaine 1883, p. 87; Pl. XLVI; Pl. XLVII, figs. 1, 2). As implied by its specific name, this North American is characterized by the segments which are divided many times. Moreover, the leaf-base of this species is much more broader than that of our species.

Taken into account the feature of the broad leaf-base, the species described by the writer from the Hsiangchi Coal Series of Western Hupei (Sze 1949, p. 32; Pl. VII, figs. 1—4) as *Baiera huangi* belongs also undeniably to the genus *Sphenobaiera*.

Locality: Huanglung District, Shensi (Exact locality unknown).

Horizon: Unknown.

?Sphenobaiera furcata (Heer) Florin

Pl. XLVII, figs. 6, 6a, 6b.

The specimen shown in Pl. XLVII, fig. 6 appears to be identical with *Sphenobaiera furcata* (Heer) Florin from the Basler Keuper and the Lunzer Keuper of Europe. It is the only specimen found from the Yenchang Formation which has preserved the thin carbonaceous films and which can be examined microscopically. A part of the removed films was treated with nitric acid and chlorate of potash and afterwards transferred to ammonia. It shows the outline of the epidermal cells very clearly, but the shape and the structure of the stomata are preserved very unsatisfactory. Two figures of the epidermal feature are shown in Pl. XLVII, figs. 6a and 6b. The cuticles show elongated rectangular and polygonal cells. Cell outlines are almost straight, only very slightly sinuous. There are no papillae observed in the cells. The stomata are preserved very unsatisfactory. On the whole, the cuticular structures of our form agree well with the species from Lunz in Austria and from Basel in Switzerland.

According to Lundblad, the leaves of this species are bifurcated two times and according to Kräusel it may be divided three times. In our specimen, one leaf shows only one bifurcation and the other is divided about twice. The segments of our leaves are very slender, measured only about 2 mm broad, and in this respect, the species agrees well with *Sphenobaiera furcata* found from Lunz and Basel in Europe.

In regard to the shape of bifurcation of the leaves, our form can also be more or less compared with the species *Stenopteris dinosaurensis* Harris (Harris 1937, p. 37, textfigs. A–C) from the *Thaumatopteris* zone of Eastern Greenland; but according to the epidermal features, our form is more related to another species of *Stenopteris*, namely *S. astartensis* Harris (Harris 1932, p. 77–78, textfigs. A–E) from the *Lepidopteris* zone of E. Greenland. Prof. Harris (1932, p. 75) pointed out that the fragments of *Stenopteris* might well be mistaken for *Czekanowskia*: the branches fork in the same way and even the cuticles are rather similar. At any rate, the present form is more similar in shape and size of the leaves and their segments to the Middle Keuper species of Lunz and Basel, and there is no probability that our species should belong to the genus *Czekanowskia*.

The species *Sphenobaiera furcata* has also been recorded by Ôishi (1932b, p. 348; Pl. L, figs. 2a-3) from the Nariwa flora of Japan. In the shape of the bifurcation of leaves as well as in the size of segments, the Japanese specimens agree fairly well with the present form found from the Yenchang Formation of Western Shansi, but the Japanese specimens too are very fragmentary preserved for a definite generic and specific determination, and it seems to the present writer that the better course to follow is to put also provisionally a question mark before the generic name for the Japanese specimens.

Locality: Lichiayao, Hsinghsien District, Shansi.

Horizon: The lower part of the Yenchang Formation.

Genus *Psygmophyllum* Schimper

Psygmophyllum? sp.

Pl. XLVII, fig. 5.

The specimen shown in Pl. XLVII, fig. 5 was at a first glance believed by the writer to be identical with the species originally described by Harris as *Baiera boeggildiana* (1935, p. 28, Pl. IV, fig. 2) and afterwards referred with a question mark by the same author to the genus *Sphenobaiera* (see Harris 1937, p. 58, *?Sphenobaiera boeggildiana* (Harris) Harris). A careful examination of the specimen led the writer to believe that our plant may be specifically or even generically distinct from that species. The mode of attachment of the leaves in our specimen is quite different from that of the Greenland species. The leaves of our specimen are suboppositely or alternately attached to the very slender axis. The shape of the leaves is typically wedge-like with probably truncated apex. The veins of our plant are also more fine and dense than those of the Greenland species. The veins are repeatedly dichotomising in our specimen. The number of veins entering the leaf-base cannot be settled, because of the poor preservation of the specimen.

In regard to the mode of attachment of the leaves and in regard to the whole habit of the plant, the present form is more related to the type described as *Psygmophyllum flabellum* (L & H.) of the Palaeozoic, but the veins of our form are not anastomosed like those of the Palaeozoic species. It is of interest to note that our form can also be compared with the species *Psygmophyllum kidstoni* Seward from the Permo-Triassic of South Africa, and the veins of this latter species are also not anastomosed.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

GYMNOSPERMAE?

IV. CAYTONIALES

Genus *Sagenopteris* Presl

Sagenopteris spatulata sp. nov.

Pl. XXXV, figs. 1, 1a.

A specimen of a *Sagenopteris*, figured in Pl. XXXV, figs. 1, 1a appears to belong to a new species on account of the spatulate shape of the leaflets.

Frond petiolate, bearing four spatulate leaflets. Petiole stout and smooth, without any markings, attaining a breadth of 2.5 mm, length of petiole unknown, estimated at 6–7 cm. Leaflets spatulate, more or less oblong-lanceolate, attaining a length of 6.5 cm and a maximum breadth of 18 mm, with the broadest part at one third below the apex, gradually tapering to the narrow base measured about 2–2.5 mm broad. Leaflets from the broadest part (i. e. from one third below the apex) more abruptly budged to a breadth of about 11 mm and then again gradually narrowing toward the obtusely rounded apex. Margin entire. Venation indistinct, midrib seems to be distinct and can be traced almost up to the apex, occasionally evanescent and dissolving into lateral veins. Lateral veins very fine and dense, given off from the midrib at very acute angles, arching and spreading forwards and outwards, repeatedly anastomosing into long and elongated meshes.

As has been stated in the diagnosis given above, the midrib of some leaflets of our species seems to be distinct and can be traced almost up to the apex, and in some leaflets it is very indistinct, evanescent and dissolving into lateral veins. In this respect, the present form is similar to the species *Sagenopteris nilssoniana* Brongn. sp. The existence of a real midrib of this Swedish species has often been denied by many authors, and Salfeld claims to have discovered a distinct midrib in specimens of Theta. According to Halle, the older figures of this species given by Nilsson leave hardly any doubt in this respect and many of the specimens from Hoer show a perfectly distinct midrib which often reaches nearly to the apex. The final conclusion reached by Prof. Halle in this respect is that the dévelopment of a midrib is subject to great variation in *S. nilssoniana* as well as in other species of *Sagenopteris* generally, and is not of much value as a distinction of species (see Halle 1910b, p. 7). In our collection there is a very fragmentary detached leaflet which shows a very distinct and comparatively stout midrib (see Pl. XXXV, figs. 2, 2a). Since this specimen was found from another locality and from a bed slightly lower than the specimen here described as *S. spatulata* sp. nov., the writer thinks that it is safer to regard it as a separate species at least for the present. It is however highly possible that this detached leaflet provisionally described as *Sagenopteris* sp. might belong also to the species *S. spatulata.*

Among the known forms which show some similarity to the present example may be mentioned Nathorst's *Sagenopteris undulata* (see Halle 1910b, p. 4; Pl. I, figs. 1—5; Pl. III, figs. 1—5) in which however the leaflets are more lanceolate in shape with the broadest part almost at the middle, and are characterized by the undulating or dentate margin in the full-grown leaves. In the shape of leaflets, our specimen can also be compared with the species described by Du Toit from the Upper Karoo Beds of South Africa as *Sagenopteris longicaulis* (Du Toit 1927, p. 328, Textfig. 4). The shape of leaflets of this South African species is characterized also by the undulating or dentate margin, very similar to the Swedish species *S. undulata* Nathorst, but the leaflets are distinguished by a narrow and stalklike base attached to the petiole. There are some resemblances between specimens of our species and the specimens from Kamenka in the district of Izium described by Thomas as *Sagenopteris kamenkensis,* the leaflets of which, as described by Thomas, are somewhat irregular in shape, some apparently being lanceolate, but others having one or two large lateral lobes. Moreover, the margins are usually crenulated, the crenulations varying in size, and the larger ones giving rise to the lobes. The apex is acute, the leaflet tapering gradually towards it. It seems to the present writer that the other fragment of a detached leaflet discovered from the same region and described by Thomas as *Sagenopteris phillipsi* (Brongi.) is identical with *S. kamenkensis* (see Thomas 1911, p. 59—60; Pl. I, fig. 9 and figs. 10, 11).

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Sagenopteris sp.

Pl. XXXV, figs. 2, 2a.

A very small fragment measuring only 22 mm in length represents evidently the lower portion of a leaflet of *Sagenopteris.* In spite of the small size, identification is fairly certain because of the characteristic venation shown by the fragment. The fragment is wedge-shaped, gradually tapering to the base. Venation very distinct, midrib comparatively stout and very distinct being 1 mm broad; lateral veins very fine, arising from the midrib at very acute angles, some lateral veins even more or less parallel to the midrib, repeatedly dichotomising and anastomosing into narrow and elongated or short and polygonal meshes.

As stated above, this fragment might belong to the species here described as *Sagenopteris spatulata* sp. nov. For the present purposes, the question of specific identification of this fragment with *S. spatulata* must be postponed, since this fragment was found from another locality and from a slightly lower horizon, and since the venation is more distinct and the midrib is more strong and distinct.

Locality: Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

V. GYMNOSPERMAE INCERTAE SEDIS

Form-genus *Desmiophyllum* (Lesquerx), Solms-Laubach

Desmiophyllum sp.

Pl. LIII, fig. 6.

A single specimen of band-like leaf may be mentioned under the generic name *Desmiophyllum*. The species has a length of 10 cm without being complete and has a maximum breadth of about 17 mm at the middle part of the leaf, tapering gradually to both ends. The leaf is therefore lanceolate in shape. It appears that in shape and size of the leaf, the specimen may belong to *Podozamites lanceolatus* f. *latior* Sze (1931, p. 28), formerly known as *Podozamites lanceolatus latifolius* Schenk (Heer 1876a, Fl. Foss. Arct. 4, p. 109; Pl. XXVI, figs. 5, 6, 8b–c). The form-genus or "Sammelgattung" *Desmiophyllum* is generally used for isolated Mesozoic ribbon-shaped or band-like leaves of unknown systematic position. In the sense of Lesquerx, the genus *Desmiophyllum* is probably a synonym for *Cordaites*, but as stated by Lundbland (1950, p. 49), the question of the exitence of Cordaitalean forms in Mesozoic time has been discussed by Florin, who studied the cuticular characters of several leaves of the *Desmiophyllum* type, but in no case found convincing evidence in favor of the assumption that the Cordaitales survived in the Mesozoic. The present material is too small to warrant a more extensive discussion of this question.

Locality: Wangchiahsü, Chinchien District, Shensi.

Horizon: The middle part of the Yenchang Formation.

VI. FRUCTIFICATIONS AND SEEDS

Genus *Swedenborgia* Nathorst

Swedenborgia cryptomerioides Nathorst

Pl. LI, figs. 1—3.

Several very well preserved specimens of *Swedenborgia* occur in the material, all of which appear to belong to *S. cryptomerioides* Nathorst. The best description of this species is given by Harris (1935, p. 107), he defined the species as follows:-

"The cones are caducous, and all that have been examined so far seem to be ripe and to have shed nearly all their seeds. The axis is slender and bears spirally arranged cone-scales but no other appendage. Each cone-scale has a slender stalk which becomes broader at the distal end and divides palmately into five almost equal rigid lobes. The lower surface is concave and a small outgrowth from the stalk, the bract scale, projects into the base of the concavity. On the ventral (upper) surface, which is convex, at the base of each of the five lobes are small upgrowths where the seeds were probably attached. In all specimens seen there are five of these upgrowths, and therefore conclude that the scale normally bore five seeds. The seed is oval and probably flat, the base is slightly hollowed, the margins bear a delicate wing, 0.5 mm wide, which ceases just below the apex leaving a notch which is occupied by the projecting micropyle. The seeds were inverted, the micropyle facing the cone-axis. A good deal of the irregularity in the branching of the cone-scale observed by previous authors is probably due to cleavage of the rock in a different plane from the one in which the sporophyll branches. The cuticle is rather delicate; it shows occasional stomata surrounded by an irregular ring of unspecialized subsidiary cells. The chief features recognized for the first time are the bract-scale and the five (seed-bearing?) upgrowths of the ovuliferous scale."

The best specimen in our collection figured in Pl. LI, fig. 1 and shown in magnification in figs. la and lb, agrees in the shape and size of the cones fairly well with those found from Eastern Greenland. The axis of our specimen is measured about 4 mm broad. It bears spirally arranged cone-scales without other appendages and each cone-scale has a slender stalk of about 1-1.5 mm broad and 1 cm long which becomes broader at the distal end and divides palmately into six almost equal rigid lobes measuring about 1 mm in breadth and 4–5 mm in length. The cone-scale are almost perpendicular to the axis. Two detached seeds can be seen on the right side of the cone (Pl. LI, fig. 1, S.). The seeds are ovoid in shape, attaining a breadth of 3 mm and a length of 4.5 mm. The impression of seed is flat, without any surface sculpture, but has a sharply defined border or wing about 0.5 mm broad. In shape and size, the seed agrees also fairly well with those found in close association with the cones from Eastern Greenland. Of special interest is the fact that on the upper part of our specimen, there are many detached cone-scales, the lobes of which are stretched horizontally and plainly into star-like impressions. There are some indications of the presence of a rigid midrib in the lobes. One of the most interesting points is that the number of the lobes is always six in the impressions. Each cone-scale of our form must therefore have borne six seeds. This feature seems to be somewhat different from the species found from E. Greenland, since each cone-scale of that species, as has been stated above, is divided into only five lobes and therefore bears only five seeds. This important difference may well incline us favorably to consider the possibility of separating our species from that of E. Greenland; but after a deliberation the writer is inclined to the view that this difference does not appear to be of sufficient importance for specific separation. It is quite conceivable that the discovery of more specimens from E. Greenland and Sweden may reveal similar cones which may bear cone-scales dividing into six lobes and may compel us to recognize more definitely the close agreement between the two forms. It is also possible that one lobe in our specimen might represent the slender stalk of the cone-scale.

As implied by its specific name, the species *S. cryptomerioides* resembles the recent genus ***Cryptomeria*** in its cone. The investigation of Harris shows that the agreement is very close, the main difference being that the cone-scale of *Cryptomeria* is more solid and its parts more intimately fused. Harris pointed out that this resemblance supports the suggestion which has been put forward by various authors that the lobing of the cone-scale of *Cryptomeria* is a primitive feature. Prof. Harris further pointed out (1935, p. 108): "It also resembles *Cheirolepis* (Hörhammer 1933), a conifer of the same age, and the Palaeozoic genus *Voltzia* (Walton 1929) in its lobed cone-scale, though it is readily distinguished from both — and indeed from nearly all conifers — by its long stalked cone-scales. Moreover in *Voltzia,* the lobing of the cone-scale is more elaborate; while in *Cheirolepis* the seeds are embeded in the scale. The resemblance is, however, important from an evolutionary point of view; it suggests that there was a large group of ancient conifers with cone-scales of elaborate structure, and it seems to me preferable to classify it with these fossil genera than with the modern Taxodineae or Podocarpaceae. If I am right in supposing that its leaves may be of the *Podozamites* type, any very close affinity with any known genus seems to be precluded."

In view of the fact that the species has been often found in close association with certain narrow leaved species of *Podozamites* of *P. schenki—P. agardhianus* group in E. Greenland, Prof. Harris is inclined to believe that this type of cones might belong to *Podozamites* (1935, p. 107). It is however very remarkable that in the present material, there are almost no typical specimens of *Podozamites* to be observed, although several well preserved specimens of *Podozamites* of the type of *P. lanceolatus* have been described by P'an from a few localities. Two type-specimens of Dr. P'an may be refigured here for the purpose of reference (Pl. LII, fig. 1; Pl. LIII, fig. 1). On the other hand, in our localities there are a great amount of specimens of the species *Glossophyllum? shensiense* often found in close association with the cones here described as *Swedenborgia cryptomerioides*. Both species are often found to be preserved on the same slab. On the left side of the same specimen of *S. cryptomerioides,* figured in Pl. LI, fig. 1, there is a bend-like leaf with parallel veins proved to be identical with *G. ? shensiense* (the photo of this species is already cut off in this figure), and on the back side of this specimen, there is a twig (or branch) of the species *G. ? shensiense* figured in Pl. XLIX, fig. 6. It seems however that these two forms might have no direct relations.

The species *Swedenborgia cryptomerioides* has been described by Ôishi and Yamasita (1935, p. 439, figs. 1—3) from the Nariwa Series of Japan, and by Sze from the Hsiangchi Coal Series of Western Hupei (Sze 1949, p. 37, Pl. XV, fig 28).

Localities: T'anhokou, near Shihlangmiao, Ichün District, Shensi; Ch'imochiao, near Hsinshüping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Genus *Stenorachis* Saporta

? *Stenorachis* (*Ixostrobus?*) *konianus* Ôishi et Huzioka

Pl. LI, figs. 4, 5.

The fragments shown in Pl. LI, figs. 4, 5 (Part and Counterpart) and fig. 6 probably belong to species different from that described above. These fragments were seen only in a very poorly preserved condition, and consequently their true nature can not be definitely fixed. They are probably of the nature of a cone, and may belong to the form described by Ôishi and Huzioka as *Stenorachis* (*Ixostrobus?*) *konianus* from the Nariwa Series of Japan. The species is defined by the two Japanese authors (1938, p. 97—98) as follows:—

"Under the comprehensive generic designation *Stenorachis* has been included a specimen in Pl. XI (V), fig. 7 which consists of a stout, woody central axis more than 3.5 cm long, 2 mm thick with some longitudinal striations (vascular courses?). To it appendages are attached at a right angle in the upper part and at a decreasing angle towards the proximal portion and spirally arranged, crowded, 7 mm long, 0.6–0.9 mm thick and bi-lobed at the apex towards which they increase in breadth gradually from the base somewhat decurrent to the central axis. Near the bottom of the lobes at the apex of each appendage is an indication of the presence of a small oval body which may indicate the presence of a microsporangium, but there is no proof of it. There are one or two thin, longitudinal ridges in each appendage which probably indicate vascular course."

Judging from the diagnosis given above, it is highly possible that the present specimens may be identical with this Japanese species. Since our specimens are too poorly and too indistinctly preserved to permit of a definite determination, they may be mentioned here as ?*Stenorachis* (*Ixostrobus?*) *konianus* Ô. et H. for the purpose of reference. It has been pointed out by Ôishi and Huzioka that the Japanese species bears a close resemblance to the form described by Harris as *Ixostrobus greenlandicus* from the *Thaumatopteris* Zone of Eastern Greenland. This Greenland species has been thought to be a male cone probably of *Podozamites*. The Japanese species is however distinguished according to the two authors, in having more thicker appendages and there is also a difference in the nature of the apex of the appendages which is more complicated in the Greenland specimens. According to Ôishi and Huzioka, the Japanese species resembles also *Ixostrobus siemiradzkii* Raciborski from Poland, but the latter species is more closely related to Harris' species. Finally, the two Japanese authors were inclined to the view that the better course to follow is to make use of the generic name *Stenorachis* which is non-committal in preference to the name *Ixostrobus*, and with this view the present writer is in complete accord.

More or less similar specimens have also been found from the Hsiangchi Coal Series of Western Hupei. Sze described the specimens as *Stenorachis lepida* Heer (Sze 1949, p. 33, Pl. XV, figs. 12, 13).

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Genus *Conites* Seward

Conites sp.

Pl. LVI, fig. 3.

Pl. LVI, fig. 3 shows an impression of strobili of uncertain affinity, but appears to be identical with the specimens described by P'an as "Problematicum" from the same formation. It has been pointed out by P'an that his specimens may probably belong to the coniferous fructification. With this view one can well agree. The present specimen is somewhat ovoid-oblong in shape, attaining a length of 3 cm and a breadth of 12 mm. The axis is not well distinct in our specimen. The specimen are embricated with small and fluxious scale-leaves. According to Dr. P'an (1936, p. 34), this form was found in association with *Noeggerathiopsis hislopi* and other narrow *Desmiophyllum* leaves in the locality Shataiping of Suite District, and in association generally with a kind of *Cordaites*-like leaves which are much larger and broader than *Noeggerathiopsis hislopi* in other localities. It seems to the present writer however that these cones are certainly no direct relation with the species here described as *Glossophyllum? shensiense* (=P'an's *N. hislopi*). The important fact worthy of notice is that in Dr. P'an's collection, there are also many *Cordaites*-like specimens of much larger and broader leaves which he did not figure and describe at that time. All these *Cordaites*-like leaves are included in the species *Glossophyllum? shensiense* in this memoir. It is possible that a part of the so-called "narrow *Desmiophyllum* leaves" which P'an did not describe and figure in 1936, might also belong to this species.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Locality: Shataiping, Suite District, Shensi.

Horizon: The middle part of the Yenchang Formation.

Locality: Kaokiaan, Suite District, Shensi.

Horizon: The lower part of the Yenchang Formation.

Genus *Carpolithus* Wallerius

Carpolithus spp.

Pl. LVI, figs. 8—14, 8a, 9a, 10a, 11a, 12a, 13a, 14a.

As remarked by Prof. Halle (1927, p. 212), a history of the generic name *Carpolithus* was given in 1920 by Nathorst (1920, p. 16) who showed that the name was first employed by the Swedish mineralogist Wallerius in 1847. In the great memoir 'Palaeozoic Plants from Central Shansi', Prof. Halle had adopted this provisional designation for a couple of forms which may be seeds, but which differ from all known types and are too obscure to warrant the creation of a new generic name. The writer follows this course and names all the present specimens collectively as *Carpolithus* spp. The objects are of different nature and probably represent at least two or three species. Many of them have a flat surface without any marked sculpture, but have a sharply defined border or wing about 0.5–1 mm broad. It is possible that some of them might belong to the Ginkgoales and some of them might belong to the Coniferales. A part of the specimens can be compared with those found from Eastern Greenland described by Harris (1935, Pl. 11, figs. 7—9) as *Allicospermum*. It is of interest to point out that the specimen in fig. 8, shown in magnification in fig. 8a is characterized by the presence of a small and obtuse "mucro" at the apex of the seed. It is highly possible that this type of seed may represent a new genus.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

PROBLEMATICA

Problematicum a

Pl. XXVIII, figs. 7—8.

In figs. 7, 8, plate XXVIII, the writer gives a representation of a plant which was found in the upper part of the Yenchang Formation. It occurs in the gray-greenish, hard and compact sandstone and is marked by a short or long elongated central body with rather smooth surface, and a well-defined border or wing of thin lamina with strongly folding surface. The nature of these specimens is entirely obscure. There is, however, a considerable resemblance in habit between some of the scale-leaves of the Cycadophyta. The objects are determined here under the heading of Problematicum, pending the discovery of more and better material from the localities. A determination of the present fragments or any closer comparison with any known forms is clearly impossible.

Locality: Ch'ilitsun, Yenchang District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Problematicum b

Pl. LVI, fig. 4.

Only a single specimen of this type preserved as an impression is available. The shape of the object is very peculiar and cannot be compared with any other known forms. The lower portion of the object is very plump and the upper part is characterized by the presence of a few slender and sharp, more or less falcate teeth. The shape of the whole object bears a superficial resemblance to the recent *Eleocharis*. The nature of this object is also very obscure. It is very much like the leaf-sheath of *Equisetites*, but as no nodes or stems are preserved, a definite determination is impossible. On the same slab, there preserved many detached leaves of the *Neocalamites* type.

Locality: Kiaochiaping, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Problematicum c (*Muscites* sp.)

Pl. LVI, figs. 5, 5a

The single specimen shown in Pl. LVI, figs. 5, 5a is naturally indeterminable, but has been figured because it shows a fairly close resemblance to the specimens described by many authors under the generic name *Muscites*. The name *Muscites* was originally founded by Brongniart, it represents certainly a form-genus or "Sammelgattung." Prof. Seward (1898, p. 238) defined this comprehensive genus as follows: "Stem filiform, simple or branched, bearing small sessile leaves, with a delicate lamina, without veins or with a single median vein, arranged in a spiral manner on the stem." According to the generic definition given by Seward, it appears that the present specimen may well belong to this genus. Of special interest is the fact that on the magnification-figure (Pl. LVI, fig. 5a), one can clearly notice the characteristic "Polsterbildung" of this genus. As remarked by Gothan, the "Polsterbildung" or "Polsterwuchs" can also be well seen on a Palaeozoic species *Muscites polytrichaceus* Renault et Zeiller from the "Oberen Prod. Carbon" of Commentry (Fl. foss. Commentry 1888, Pl. 41, 2—4). Regarding the systematic position of this Palaeozoic species, Gothan stated (1921, p. 36): "Sein Aeusseres is in der Tat sehr moosähnlich, auch zeigt sich deutlich bei der bei manchen Moosen so beliebte Polsterwuchs; indes ist die genaue systematische Stellung dieses Restes keineswegs sicher." In spite of the fact that the reproductive organs of this Palaeozoic species are still unknown, Prof. Seward believed that it should be referred to the Class Musci, he said for instance (1898, p. 239): "The authors of the species point out that the tufted habit of the specimens, their small size and the membranous character of the leaves, all point to the Musci as the class to which the plant should be referred in spite of the absence of reproductive organs." It seems to the present writer that this Palaeozoic species bears indeed a close resemblance to the recent Musci, but the evidence of relationship hardly amounts to proof, and the same can be said for the present specimen from the Yenchang Formation. Since the reproductive organs of our form are also unknown, it would seem that the better course to follow is to name the present specimen provisionally Problematicum c. (*Muscites* sp.).

There are also several species originally described as *Lycopodites* or *Selaginellites* and afterwards referred to the genus *Muscites* (e.g. Lesquereux's species *Lycopodites meeki* from the Coal-Measures of North America), but all these specimens do not appear to be at all convincing and cannot well be included as probable representatives of Palaeozoic Musci, as remarked also by Seward (1898, p. 240).

Many species of *Muscites* have been described in the Tertiary rocks, e.g. *Muscites torifolius* Caspary, *Muscites ferrugineus* Ludwig. . . . . . .etc. The latter species *M. ferrugineus* possesses a slender stem bearing crowded ovate-acuminate leaves. The capsules are cupshaped, borne on a short stalk, with a circular opening without marginal teeth. According to Seward (1898, p. 241), the evidence of this species is hardly strong enough to justify a generic designation which implies identity with a particular recent genus and it is a much safer plan to adopt the non-committal term *Muscites*, and finally he said: "Without having examined the type-specimen, it is impossible to express a definite opinion as to the accuracy of the description given by Ludwig; if the capsule is correctly identified, it is the oldest example hitherto recorded of a fossil moss-sporogonium." It seems that the most reliable fossil of the Class Musci in the Tertiary rocks is that described by Weber as *Hypnum lycopodiöides* refigured by Gothan and Weyland in their recently published "Lehrbuch der Palaeobotanik" (1954, p. 68, textfig. 48).

From Mesozoic rocks we have no absolutely trustworthy fossil mosses. It may be mentioned the fossil described as *Najadita* from the Liassic of England; but according to Gothan (1921, p. 36), even the determination of this fossil is questionable, it recalls more or less *Lycopodites* and *Sellaginellites*.

Locality: In the vicinity of the Yenchang city, Yenchang District, Shensi.

Horizon. The upper part of the Yenchang Formation.

ROOTS

Radicites sp.

Pl. LVI, figs. 6—7.

Radicites is a common name of the subterranean part of plant fossils, most of which belong to the *Equisetales*. Many similar specimens have been described by various authors as *Radicites, Pinnularia, Myriophyllites,* etc. The axis of our specimens may reach 4–5 mm broad, with irregularly arranged very small circular scars marking the point at which lateral appendages or rootlets are given off. The appendages or rootlets are filiform, only about 1 mm or less than 1 mm broad, with sharp and acute apex. There is but little evidence that any of the appendages are terminated in situ, since their appendages are spreading in the rock in various directions. In view of the fact that in our locality, there have been found numerous leaves, stems and pith-casts of *Neocalamites,* it seems evident that this type of roots belongs to this genus. The same is the case of the roots of the Palaeozoic *Equisetales* which show no distinguishing feature from those of the Mesozoic specimens. The Palaeozoic specimens are often grouped together under the designation *Pinnularia* Lindley and Hutton and are usually regarded as belonging to the genus *Calamites*.

More or less similar fossil roots have also been found from the Fangtze Coal Series in Eastern Shantung. They were described by Yabe and Ôishi as *Pityocladus shantungensis* (1928, p. 12; Pl. IV, figs. 2, 3) believing to be the shoots of the Coniferales. The two Japanese authors had compared their specimens with *Abietites* and *Laricopsis*. In a memoir published in 1933 entitled 'Beiträge zur Mesozoischen Flora von China', the present writer expressed the view that such comparison are of very little importance. He said for instance (1933b, p. 39): "Ohne Kenntnis der Zapfen und Kuticular-Structur is jeder Vergleich mit rezenten Coniferen natürlich zwecklos, abgesehen davon, dass es sich nicht um beblätterte Zweige sondern um Wurzeln handlet."

A perusal of palaeobotanical literature reveals the fact that many similar specimens of root-remains have been described as belonging to the shoots of the conifers. The specimens described by Thomas from Kamenka as *Abietites desifolia* (1911, p. 79; Pl. IV, fig. 16; Pl. V, fig. 12) and those described by Fontaine (1889, p. 233; Pl. 102, fig. 78; Pl. 103, fig. 234; 1905, p. 312, Pl. 73, figs. 11—14) as *Laricopsis longifolia* and *Laricopsis latifolia,* etc. from North America belong evidently to this type. All of them should be described as *Radicites* sp. The same is the case of the specimens described by Du Toit from the Upper Karoo Beds of South Africa as *Elatocladus* sp. (1927, p. 392. Pl. 23, fig. 4). Du Toit compared his specimens with the species *Palissya brauni* Endl. described by Schenk from Franconia in Germany. This is certainly not justified, as has been remarked by Sze in 1933, since Schenk's specimens (1867, Pl. 4, figs. 2—14) belong evidently to the conifers on account of the distinct leaf-cushions on the stems and on account of the presence of a distinct midrib in the leaves. In addition to these features, there are also cones and seeds as well as the knowledge of cuticular structures known in the Franconia species.

Some better preserved specimens of the present type have been found recently from the Jurassic of Western Kazakstan, Brick (1952, p. 60; Pl. 21, fig. 3) believed that these specimens are identical with the species *Equisetites* *hallei* Thomas. It is certain that these specimens represent root-remains of the *Equisetales*, but it would be rush to assume the identity of the root-remains with a particular species which are founded on the stem-remains. The writer therefore believes that it is a much safer plan to adopt the non-committal term *Radicites* also for the Kazakstan specimens.

Locality: T'anhokou, near Shihlangmiao, Ichün District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Genus *Taeniocladopsis* gen. nov.

The curious specimens described below as *Taeniocladopsis rhizomoides* cannot be referred to any existing genus of fossil plants. The shape of the plant and many of their details are clearly like those of the Devonian species *Taenioclada* (*"Haliserites"*) *decheniana* Kr. & Wld. and from this resemblance the writer derives the name for the genus. *Taenioclada decheniana* is described as showing not rarely the dichotomous bifurcations of the shoots, but it is not the case of the species of *Taeniocladopsis*. *Taeniocladopsis* is characterized by having many slender appendages still in position at the sides of the main axis. It appears therefore evident that this form is not a shoot, but may represent the subterranean part of plant fossils. The genus is at present monotypic, and the generic diagnosis is embodied in the description of the single species given below.

Taeniocladopsis rhizomoides sp. nov.

Pl. LIV, figs. 1—2; Pl. LV, figs. 1—4.

"Axis" of unknown length, long and linear with parallel sides, attaining a breadth of about 5–12 mm. Surface of the "axis" smooth, with a distinct midrib about 1 mm broad representing the central vascular bundle persisting from the base to the apex. Appendages or rootlets very slender and filiform, with an acute apex, measuring only about 1 mm in breadth and 3.5 cm in length, forming generally very wide angles with the rachis. Appendages seem not to be closely set. All the "axes" appear to be arranged on the same level.

It would seem probable that these specimens represent subterranean part of fossil plants and may well belong to *Neocalamites*. The three-specimens figured in Pl. LV, figs. 1—3 show clearly the bases of the "axes" attached to the rhizomes which are of the *Neocalamites* type. The internodes of the rhizomes are very short, measuring only about 1 cm in length. The ribs are not very distinct, in some cases they appear to alternate at the node.

In regard to the mode of attachment of the "axes", the present form bears a strong resemblance to the two Palaeozoic specimens figured by Prof. Jongmans in the great memoir dealing with the *Calamites* of Western Europe (Kidston & Jongmans 1915–1917, Pl. 140, figs. 1, 2). The "axes" of these Palaeozoic specimens seem to be more or less articulate, and there is no distinct midrib in the "axes". Judging solely from the illustrations, there seem to be no appendages attached to the "axes", or at least the appendages are very scanty in these Palaeozoic specimens.

Locality: Chowchiawan, Yenchang District, Shensi.

Horizon: Unknown.

CONCLUSION

I. BOTANICAL CHARACTER OF THE FLORA

The flora of the Yenchang Formation in Northern Shensi, as described in this memoir, comprises 62 recognizable forms. The following list is introduced to show the relation of the Yenchang species to one another and to recent forms. Names of species with doubtful affinities are accompanied by a question mark, or are placed in a group under the heading of Problematica at the end of the list.

Bryophyta

Thallites sp.

Pteridophyta

I. Articulatae

Equisetales:

Equisetites sarrani Zeiller
Equisetites brevidentatus Sze sp. nov.
Equisetites sthenodon Sze sp. nov.
Equisetites acanthodon Sze sp. nov.
Equisetites deltodon Sze sp. nov.
Equisetites? sp. (Cf. *E. rogersi* Schimper)
Equisetites sp. (Strobili of *Equisetites*)
Neocalamites carrerei (Zeiller) Halle
Neocalamites carcinoides Harris
Neocalamites brevifolius Sze sp. nov.
Neocalamites rugosus Sze sp. nov.
Neocalamites sp.
Neocalamites? sp.

II. Filicinae

1. Eufilicales

Osmundaceae

Cladophlebis (*Todites*) *shensiensis* P'an

Matoniaceae

Phlebopteris? linearifolia Sze sp. nov.

2. Filicales Incertae Sedis

Cladophlebis cf. *gigantea* Ôishi
Cladophlebis raciborskii Zeiller
Cladophlebis kaoiana Sze sp. nov.
Cladophlebis graciles Sze sp. nov.
Cladophlebis ichünensis Sze sp. nov.
Cladophlebis stenophylla Sze sp. nov.
Cladophlebis paralobifolia Sze sp. nov.
Cladophlebis suniana Sze sp. nov.
Cladophlebis sp. a.
Cladophlebis sp. b.
Sphenopteris sp. (Cf. *Sph. arizonica* Daugherty)
Sphenopteris? chowkiawanensis Sze sp. nov.
Undetermined Sterile Pinnae

3. Marattiales

Marattiaceae

Danaeopsis fecunda Halle
Danaeopsis? sp.

4. Marattiales?

Bernoullia zeilleri P'an

Cladophlebis (Asterotheca?) szeiana P'an

Gymnospermae

I. Pteridospermae

Thinnfeldia rhomboidalis Ettingshausen

Thinnfeldia major Raciborskii

?*Thinnfeldia nordenskiöldi* Nathorst

Thinnfeldia rigida Sze sp. nov.

Thinnfeldia alethopteroides Sze sp. nov.

Thinnfeldia laxusa Sze sp. nov.

Ctenopteris sarrani Zeiller

?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)

II. Cycadophyta

Sphenozamites changi Sze sp. nov.

Drepanozamites? P'ani Sze sp. nov.

Sinozamites leeiana Sze gen. et sp. nov.

III. Ginkgophyta

Ginkgoites chowi Sze sp. nov.

Ginkgoites sp.

Glossophyllum? shensiense Sze sp. nov.

Sphenobaiera crassinervis Sze sp. nov.

?*Sphenobaiera furcata* (Heer) Florin

Psygmophyllum? sp.

IV. Caytoniales

Sagenopteris spatulata Sze sp. nov.

Sagenopteris sp.

V. Gymnospermae Incertae Sedis

Desmiophyllum sp.

VI. Fructifications and Seeds

Swedenborgia cryptomerioides Nathorst

?*Stenorachis (Ixostrobus?) konianus* (Ôishi et Huzioka)

Conites sp.

Carpolithus spp.

Problematica

Problematicum a.

Problematicum b.

Problematicum c. (*Muscites?* sp.)

Roots

Radicites sp.

Taeniocladopsis rhizomoides Sze gen. et sp. nov.

In his important memoir published in 1936, Dr. C. H. P'an described 15 species from the Yenchang Formation. It seems to the present writer that his ?*Schizoneura gondwanensis* Feistm. is probably identical with *Neocalamites carcinoides* Harris and his *Cladophlebis* cf. *roesserti* Zeiller agrees fairly well with *Cl. shensiensis* P'an. The discovery of numerous fertile specimens of *Todites*-type from the Yenchang Formation affords evidence in favor of assigning the species of Tonking to *Cl. shensiensis*. Zeiller identified his Tonking specimens with *Cl. roesserti* Presl but Presl's type specimen of this species is an indeterminable fragment. Harris referred the Tonking specimens to the species *Todites goeppertianus* (Münster) Krasser. It seems however that in regard to the shape of the pinnules and the pattern of venation, both the specimens of Tonking and Northern Shensi are not identical with this species. The other species described by P'an may be listed below: *Cl. shensiensis, Cl. szeiana, Cl.* cf. *gigantea, Cl. grabauiana, Bernoullia zeilleri, Danaeopsis fecunda* (=P'an's *Danaeopsis hallei*), *Protoblechnum hughesi* (*Feistm.*) Halle (=P'an's "*Danaeopsis*" *hughesi*), *Glossophyllum? shensiense* (=Pan's *?Noeggerathiopsis hislopi*), *Ginkgoites magnifolia, Podozamites lanceolatus* and *Conites* sp. (=Pan's Problematicum). The following three species are not described in the writer's monograph:

Cladophlebis grabauiana P'an

Ginkgoites magnifolia Fontaine

Podozamites lanceolatus (L. & H.) Braun

The Yenchang Flora hitherto described numbers 65 forms. The distribution of these 65 forms among the different groups is as follows (the numbers in brackets denote new species):

Bryophyta	1	(0)
Equisetales	13	(6)
Filicineae	20	(8)
Pteridospermae	8	(3)
Cycadophyta	3	(3)
Coniferales	0	(0)
Podozamitales	1	(0)
Ginkgophyta	7	(3)
Caytoniales	2	(1)
Fructifications and seeds	4	(0)
Plantae Incertae Sedis	1	(0)
Problematica	3	(0)
Roots	2	(1)
Total	65	(25)

The proportion of the different groups is on the whole what may be expected in a flora of the Older Mesozoic. The most dominent class of the Yenchang Flora is Filicineae in which the Filicales consists of 16 species and the Marattiales of 4 species. The Filicales and the Marattiales form about one half of the entire flora. The striking feature is the abundance of *Cladophlebis*-forms in regard to both species and individuals. Most of the *Cladophlebis*-forms are described as new species on the basis of leaf-impressions. Fructifications are rather scarce and the determination of species is therefore difficult. The sporangium-bearing specimens occur only in two species, one belonging to the *Todites* type and the other probably to the *Asterotheca* type. The species *Cl.* (*Todites*) *shensiensis* belongs certainly to Osmundaceae and the species *Cl.* (*Asterotheca?*) *szeiana* is probably a member of Marattiaceae. As has been pointed out by many previous authors, most of the known species of *Cladophlebis* might belong to Osmundaceae. It is therefore highly probable that, although proof is lacking, the large number of new species described in the present papar belong also to this family. Another form of fertile Fern-frond is a typical *Bernoullia*. No evidence can be brought forward to show the exact nature of the Sporangium or Synangium, but this peculiar type of fern belongs possibly to Marattiales, as has been believed by many authors (e. g. Hirmer 1927, p. 591). There are many beautifully preserved specimens of *Danaeopsis* in the collection. It is believed that all the specimens belong to one species, *D. fecunda* Halle, because of the fact that a very characteristic and well preserved fertile specimen was found a few years ago from the Yenchang Formation of Kansu Province (Sze & Lee 1951, p. 86—91; Pl. 1, figs. 5—9). Like the type-specimen of Scania, the whole surface of this fertile pinna is completely covered with the carbonized remains of the sporangia. The sporangia are free from each other right down to their base and are thus not fused together to form synangia. The individual sporangia are ellipsoidal in form similar to those of the Scanian specimen. At the apex of each sporangium, there is a slightly rounded depression, not very sharply circumscribed, but always distinct. There is no evidence that the wall of the sporangia is ever perforated at the apex. The cells of the sporangial wall appear to be uniform all over the sporangium, there can not be observed any differentiation of the tissure to indicate the existence of an annulus. *Danaeopsis fecunda* agrees most closely in the structure of its sporangia, borne on the long and narrow pinnae, with the recent Chinese marrattiaceous fern, *Archangiopteris*. The species belongs therefore undoubtedly to Marratiaceae. A new species, *Phlebopteris? linearifolia*, is described, which belongs most probably to the Matoniaceae.

The Equisetales occupies the second largest number among the flora. It consists of 13 forms with 6 new species. One of the new species named *Neocalamites rugosus* is of interest, from a botanical point of view, chiefly through the abundance of specimens with a marked zig-zag ornamentation of the outer surface of the cortex. This species agrees fairly well with *Calamites rugosus* Jongmans of the Westphalian age (Jongmans 1951, Sud-Oranais, Pl. 1, fig. 1). On the right side of a best preserved specimen, one can clearly notice the surface stem-feature of a *Neocalamites* type, so that our specimens can not be placed in the genus *Calamites*. The close resemblance of the zig-zag structure of the Palaeozoic and Mesozoic forms is indeed very interesting. Many new species of *Equisetites* have been described on the basis of leaf-sheath. All of them are more closely related to the Older Mesozoic known forms. The impressions of fructification found in the material are generally too indistinct for description; they have been described as *Equisetites* sp. (Strobili of *Equisetites*).

The "Mesozoic Pteridospermae" are represented by 8 species of *Thinnfeldia*, among which three new species have been described. Another few small pinna-fragments found in the collection are generally too imperfect for accurate determination, but they are undoubtedly identical with the species described by Zeiller as *Ctenopteris sarrani* from the Tonking Coal Field of Indo-China. A few very fragmentary specimens are here described under the name of *?Protoblechnum hughesi* (Feistm.) Halle (? sp. nov.); they possibly have nothing to do with the Gondwana species. The presence of abundant specimens of the *Thinnfeldia*-type both in species and individuals in the collection suggests also an Older Mesozoic age of the Yenchang Formation, since the *Thinnfeldia* type of plants played a prominent part in the Triassic-Rhaetic vegetation of the world, and in the form *Dicroidium*, distinguished by its forked fronds, is especially characteristic of the later Triassic floras of South Africa, South America and Australia. The genus *Ctenopteris* is founded on frond-like specimens with a broad axis giving off long lateral arms bearing broadly linear segments; these may be the large fronds of a Pteridosperm related to *Thinnfeldia* and to other Mesozoic genera, all of which have thick leaflets and none of them afford any convincing evidence of relationship to ferns, as remarked also by Prof. Seward.

Of the Cycadophyta, only three new species have been described. The new genus here described as *Sinozamites* is of particular interest, because it might represent a new leaf-type of the Bennettitales. The new species of *Sphenozamites*, *Sphenozamites changi*, is closely comparable to the known forms characteristic of the Triassic-Rhaetic. In regard to the size of frond and its segments, our species recalls *Sphenozamites rogersianus* Fontaine from the Upper Triassic (Keuper) Beds of Virginia. The genus *Sphenozamites* occurs first in an early Permian flora of France; it persisted through the Triassic to the latter part of the Jurassic Period. A different type of leaf is illustrated by a new species of *Drepanozamites?* with its very characteristic segments attached to a slender axis and with a more or less distinct midrib in the segments. The generic determination has been noted as somewhat doubtful, but the identity is highly probable. According to Prof. Harris (1937, p. 27), the species *Drepanozamites nilssoni* (Nathorst) Harris belongs to the Cycadales.

It was in the Triassic-Rhaetic floras that the class Ginkgoales first gained a strong position. In our collection the Ginkgoales are represented by four genera, *Ginkgoites*, *Sphenobaiera*, *Glossophyllum?* and *Psygomophyllum?*. The genera *Ginkgoites* and *Sphenobaiera* belong undoubtedly to this class, and the other two genera *Glossophyllum?* and

Psygmophyllum? are of more doubtful affinity. One of the most remarkable species of the Yenchang Formation in Northern Shensi is ***Glossophyllum? shensiense*** sp. nov. which was described by P'an in 1936 as *?Noeggerathiopsis hislopi* (Bunburg). According to Dr. P'an, the Yenchang species is identical with the specimens described by Zeiller under the same specific name (see P'an 1936, p. 32, Synonym-list). It is of interest to note that Seward and Sahni had determined some specimens found by Coggin Brown from the Rhaeto-Liassic beds of Yunnan as *Pelourdea zeilleri* Seward It is stated that this species is no doubt identical with Zeiller's supposed *Noeggerathiopsis hislopi from* Tonking (see Coggin Brown 1938, l. c.). In his classical paper published in 1943, Prof. Kräusel pointed out that the Tonking specimens might belong to his new genus *Glossophyllum*. It is noteworthy that a few similar characteristic stem-remains of *Glossophyllum florini* Kräusel from the Lunzer Keuper of Austria have been found in the present collection and the same stem-fossils were also found from the Tonking Coal Field. These specimens were believed by Zeiller also as "Rameau appartenant probabement au *Noeggerathiopsis hislopi*" (1903, Pl. XL, figs. 7—9). It appears to have escaped the notice of Prof. Kräusel that Seward and Sahni had already transferred the specimens from Tonking and Yunnan to the genus *Pelourdea* and that Prof. Halle in 1927 gave a "narrow definition" of this genus. In a paper published just a few months ago, the present writer expressed the view (Sze 1955b, p. 416) that *Glossophyllum* might be regarded as a natural genus and that *Pelourdea* is only a form genus or Sammelgattung. The relation of the two genera is just like that between *Walchia* and *Lebachia* as well as between *Phoenicopsis* and *Windwardia* etc. The Yenchang specimens may thus more appropriately be named *Pelourdea* (*Glossophyllum?*) *shensiense* Sze sp. nov. A more or less similar type of leaf has been recently found from the Upper Shihhotze Series of southeastern Shansi, the specimens being described by Sze as *Pelourdea hallei* sp. nov. (Scientia Sinica, Vol. IV, No. 3, 1955). The fact that only two veins placed side by side enter the stalk-like leaf-base of these Permian specimens is more closely comparable to the Ginkgoales.

The occurrence of Caytoniales in the collection is of some interest, though the specimens are fairly rare. Only two fragments of *Sagenopteris* type of leaves have been found. One specimen has been described as a new species, *Sagenopteris spatulata* and the other described as *Sagenopteris* sp. It is however quite possible that these two specimens belong to one species. No fructifications or seeds have been found in the material. The position in the plant-kingdom of this widely distributed Upper Triassic and Jurassic genus *Sagenopteris* has long been in doubt. It has been shown by Prof. Hamshaw Thomas that *Sagenopteris* is in all probability the foliage of plants which bore reproductive organs indicating affinity to the flowering plants. The genus *Caytonia* was first described by Thomas and was compared with the angiosperms, it has later been referred to by many writers as a Jurassic representative of angiosperms. Later investigators (e. g. Hirmer, Harris, etc) have shown that the genus *Caytonia* is essentially gymnospermous and most closely related to the Pteridospermae (see also Arnold "An Introduction to Palaeobotany", p. 243, 1947). In a recently published Lehrbuch, Prof. Gothan (1954, p. 325) expressed his view as follows: "Die Caytoniales und Verwandte sind nach dem Gesagten im Pflanzensystem schwierig unterzubringen und werden hier nur gewissermassen aus Verlegenheit bei den Gymnospermen mitbehandelt." The identity of the *Sagenopteris*-type of leaves and fertile parts has been established by the similarities in the structure of the stomata and epidermal cells of these organs.

Of the Coniferales, no definitely determined specimens have been discovered. The only existing fragment here described as *Conites* sp. is very poorly preserved and to some extent doubtful. The absence of any undoubted remains of Conifers is very striking, as the conifers mostly form a conspicuous feature of the Mesozoic floras. The absence of any remains of the Podozamitales in the present collection is also very surprising, since the genus *Podozamites* also forms mostly a conspicuous feature of the Upper Triassic and Jurassic floras. The single specimen here determined as *Desmiophyllum* sp. might probably represent a detached leaf-let of this genus. In Dr. Pan's memoir, many well-preserved specimens of the type of *Podozamites lanceolatus* have been described.

A number of detached seeds and fructifications are found in the material. Most of them are of obscure affinities. *Swedenborgia cryptomerioides* may belong to the Coniferales. As implied by the specific name, the shape of the cone-scales of this species is closely comparable to the recent genus *Cryptomeria*. Harris believed that this type of fructification might belong to the Podozamitales, because in Eastern Greenland, the specimens of ***Swedenborgia cryptomerioides*** are found in constant association with ***Podozamites***-leaves, and the stomata of ***Swedenborgia*** match fairly well those of two or three species of *Podozamites*. Harris also compared the genus ***Swedenborgia*** with ***Cheirolepis,*** a conifer of the same age and the Palaeozoic *Voltzia* in its lobed cone-scales. Regarding the systematic position of the genus ***Swedenborgia,*** Harris further pointed out: "The resemblance is, however, important from an evolutionary point of view; it suggests that there was a large group of ancient conifers with cone-scales of eleborate structure, and it seems to me preferable to classify it with these fossil genera than with the modern Taxodineae or Podocarpaceae. If I am right in supposing that its leaves may be of the *Podozamites* type, any very close affinity with any known genus seems to be precluded." (Harris, 1935, p. 108). The specimen here determined as *?Stenorachis* (*Ixostrobus?*) ***konianus*** Ôishi & Huzioka are too poorly preserved to permit definite generic reference and are therefore of very little botanical interest. The specimen of *Conites* sp. may belong, as stated above, to the Coniferales. The detached seeds found in the collection are collectively determined as *Carpolithus* spp. Some of them may belong to the Ginkgoales. It serves indeed no useful purpose to create specific names for these impressions. Under "Problematica" have been placed some forms of entirely obscure nature. The impression here described as Problematica c (*Muscites*? sp.) belongs probably to Bryophyta, But as the reproductive organs are unknown it has not been definitely placed in that class. Other specimens in the collection have been determined as *Thallites* sp. and might possibly represent the remains of a thalloid Liverwort.

A large number of root-remains are found in the collection. They are described as *Radicites* sp. and ***Taeniocladopsis rhizomoides*** gen. et sp. nov. Both of them may belong to the Equisetales. ***Taeniocladopsis*** is a very peculiar type of root-remains, especially through the arrangement of the appendages. It is different from any form previously known and has been described as a new genus; at present it is only known from the Yenchang Formation of Northern Shensi.

II. LOCALITIES AND VERTICAL DISTRIBUTIONS OF THE FLORA

Before entering on the discussion of the age and correlation of the Yenchang flora, it is desirable to enumerate briefly the plant localities and the vertical distributions of the species described in this memoir. The most extensive collections were made from two important localities: (1) T'anhokou near Shihlangmiao, Ichün District and (2) Ch'imochiao, near Hsinshüping, Ichün District.

I. Locality: T'anhokou near Shihlangmiao, Ichün District.

Horizon: The upper part of the Yenchang Formation.

Thallites sp.
Equisetites acanthodon Sze sp. nov.
Neocalamites carrerei (Zeiller) Halle
N. carcinoides Harris
N. rugosus Sze sp. nov.
N.? sp.
Cladophlebis szeiana P'an
Cl. shensiensis P'an.
Cl. cfr. *gigantea* Ôishi.
Cl. raciborskii Zeiller
Cl. kaoiana Sze sp. nov.
Cl. sp. a.
Cl. sp. b.
Phlebopteris? linearifolia Sze sp. nov.
Danaeopsis fecunda Halle
D.? sp.
Bernoullia zeilleri P'an

Ctenopteris sarrani Zeiller
?Protoblechnum hughesi (Feistm.) Halle (? sp. nov.)
Drepanozamites? p'ani Sze sp. nov.
Glossophyllum? shensiense Sze sp. nov.
Sagenopteris spatulata Sze sp. nov.
?Stenorachis (Ixostrobus?) konianus Ôishi & Huzioka
Swedenborgia cryptomerioides Nathort.
Carpolithus sp.
Conites sp.
Radicites sp.

The great majority of fossil plants from this locality were collected by the writer in a field trip to Northern Shensi in the winter of 1951. The fossils were collected from a bed of yellowish argillaceous shale at the uppermost part of the Yenchang Formation. All the fossils are preserved as impressions without any carbonaceous films which could be examined microscopically. About 27 forms were found from this locality. The most important of these species is *Cladophlebis shensiensis* which occurs very abundantly in this bed. Other very characterstic plants are *Cladophlebis szeiana, Cl. raciborskii, Danaeopsis fecunda, Bernoullia zeilleri, Ctenopteris sarrani, Glossophyllum? shensiense, Neocalamites carcinoides, N. carrerei, N. rugosus.* etc. The presence of the species *Neocalamites rugosus* in this locality is of particular interest, since this species in regard to the zigzag ornamentation of the outer surface of the cortex agrees in all respects with *Calamites rugosus* Jongmans from the Westphalian age. The occurrence of *Sagenopteris, Swedenborgia, Bernoullia, Danaeopsis* and *Glossophyllum?* also deserves special notice; the last mentioned 3 genera are the most important index fossils of the Middle Keuper (Lunzer Keuper and Basler Keuper) of Europe. *Ctenopteris sarrani* is a very characteristic fossil plant of the Tonking Coal Series in Indo-China. The material is insufficient for definite determination, but the species is so characteristic and easily recognized that even these imperfect fragments can be assigned to it without any hesitation. The specimens of *?Protoblechnum hughesi* (Feistm.) Halle (? sp. nov.) found from this locality are very fragmentary, but they agree fairly well with the better material described by P'an from the Yenchang Formation. It is one of the most characteristic elements of the Gondwana flora, and if the generic determination of our specimens is correct, it can be regarded as a relic of the Palaeozoic forms. The specimens found from the Yenchang Formation can be equally well determined as *Protoblechnum wongii* Halle which is a characteristic species of the Upper Shihhotze Series of China. It is probable that the present specimens may belong to anather genus.

2. Locality: Ch'imochiao, near Hsinshüping, Ichün District.
   Horizon: The upper part of the Yenchang Formation.

Cladophlebis shensiensis P'an.
Cl. graciles Sze sp. nov.
Cl. ichunensis Sze sp. nov.
Cl. stenophylla Sze sp. nov.
Cl. suniana Sze sp. nov.
Bernoullia zeilleri P'an.
Thinnfeldia rhomboidalis Ettinghausen
Th. major Raciborski.
?Th. nordenskiöldi Nathorst.
Th. rigida Sze sp. nov.
Th. alethopteroides Sze sp. nov.
Th. laxusa Sze sp. nov.
Sphenozamites changi Sze sp. nov.
Sinozamites leeiana Sze gen. et sp. nov.
Ginkgoites chowi Sze sp. nov.
G. sp.
Glossophyllum? shensiense Sze sp. nov.

Psygmophyllum? sp.
Sagenopteris sp.
Swedenborgia cryptomerioides Nathorst

The horizon of this locality is slightly lower than that of the preceding one. The plant fossils were found from a grayish and slightly greenish sandstone bed. Among the species found from this locality the following are most common and most important: *Bernoullia zeilleri, Glossophyllum? shensiense, Sphenozamites changi, Sinozamites leeiana* and many species of *Cladophlebis* and *Thinnfeldia.* The most interesting of these species is *Sinozamites leeiana* which may represent a new leaf-type of the Bennettitales. Among the species described as new, *Sphenozamites changi* is closely comparable to the known forms characteristic of the Upper Triassic. This species, though, no doubt, a distinct one, is similar in the size of the leaf to *Sphenozamites rogersianus* Fontaine which is known only from the Middle Keuper of Virgina, North America. The occurrence of many species of both *Cladophlebis* and *Thinnfeldia* from this locality claims special attention. All these new species afford evidence of considerable weight, they seem to be more closely related to the Upper Triassic known forms. The form here described as *Psygmophyllum?* sp. is also a very peculiar plant. The fossil plants of this locality were collected by the writer in 1951.

3. Locality: Kiaochiaping, Ichün District.
   Horizon: The upper part of the Yenchang Formation.

Equisetites deltodon Sze sp. nov.
Neocalamites sp. (only isolated detached leaves)
Problematicum b.

The specimens of this locality were collected by Mr. C. S. Huang in 1950. This locality has yielded only three forms, one of which, *Equisetites deltodon* Sze sp. nov. is significant. Similar known forms of *Equisetites* are almost exclusively confined to the Triassic, especially Upper Triassic.

4. Locality: Ch'ilitsun, Yenchang District.
   Horizon: The upper part of the Yenchang Formation.

Equisetites sarrani Zeiller
E. sp. (Strobili of *Equisetites*).
Neocalamites carcinoides Harris.
N. brevifolius Sze sp. nov.
Cladophlebis szeiana P'an.
Cl. shensiensis P'an.
Cl. cfr. *gigantea* Ôishi
Sphenopteris sp. (cf. *Sph. arizonica* Daugherty).
Problematicum a

All the specimens of this type-locality were sent to the writer for determination by the Director of the China Petroleum Administration. The matrix of the specimens is grayish and slightly greenish compact sandstone. According to the lithological character, the plant bed of this locality corresponds more or less to that of the locality Ch'imochiao, near Hsinshüping of the Ichün District and belongs also to the upper part of the Yenchang Formation. *Neocalamites carcinoides* occurs very abundantly in the locality. Many specimens of this species are beautifully preserved. Of other species, especially *Cladophlebis shensiensis* and *Cl. szeiana* were found a great number of specimens. *Cl.* cfr. *gigantea* Ôishi which is almost absent in other localities, is represented by a few good specimens in the material of this locality. *Sphenopteris* sp. is represented by a few indeterminable fragments, but in the shape of the pinnules, this form recalls more or less *Sph. arizonica* D. from the Upper Triassic of Arizona, North America. *Neocalamites brevifolius* is a new species only known in this locality. The specimens here described as Problematicum a. might probably belong to the Cycadophyta.

5. Locality: Yehchiaping, Suite District.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis shensiensis P'an
Cl. szeiana P'an
Cl. grabauiana P'an
Thinnfeldia rhomboidalis Ettingshausen
?*Th. nordenskiöldi* Nathorst
?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)
Podozamites lanceolatus (L. & H.) Braun
Danaeopsis fecunda Halle

The fossil plants were fully described by P'an in 1936. The most noteworthy exception of this locality is the presence of *Podozamites lanceolatus* and *Cladophlebis grabauiana*. Both species have not yet been found from the other localities of the Yenchang Formation.

6. Locality: "Schlucht beim Dorfe San-schi-li-pu", Suite District.

Horizon: Probably belong to the upper part of the Yenchang Formation.

?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)
Glossophyllum? shensiense Sze sp. nov.

This locality has a special historical significance, because it was visited by Prof. Obrutschew in 1893—94. The specimens collected by him were described by Krasser in 1900 under the names of *Danaeopsis hughesi* and ?*Noeggerathiopsis hislopi*. Krasser's identification of these specimens has long been the cause of too much speculation on the occurrence of a Gondwana flora in Northern China. The specimens collected by Prof. Obrutschew are indeed too imperfect for accurate determination, as has been repeatedly discussed by many authors (Gothan 1915, p. 270; Halle 1927, p. 138; Sze 1931, p. 7; Gothan & Sze 1933, p. 29 etc.)

7. Locality: Yenwukou, Yenchang District.

Horizon: The upper part of the Yenchang Formation.

Cladophlebis shensiensis P'an

From this locality, only one species has been sent by the Director of China Petroleum Administration to the writer for examination.

8. Locality: Hungchiatsunkou, Yenchang District.

Horizon: The upper part of the Yenchang Formation.

Neocalamites rugosus Sze sp. nov.

This locality yields only one species, which, however, is a very characteristic plant of the Yenchang Formation. In regard to the zigzag feature of the stem, this species recalls *Calamites rugosus* Jongmans from the Westphalian age. On the right side of the stem figured on Pl. VIII, figs. 1, 1a, one can clearly notice the fine ribs of the *Neocalamites* type. The species has also been found from the locality T'anhokou, near Shihlangmiao of the Ichün District.

9. Locality: Hsükoutsun, Yenchang District.

Horizon: The upper part of the Yenchang Formation.

Neocalamites sp.
Glossophyllum? shensiense Sze sp. nov.

The specimens of this locality were collected by the geologists of the China Petroleum Administration.

10. Locality: In the vicinity of the Yenchang City, Yenchang District.

Horizon: The upper part of the Yenchang Formation.

Problematicum c. (*Muscites?*)

This locality yields only a few indeterminable fragments of obscure nature. The fragments show a certain superficial resemblance to the forms referred to *Muscites* by many authors, but there is probably no real relationship.

11. Locality: Outside of the Chinchien City, Chinchien District.

Horizon: The middle part of the Yenchang Formation.

Bernoullia zeilleri P'an

Only one species was found by P'an from this locality, but it is a very characteristic plant of the Yenchang Formation, although it occurs also in the basal part of the overlying Wayaopu Coal Series.

12. Locality: Wangchiahsü, Chinchien District.

Horizon: The middle part of the Yenchang Formation.

Demiophyllum sp.

Only a single specimen has been found. It is highly possible that this specimen may represent a detached leaflet of *Podozamites*. In regard to the size and shape of the leaflet, it might probably belong to *Podozamites lanceolatus* form a *latior* Sze (see Sze 1931, p. 28).

13. Locality: Huailingping, 5 li west of the Yenchang City, Yenchang District.

Horizon: The middle part of the Yenchang Formation.

Cladophlebis szeiana P'an

This characteristic species of the Yenchang Formation was made known by P'an in 1936 from this locality. P'an described also a few specimens from the locality Yehchiaping of the Yenchang District.

14. Locality: Shihchiakou, Yenchang District.

Horizon: The middle part of the Yenchang Formation.

Cladophlebis shensiensis P'an

P'an described also a few specimens of this species from this locality.

15. Locality: Shataiping, Yenchang District.

Horizon: The middle part of the Yenchang Formation.

Cladophlebis cf. *gigantea* Ôishi
Cladophlebis shensiensis P'an
Glossophyllum? shensiense Sze sp. nov.
Conites sp.

All the specimens found from this locality were described by P'an in 1936. The species *Glossophyllum? shensiense* Sze was determined by P'an as ?*Noeggerathiopsis hislopi* (Bunburg) and the form *Conites* sp. was described by him as Problematicum.

16. Locality: Kaochiaan, Suite District.

Horizon: The lower part of the Yenchang Formation.

Ginkgoites magnifolia (Fontaine)
Danaeopsis fecunda Halle
Cladophlebis shensiensis P'an
?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)
Conites sp.

These five species were also described by P'an in 1936. *Danaeopsis fecunda* Halle was regarded as a new species (*D. haller* P'an) at that time, and later P'an agrees with the writer to refer his new species to *Danaeopsis fecunda* because a very characteristic fertile specimen of this species has been found from the Yenchang Formation of the Kansu Province. The specimens of ?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.) and *Conites* sp. were determined by P'an in 1936 as "*Danaeopsis*" *hughesi* Feistm. and Problematicum respectively.

17. Locality: Chiaoshang, Suite District.

Horizon: The lower part of the Yenchang Formation.

Cladophlebis shensiensis P'an

This locality yields only one characteristic species. The single very fragmentary specimen was figured on Pl. IV, fig. 16 in Pan's memoir. Several better preserved specimens were figured in figs. 11—15 on the same plate as *Cladophlebis* (*Todites*) cf. *roesserti* Zeiller (non Presl). These specimens belong evidently to *Cl. shensiensis.*

18. Locality: Laoyakuan, Chinchien District.

Horizon: The lower part of the Yenchang Formation.

Neocalamites sp.

The specimens were collected by Mr. S. Wang of the Institute of Palaeontology, Academia Sinica.

19. Locality: Yensuikuan, Yenchuan District.

Horizon: The lower part of the Yenchang Formation.

Danaeopsis fecunda Halle.

The specimens of this locality were collected by Mr. S. Wang.

20. Locality: Taweiping, Chiahsien District.

Horizon: The lower part of the Yenchang Formation.

Danaeopsis fecunda Halle

Undetermined sterile pinnae.

The specimens were collected by Mr. S. Wang. Several sterile pinnae of *Danaeopsis fecunda* Halle found from this locality are preserved very beautifully. One specimen has been figured on Pl. XXIX, figs. 1, 1a, 1b of this memoir.

21. Locality: Yük'ou, Chiahsien District.

Horizon: The lower part of the Yenchang Formation.

Neocalamites sp.

This locality was visited also by Mr. S. Wang in 1952. Wang collected only a few specimens of this characteristic genus.

22. Locality: Kaoyenti, Tungchuan District.

Horizon: The basal part of the Yenchang Formation.

Equisetites? sp. (cf. *E. rogersi* Schimper)

A few very small fragments of this form were collected by the writer's friend, Dr. C. Y. Lee. The specimens though naturally indeterminable are of some interest, because they seem to represent the remains of the leaf-sheath of a distinct species of *Equisetites*. The fragments might be compared with the leaf-sheath of *Equisetites rogersi* Schimper described by Fontaine from the Virginia-Keuper of North America.

The following localities namely Loc. 23, Loc. 24, Loc. 25, Loc. 26 and Loc. 27 belong to Shansi Province. They are situated just on the Shansi and Shensi border. The great majority of the specimens were collected by Mr. S. Wang in 1952. The plant-bearing horizons belong apparently to the lower part of the Yenchang Formation. Some specimens of *Danaeopsis* are well-preserved. Many indterminable specimens of *Neocalamites*-stem have also been found. A few specimens of *Equisetites brevidentatus* sp. nov. were found by Messrs. F. H. Chia and C. L. Kao in 1953.

23. Locality: Machiawan, Linghsien, District, Shansi.

Neocalamites sp.
Danaeopsis fecunda Halle.

24. Locality: T'ipapao, Linhsien District, Shansi.

Equisetites brevidentatus Sze sp. nov.
Danaeopsis fecunda Halle.

25. Locality: Lichiayao, Hsinghsien District, Shansi.

Equisetites sp. (Strobili of *Equisetites*)
Neocalamites sp.
Danaeopsis fecunda Halle.
?*Sphenobaiera furcata* (Heer) Florin.

This locality yields the single specimen here determined as ?*Sphenobaiera furcata* (Heer) Florin. This specimen, though very fragmentary, is of special interest, because it is the sole one in the whole material of the Yenchang Formation to have preserved the carbonaceous films, and to be feasible for microscopical examination.

26. Locality: Chuanchiaochên, Shihlou District, Shansi.

Neocalamites sp.

27. Locality: Wumeng, Yungho District, Shensi

Danaeopsis fecunda Halle.

28. Locality: Santzuhokou, Chungyang District, Shansi.

Neocalamites sp.

The specimens of the following localities Nos. 29, 30, 32, 33, 34, 35, 36 were collected by the geologists of the Petroleum Administration. The exact stratigraphical horizon from which the fossils were collected is unknown.

29. Locality: Pemafang, Linyü District, Shensi.

Danaeopsis fecunda Halle.

30. Locality: Fangêrhshang, Yaohsien District, Shensi.

Equisetites sthenodon Sze sp. nov.
Danaeopsis fecunda Halle.

31. Locality: South of Hsiaomaho, Yaohsien District, Shensi (Collector: C. Y. Lee).

Danaeopsis fecunda Halle.

32. Locality: Pingti, Shunhwa District, Shensi.

Danaeopsis fecunda Halle.

33. Locality: Yenan District (exact locality unknown), Shensi.

Cladophlebis paralobifolia Sze sp. nov.
Thinnfeldia major Raciborski

34. Locality: Ihochen, Suite District, Shensi.

Equisetites sarrani Zeiller.

This locality belongs probably to the upper part of the Yenchang Formation.

35. Locality: Chowkiawan, Yenchang District, Shensi.

Sphenopteris? chowkiawanensis Sze sp. nov.
Taeniocladopsis rhizomoides Sze Gen. et sp. nov.

36. Locality: Huanglung District (exact locality unknown), Shensi.

Sphenobaiera crassinervis Sze sp. nov.
Insect-Wing (figured in Pl. LV, figs. 6, 6a in this memoir).

The material dealt with in this memoir was collected from about 36 different localities, distributed in different districts. It was not collected from one general section, so that it is impossible to divide the plant-bearing horizons of the whole formation in Bed 1, Bed 2, Bed 3 etc, etc. So far as the present knowledge goes, the horizons of most localities belong apparently to the upper part of the Yenchang Formation, while those of only a few other localities belong to the middle or the lower part of the formation. The vertical range of the species may be approximately given as follows:—

(1) The species belong to the upper part of the formation:

Thallites sp.
Equisetites deltodon Sze sp. nov.
Equisetites acanthodon Sze sp. nov.
E. sarrani Zeiller.
E. sp. (Strobili of *Equisetites*)
Neocalamites carrerei (Zeiller) Halle.
N. carcinoides Harris.

N. rugosus Sze sp. nov.
N. brevifolius Sze sp. nov.
N. sp.
N.? sp.
Cladophlebis shensiensis P'an.
Cl. szeiana P'an.
Cl. cfr. *gigantea* Ôishi.
Cl. raciborskii Zeiller.
Cl. grabauiana P'an.
Cl. kaoiana Sze sp. nov.
Cl. graciles Sze sp. nov.
Cl. ichunensis Sze sp. nov.
Cl. stenophylla Sze sp. nov.
Cl. suniana Sze sp. nov.
Cl. sp. a.
Cl. sp. b.
Phlebopteris? linearifolia Sze sp. nov.
Danaeopsis fecunda Halle.
D.? sp.
Bernoullia zeilleri P'an.
Thinnfeldia rhomboidalis Ettinghausen.
Th. major Raciborski
?*Th. nordenskiöldi* Nathorst.
Th. rigida Sze sp. nov.
Th. alethopteroides Sze sp. nov.
Th. laxusa Sze sp. nov.
Ctenopteris sarrani Zeiller.
?*Protoblechnum hughesi* (Feistm.) Halle (? sp. nov.).
Sphenozamites changi Sze sp. nov.
Sinozamites leeiana Sze Gen. et sp. nov.
Drepanozamites? p'ani Sze sp. nov.
Ginkgoites chowi Sze sp. nov.
G. sp.
Glossophyllum? shensiense Sze sp. nov.
Psygmophyllum? sp.
Sagenopteris spatulata Sze sp. nov.
S. sp.
Swedenborgia cryptomerioides Nathorst.
?*Stenoarachis* (?*Ixostrobus*) *konianus* Ôishi & Huzioka.
Carpolithus spp.
Conites sp.
Radicites sp.
problematicum a.
problematicum b.
problematicum c. (*Muscites?* sp.).

(2) The species belong to the middle part of the formation:—

Neocalamites carcinoides Harris.
Cladophlebis shensiensis P'an.
Cl. szeiana P'an.
Cl. cf. *gigantea* Ôishi.
Bernoullia zeilleri P'an.
Glossophyllum? shensiense Sze sp. nov.
Conites sp.

(3) The species belong to the lower part of the formation:—

Equisetites brevidentatus Sze sp. nov.
Equisetites? sp. (cf. *E. rogersi* Schimper).
Equisetites sp. (strobili of *Equisetites*).
Neocalamites spp.
Cladophlebis shensiensis P'an.
Danaeopsis fecunda Halle.
Undetermined Sterile Pinnae.
Ginkgoites magnifolia (Fontaine).
?*Sphenobaiera furcata* (Heer) Florin.
?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.).
Conites sp.

(4) The species belong to the unknown stratigraphical position of the formation:—

Equisetites sthenodon Sze sp. nov.
Cladophlebis paralobifolia Sze sp. nov.
Thinnfeldia major Raciborski.
Sphenopteris? chowkiawanensis Sze sp. nov.
Sphenobaiera crassinervis Sze sp. nov.
Taeniocladopsis rhizomoides Sze Gen. et sp. nov.

From the foregoing lists, it appears clear that the two most important and most characteristic species which occur in the lower part and extend up into the uppermost part of the formation are *Cladophlebis shensiensis* P'an and *Danaeopsis fecunda* Halle. It seems that *Cl. shensiensis* occurs not very abundant in the lower part of the formation, since it has been found only from two localities, namely, the localities Kaochiaan and Chiaoshang of the Suite district. On the other hand, *Danaeopsis fecunda* is a very common species in the lower part of the Yenchang Formation. It has been found from many localities. As stated on p. 171 in this memoir, it is highly possible that there are more than one species of this genus presented in the material, but judging from the size and shape of the specimens, it is difficult to describe them as different species at least for the present. The majority of the specimens are intermediate in size and form between two extremities and provide a fairly complete series of stages between the larger and the smaller types, so that the writer believes that we are justified in regarding all of them as belonging to one species. And because a typical fertile pinna of *Danaeopsis fecunda* Halle was found a few years ago from the Yenchang Formation of Kansu province, all the sterile specimens found from this formation in Northern Shensi have been regarded as belonging to this species. In venation, this species is somewhat different from the well-known species *Danaeopsis marantacea* Heer of the Upper Triassic of Europe. In a recent publication, P'an (1954, p. 211) reported that this species extends up into the basal part of the Wayaopu Coal Series. The same is the case of ?*Protoblechnum hughesi* which occurs in the lower part of the Yenchang Formation and extends up above the boundary of this formation into the basal part of the Wayaopu Series (P'an 1936, p. 24). The most noteworthy fact is that the specimens of *Neocalamites* appear abundantly almost in every plant-bearing horizons of the Yenchang Formation. Many *Neocalamites*-like stems have been found even in the underlying Shihchienfeng Series. It is possible that the specimens found in the Shihchienfeng Series might belong to *Calamites* (Sze 1952, p. 17—22). According to the vertical distribution of *Danaeopsis* in the Yenchang Formation, *Bernoullia* might also be found probably in the lower part of this formation in future investigations. In Europe, the vertical range of *Bernoullia* is exactly like that of *Danaeopsis*, both have been found in the lower and the middle part of the Upper Triassic (see Hirmer 1927, p. 592). In connection herewith, it should be remarked that the species *Bernoullia zeilleri* P'an occurs also in a slight higher horizon than the Yenchang Formation in Eastern Asia, it has been recorded from the Rhaeto-Liassic beds of the Tonking Coal Field in Indo-China (see Zeiller 1903, p. 34; Pl. 1, figs. 14—16 and P'an 1936, p. 26). Except the species *Cl. shensiensis,* there are no other species of *Cladophlebis* to have been found from the lower part of the Yenchang Formation, up to the present.

The characteristic species extending from the middle part to the upper part of the formation may be mentioned below:—

Neocalamites carcinoides Harris.
Cladophlebis shensiensis P'an.
Cladophlebis szeiana P'an.
Cladophlebis cf. *gigantea* Ôishi.
Bernoullia zeilleii P'an.
Glossophyllum? shensiense Sze sp. nov.

It seems evident at the first glance that the species found in the middle part of the Yenchang Formation are chiefly the most abundant forms of the upper part of this formation. It is to be expected that the species in the upper and middle parts may also be found from the lower part of the formation in the future investigations. The most abundant specimens of the Yenchang flora are clearly those of *Cladophlebis shensiensis, Danaeopsis fecunda, Bernoullia zeilleri* and *Glossophyllum? shensiense*. The remaining dominants in their apparently relative order are as follows: *Cladophlebis szeiana, Cl. raciborskii Neocalamites carcinoides*, the new species of *Cladophlebis* and *Thinnfeldia*, etc. Wherever fossil plants can be collected from a large number of scattered localities in a single formation, reliable information concerning relative abundance of species can also be derived from a consideration of those species which occur in the largest number of localities. The relative order of dominance from this point of view, summarized from the distribution of species at different localities (including those in Kansu Province) is as follows—

1. *Danaeopsis fecunda*	15	localities
2. *Cladophlebis shensiensis*	10	"
3. *Glossophyllum? shensiense*	6	"
4. *Cladophlebis szeiana*	5	"
5. *Bernoullia zeilleri*	5	"
6. *?Protoblechnum hughesi*	4	"

It should be remarked that the species *?Protoblechnum hughesi* (? sp. nov.) is more common in distribution than in individual abundance. On the other hand, there are many species such as *Cladophlebis raciborskii, Sphenozamites changi, Neocalamites carcinoides* and the species of *Thinnfeldia* which occur in great abundance only in one or two localities. Further discussion of the stratigraphical and floral problems of the Yenchang flora will be presented in the next chapters.

III. CORRELATION AND AGE OF THE FLORA

From what has been said above about the botanical character and the vertical distribution of the Yenchang flora, it is evident that the composition of this flora is quite different from the commonly known Rhaeto-Liassic and the Middle Jurassic floras in Eastern Asia and the whole world as well. The Yenchang Flora is characterized by a dominant assemblage of *Bernoullia zeilleri* and *Danaeopsis fecunda;* both species occur throughout the whole complex of the formation and from the majority of the fossil localities belonging to this formation. This flora is apparently older than the Tonking flora of Indo-China and the Pinghsiang flora of Central China; both are characterized by a dominant assemblage of *Dictyophyllum* and *Clathropteris* etc, The writer is quite prepared to agree with Dr. C. H. P'an that the Yenchang flora of Northern Shensi cannot be younger than the Rhaetic and older than the Keuper and that it is most probably mainly of Keuper — perhaps Middle and Upper Keuper — and the upper part of it is possibly Rhaetic. Dr. P'an concluded that the Yenchang formation in Northern Shensi may be tentatively designated as Keuper-Rhaetic in age, and with this view the present writer is in complete accord.

As far as the present knowledge goes, the Yenchang flora is more or less equivalent to the Lunzer Keuper of Austria and the Basler Keuper of Neuewelt, Switzerland. Both formations are characterized by a dominant assemblage of *Bernoullia, Danaeopsis* and *Glossophyllum* etc. and both belong to the Middle Keuper. The other new species described in this memoir, which show a close relationship with the characteristic forms of the Lunz and Basel floras may be mentioned: *Cladophlebis shensiensis* P'an. It is closely related to *Cl. rütimeyeri* Heer (Leuthardt 1904, p. 34; Pl. 15, figs. 1, 2) of Basal in regard to the shape of the pinnules and the pattern of the venation. The only difference between these two forms is that, in *Cl. shensiensis* the shape of the pinnules is much more varied than that of the pinnules of the latter species. As has been mentioned in the descriptive part of this memoir, there are considerable variations of the form and size of the pinnules displayed in *Cl. shensiensis* obtained from the Yenchang formation of Northern Shensi. But apart from minor differences, these two species might be classed under one morphological type. The specimen here described as *?Sphenobaiera furcata* (Heer) Florin bears a strong resemblance to the species of Basel which was first described by Heer (1865) as *Sclerophyllina furcata* and later transferred by the same author (1877) to *Baiera*. In 1936, Prof. Florin referred this species to *Sphenobaiera*. In 1943, Prof. Kräusel described many better preserved specimens from Basel finding that the epidermal and stomatal structure of this species belongs evidently to the *Sphenobaiera*-type. It is of interest to point out that the epidermal structure of our specimen can be compared more or less with that of the Basel species. The species described in the present memoir as *Ginkgoites chowi* sp. now. agrees fairly well with *Ginkgoites lunzensis* (Stur) Florin (see Kräusel 1943, p. 72; Pl. 1, figs. 1—8; Pl. II, figs. 1—8; Pl. III, figs. 1—5; text-figs. 6, 7) from Lunz, Austria, in regard to the size of the leaf with the coarse venation. It is highly possible that future investigations of our localities may reveal similar specimens of Lunz with the characteristic truncate segments (see Kräusel, 1943, p. 75, textfig. 1). The species *Cladophlebis szeiana* P'an in the present material, though no doubt a distinct one, is closely comparable with *Merianopteris angusta* (see Heer, 1877, p. 69, Pl. 24, figs. 7—12; etc.; Leuthardt 1904, p. 32; Pl. 18, figs. 1, 1a) of Basel. This species was also described by Krasser (1909, p. 108) in the Lunz flora. Krasser changed its specific name as *Asterotheca meriani* (Brongniart) Stur and placed the species *Asterocarpus virginiensis* Fontaine in the same Synonym-list. All geologists and palaeobotanists now generally agree that the age of the Virginia-Keuper of North America is equivalent more or less to the Basel Keuper and Lunzer Keuper in Europe and that all these three formations belong definitely to the Middle Keuper age. If the species *Asterocarpus virginiensis* Fontaine from the Virginia-Keuper is really identical with *Asterotheca meriani* (Brongn.) Stur (=*Merianopteris angusta* Heer) from the Basel Keuper and Lunzer Keuper in Europe, our species *Cl. szeiana* can also be compared with *Asterocarpus virginiensis* of North America and its fructification may also belong to the *Asterotheca* type. According to P'an (1936, p. 35, 36), our species is more closely comparable to the form *Asterocarpus virginiensis* var. *obtusilobus* of Virginia (Fontaine, 1883, p. 45, Pl. XXI, figs. 3, 4; Pl. XXIV, figs. 3—5; Pl. XXV, fig. 1). It seems to ths present writer that not only the sterile but also the fertile pinnae of our species recall closely those of the American species. *Cl. szeiana* is also similar to *Asterocarpus platyrachis* Fontaine 1883, p. 46; Pl. 49, fig. 2) of North America, which, according to Krasser (1909, p. 108), is also identical with *Merianopteris angusta* Heer of Europe, and can also be placed in the same synonym with *Asterotheca meriani* (Brongn.) Stur. The other species of the Yenchang formation which show a relationship to the Virginia flora of North America need also be mentioned. *Cladophlebis graciles* Sze recalls *Cladophlebis microphylla* Fontaine from the Virginia-Keuper (Fontaine, 1883, p. 51, Pl. XXVII, figs. 2, 2a), and it is also comparable with *Cl. pseudowhitbiensis* Fontaine from the same locality (Fontaine, 1883, p. 52, Pl. XXVII, fig. 4). In regard to the size of the pinnae, our *Sphenozamites changi* Sze is perhaps more closely related to *Sphenozamites rogersianus* Fontaine (1883, p. 80, Pl. 43, fig. 1; Pl. 44, figs. 1, 2; Pl. 45, figs. 1, 2) than to any other known fossil plants, in spite of the fact that the shape of the pinnae of the American species is somewhat different and that there are numerous globular prominences or dots between the nerves of this species. As explained by Fontaine, these dots do not seem to be anything but a fine granulation of the epidermis. Sometimes, owing to distortion from pressure, these dot-like elevations are drawn out into little bars which extend from nerve to nerve and look like transverse nerves. It is interesting that in regard to the size of the leaf, there are no known species of *Sphenozamites* which could be compared with *Sph. rogersianus* from the Virginia-Keuper and with *Sph. changi* from the Yenchang Formation. The form here described as *Equisetites*? sp. (cf. *E. rogersi* Schimper) resembles also *E. rogersi* (Fontaine 1883, Pl. II, figs. 1—3) from Virginia in regard to the shape and the size of the teeth of the leaf-sheath, though the evidence is not conclusive, it should probably be referred to the same genus. According to P'an (1936, p. 25), the specimens of *Danaeopsis* in the Yenchang flora bear a close resemblance to *Pseudodanaeopsis obliqua* (Emmons) Fontaine (Fontaine, 1883, p. 61, 116; Pl. XXXI, figs. 1, 2; Pl. LIV, fig. 8) and *Pseudodanaeopsis plana* (Emmons) Fontaine (Fontaine, 1883, p. 59, 116; Pl. XXX, figs. 1, 2, 2a, 3, 4, 4a; Pl. LIV, fig. 8), but in our species, the secondary veins are not so frequently anastomosed and the pinnae are also broader than those of Fontaine's species. Dr. Lundblad (1950, p. 17) is of the opinion that in the light of the evidence brought forward in the last decades even the filicinean affinities of the type of the Fontaine's genus seem very doubtful, on account of the features of the rather thick and coriaceous leaf-substances. Lundblad believes that the North American plant might in reality be a gymnosperm, and with this view, one can well agree (see also Sze & Lee 1951, p. 88). Finally, the species *Sphenobaiera crassinervis* sp. nov. bears also a certain resemblance to the American species *Sphenobaiera multifida* (Fontaine) Florin (see Fontaine 1883, p. 87; Pl. 46; Pl. 47, fig. 1). In any case, the points of resemblance between the Basel, the Lunz and the Virginia floras of Europe and America on the one side and the Yenchang flora of Northern Shensi on the other side as expressed in the number of related forms are quite significant.

In addition to the species closely similar to the characteristic species of Basel, Lunz and Virginia, there are some other forms which tend to give the Yenchang flora an aspect of the typical Keuper floras. All the new species of *Equisetites* such as *E. sthenodon, E. deltodon*........etc. are closely comparable with *Equisetites platyodon* Brongniart (Frentzen 1933, p. 37; Leuthardt 1904, Pl. XXI, figs. 1, 2), an index fossil of the Schilfsandstein (Middle Keuper) of Southern Germany and Northern Switzerland in regard to the size of the stem and the shape of the teeth of the leaf-sheath. In regard to the large size of the stem, the species *Equisetites arenaceous* Jäger, one of the most abundant plants of the Keuper formations (Lettenkohle and Schilfsandstein) in Europe can also be compared with the present new species of the Yenchang formation. The occurrence of the new species of *Neocalamites, Neocalamites rugosus* Sze sp. nov., in the collection is of special importance, since it bears an aspect of an older age of the Yenchang formation. This species agrees, in the marked zig-zag lines of the outer surface of the cortex, fairly well with the species described by Jongmans as *Calamites rugosus* of the Westphalian age (see Jongmans 1951, Süd-oranais Pl. 1, fig. 1). The presence of many specimens of this peculiar form in the Yenchang flora is of interest, and may afford evidence of considerable weight to the Older Mesozoic age of this formation.

The composition of the Yenchang flora bears also a striking resemblance to the two Upper Triassic or Keuper floras described recently by Brick from Western Kazakstan. The lower plant-bearing series is named the Курашасайская Series with a thickness of about 250—300 metres. It contains the following forms:—

Danaeopsis marantacea (Presl) Heer
Danaeopsis emarginata Brick
Danaeopsis bipinnata Brick
Danaeopsis angustipinnata Brick
Bernoullia aktiubensis Brick
Todites roesserti Zeiller
Polypodites cladophleboides Brick
Cladophlebis simplicinervis Brick
Cladophlebis tripinnata Tur-Ket ex Ms.
Equisetites arenaceus (Jaeger) Schenk
Lepidopteris ottonis (Goepp.) Schimper
Callipteridium remotum Brick
Aipteris nerviconfluens Brick
Thinnfeldia sp.
Taeniopteris angustifolia Schenk
Sphenozamites surakaicus Prynada ex Ms.
Yuccites spathulatus Prynada ex Ms.
Yuccites uralensis Prynada ex Ms.

Araucarites convexus Brick
Sagenopteris ilekensis Brick
Ixostrobus sp. cf. *I. groenlandicus* Harris
Swedenborgia cryptomerioides Nathorst

The upper series is called the **Курайлинская** Series with a thickness of about 40—45 metres. This formation has been regarded as a transitional horizon between the Upper Triassic and Lower Jurassic. According to Dr. Brick, this formation belongs also to the Upper Triassic. It contains the following forms:—

Xylomites zamitae Goepp.
Danaeopsis hughesi Feistm.
Bernoullia aktiubensis Brick
Todites roesserti Zeiller
Diplazites kazachstanicus Brick
Cladophlebis szeiana P'an
Cladophlebis aktiubensis Tur.-Ket. ex Ms.
Rhacophyllum pachyrhachis (Schenk) Schimper
Lepidopteris ottonis (Goepp.) Schimper
Taeniopteris ensis (Oldh.) Zeiller
Yuccites uralensis Prynada

From the foregoing lists, it appears evident that the Upper Triassic flora of the two horizons of Kazakstan is also characterized by a dominant assemblage of *Danaeopsis, Bernoullia* and *Glossophyllum* (=Brick's *Yuccites*) and also contains *Cladophlebis szeiana, Cl. shensiensis* (=Brick's *Todites roesserti*), *?Protoblechnum hughesi* (=Brick's *Danaeopsis hughesi*), *Swedenborgia cryptomerioides* and *Sagenopteris, Thinnfeldia, Sphenozamites, Ixostrobus, Equisetites, etc.* The two horizons of Kazakstan can therefore be undoubtedly correlated with the flora of the Yenchang formation. It should be however pointed out that some determinations of Dr. Brick can not be accepted as correct. From the examination of the published figures (Brick 1952, Pl. VII, figs. 1—7, fig. 106) the writer is convinced that her *Todites roesserti* Zeiller is undoubtedly identical with our *Cladophlebis shensiensis.* There are also considerable variations of the pinnules of the Kazakstan specimens. In regard to the pattern of the venation, the species of Kazakstan agrees fairly well with *Cl. shensiensis* and with *Todites roesserti* Presl described by Zeiller from the Tonking Coal Field. The writer has already pointed out (see p. 171) that Zeiller identified his Tonking specimens with *Cl. roesserti* Presl, but Presl's type specimen of this species is an indeterminable fragment. Harris referred Zeiller's specimens to the species *Todites goeppertianus* (Münster) Krasser. It seems that both the specimens of Tonking and Northern Shensi are not identical with *Todites goeppertianus.* The specimens described by Brick (1952, Pl. XV) as *Yuccites uralensis* Presl etc. are all but indistinguishable from *Glossophyllum? shensiense* and her specimens of *Danaeopsis hughesi* (1952 Pl. IV, figs. 1—6) are all indeterminable fragments similar to those found from the Yenchang formation. It is evident that the specimens of Brick can also be determined under the name of *?Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.). The species described by Brick as *Danaeopsis emarginata* (1952, Pl. 1, figs. 1—5) is very difficult to distinguish from our *Danaeopsis fecunda* and it is possible that her *D. marantacea* (1952, Pl. 1, fig. 6) belongs also to this species. There are also many specimens of a typical *Bernoullia* in the Kazakstan flora. In regard to the size and shape of the pinnae and especially in regard to the pattern of venation, the specimens described by Brick under the name of *Danaeopsis bipinnata* and *D. angustipinnata* (1952, Pl. II, figs. 3, 4; Pl. III, figs. 1—11) agree well with our *Bernoullia zeilleri* and it is highly possible that these specimens of Kazakstan belong to this species. The determination is all the more certain, when we found a few fertile specimens of this genus presented also in the Kazakstan flora (Brick 1952, Pl. V, figs. 9—11). The sterile specimens described as *Bernoullia aktiubensis* in the Kazakstan flora are however indeterminable and the same can be said for the specimens of *Callipteridium* and *Lepidopteris.* The determinations of all these forms are apparently doubtful. Finnally, it should be pointed out that the species *Cladophlebis aktjubensis* (Brick 1952, Pl. IX, fig. 4) in Kazakstan is very closely allied to our *Cl. ichunensis.*

There can, at any rate, be no doubt that the Upper Triassic Kazakstan flora is roughly contemporaneous with our Yenchang flora of Northern Shensi. In this connection, it is of interest to point out that in Western Kazakstan, the Upper Triassic formation is overlain unconformably by a coal series (the so-called Дженишке Series with a thickness of about 100 metres) which is undoubtedly the equivalent of the Lower and Middle Jurassic coal series in North China, and is also characterized by a dominant assemblage of ***Coniopteris hymenophylloides, Cladophlebis denticulata, Cl. whitbyensis, Cl. lobifolia, Phoenicopsis speciosa, Pityophyllum nordenskiöldi*** etc. This coal series has been regarded by Brick as belonging to the Middle Jurassic. The present writer is not quite prepared to regard it as proved, this coal series in Kazakstan, as has been stated above, is characterized by a dominant assemblage of the ***Coniopteris-Phoenicopsis*** elements and its geological age must be from the Lower to Middle Jurassic. It can be roughly correlated with the Wayaopu Coal Series (the upper part of which has now been called the Ishihtsun Coal Series) of Northern Shensi, the Tatung Coal Series in Northern Shansi as well as with the Mentoukou Coal Series of Peking, which it resembles in making the maximum of coal formation of the Jurassic period. The flora of this coal series of Kazakstan cannot be said to contradict this parallelization. For the purpose of comparison, the composition of this Jurassic flora in Kazakstan may be mentioned below:

Gleichenites sphenopteroides sp. nov.
Coniopteris hymenophylloides (Brongn.) Sew.
C. porcina Brick ex Ms.
C. sp. cf. *C. fursenkoi* Pryn.
Dictyophyllum sp.
Cladophlebis haiburnensis (L. et H.) Brongn.
Cl. whitbiensis Brongn. var. *punctata* Brick
Cl. sp. ex gr. *C. denticulata* (Brongn.) Font.
Cladophlebis lobifolia (Phill.) Brongn.
Equisetites ferganensis Sew. sensu lato)
E. hallei Thomas
Ptilophyllum cutchense Morris
Nilssonia vittaeformis Pryn.
N. compta (Phillips) Brongn.
Phoenicopsis speciosa Heer
Ginkgoites sp.
Feildenia sp.
Pagiophyllum peregrinum (L. et H.)
P. setosum (Phillips)
Pityophyllum angustifolium (Nath.) Möller
Podozamites sp.
Conites sp. a.
Conites sp. b.

It should be remarked that there are no typical elements of the Upper Jurassic and Lower Cretaceous *Ruffordia-Onychiopsis* flora of Eastern Asia in this Kazakstan coal series. This coal series cannot therefore be younger than the Middle Jurassic.

The Yenchang flora of Northern Shensi may also be roughly equivalent to the Upper Triassic flora of Arizona, North America. The percentage of species common to the two regions is not high, but the close relationship of the two floras is apparent. This Arizona Upper Triassic flora contains also the following genera: *Equisetites, Neocalamites, Cladophlebis, Danaeopsis* (Daugherty wrongly determined as *Ctenis arizonicus*), *Phlebopteris* (=Daugherty's *Laccopteris*), *Sphenopteris, Podozamites* etc. It appears that the species *Equisetites bradyi* of Arizona (Daugherty 1941, p. 61, Pl. 12, figs. 4, 5) is hardly distinguishable from our *Equisetites sarrani* and the species *Cladophlebis microphylla* (Daugherty 1941, Pl. 4, fig.) is very similar to our *Cladophlebis graciles*. *Sphenopteris arizonicus* agrees well with our *Sphenopteris* sp. and *Laccopteris smithii* is closely related to our *Phlebopteris linearifolia.* In addition, the specimen *Yuccites poleonsis* Daugherty (1941, Pl. 13, fig. 1) may belong to a species of *Neocalamites* and the specimen *Ctenis neuropteroides* Daugherty (1941, Pl. 14, fig. 3) may possibly be a *Danaeopsis* of the *Danaeopsis fecunda* type. This specimen should be determined under the name of *Danaeopsis?* sp. The specimen described by Daugherty (1941, Pl. 14, figs. 1, 2) as *Podozamites arizonicus* is apparently not a new species and in regard to the size and the shape of the leaves, these specimens are almost indistinguishable from certain forms of *Podozamites lanceolatus* (L. & H.) Broun. It is surprising to find in the list of species from the Arizona flora a species of *Coniopteris* which is one of the most typical European and cosmopolitan Jurassic forms. Daugherty stated that "the sterile fronds or sterile parts of the fronds of this species closely resemble *Sphenopteris nystroemii* described by Halle from the Permian of China, but the fertile fronds more closely resemble *Coniopteris hymenophylloides* Brongniart from the Jurassic." Judging solely from the illustrations (Daugherty 1941, Pl. 9, figs. 3—5), the present writer cannot express definite opinions, but it seems to him that the species of the Upper Triassic formation of Arizona is quite distinct from the Jurassic species *Coniopteris hymenophylloides* Brongn. and that these specimens might more appropriately be referred to the genus *Sphenopteris.* The Arizona flora contains also a typical Middle Keuper species of Virginia, that is *Lonchopteris virginiensis* Fontaine (Daugherty, p. 49, Pl. 5, figs. 4, 5; Pl. 6, figs. 1, 2). In habit, the frond of this American Keuper species agrees with *Cladophlebis whitbyensis,* but the lateral veins form an anastomosing system like that in the Palaeozoic genus *Lonchopteris.* Regarding the systematic position of this American Keuper species, Prof. Seward (1910, p. 332) pointed out: "Seeing that *Lonchopteris* is a designation of a purely provisional kind, it would be convenient to institute a new generic name for Triassic species having the *Lonchopteris* venation, which there are good reasons for regarding as Osmundaceous ferns." A more or less similar form was described by Leuthardt (1904, Pl. XVIII, figs. 2, 2a) as *Pecopteris* (*Lonchopteris*) *reticulata* from the Middle Keuper flora of Basel, Switzerland.

The composition of the Upper Triassic or Rhaetic flora of the Molteno beds, South Africa (Du Toit 1927, Vol. XXII, Pt. 2; 1939, p. 317) is somewhat different from that of the Yenchang flora. There are only two species in common i. e. *Neocalamites carrerei* Zeiller and *Ginkgoites magnifolia* (Fontaine). Other closely comparable forms may be mentioned: *Cl.* (*Todites*) *roesserti, Cl.* (*Todites*) *goeppertiana* and *Cl. nebbensis.* The first two forms may be compared with our *Cl. shensiensis,* and the last one recalls more or less our *Cl. ichunensis.* The specimens described as *Stenopteris elongata* are also more or less comparable with our specimen described under the name of ?*Sphenobaiera furcata.* It is interesting that in the Molteno beds of South Africa, there are also four or five species of *Thinnfeldia,* but most of these specimens might belong to the genus *Dicroidium* according to Prof. Gothan.

Our Yenchang flora seems also to have some species in common with the Scoresby Sound flora in Eastern Greenland. They are *Equisetites sarrani, Neocalamites carcinoides, Swedenborgia cryptomerioides* etc. It is striking that all these forms are found in the Lower Jurassic *Thaumatopteris* zone in Eastern Greenland, and only *S. cryptomerioides* can be found also in the *Lepidopteris* zone or in the transitional beds between the *Lepidopteris* zone and the *Thaumatopteris* zone. Other related or closely comparable forms between the Yenchang and Scoresby Sound floras are *Neocalamites hoerensis, Todites goeppertianus, Drepanozamites nilssoni* etc. Only *T. goeppertianus* is found in the transitional beds between the *Lepidopteris* zone and *Thaumatopteris* zone, while the other two forms are confined to the *Lepidopteris* zone. *N. hoerensis* is all but indistinguishable from our *N. carrerei, Todites goeppertianus* is a closely related species of *Cl.* (*Todites*) *shensiensis. Drepanozamites nilssoni* is somewhat distinct from *D.? p'ani* from the Yenchang formation, because the latter has a more or less distinct midrib in the segments. There are many *Podozamites* forms in the Scoresby Sound flora, most of which are found in the *Lepidopteris* zone. The majority of these forms belong to the type of *Podozamites lanceolatus* and are closely comparable with the specimens found in the Yenchang formation. In conclusion, the composition of the Yenchang flora is not exactly comparable with that of the Scoresby Sound flora. It is however highly probable that the uppermost part of the Yenchang formation corresponds to the *Lepidopteris* zone of Eastern Greenland.

There are also some common species between the Yenchang flora and the Mesozoic floras in Sweden. All these forms seem to occur in the higher horizon i. e. Lower Jurassic in Sweden. They are *Neocalamites carcinoides* (found from Scania), *Thinnfeldia nordenskioldi* (known in Palsjo), *Swedenborgia cryptomerioides* (known in Hör and Palsjo) and *Danaeopsis fecunda* (known in Scania) etc. Other closely related forms may also be mentioned e. g. *Neocalamites hoerensis, Todites goeppertianus, Drepanozamites nilssoni,* the species of *Sagenopteris, Phlebopteris* and *Podozamites* etc. It is evident that only the upper part of the Yenchang formation can possibly be correlated with the Rhaetic horizons of Sweden.

The Tonking Coal Series in Indo-China which is nearly equivalent to the Anyuan Coal Series in Pinghsiang, Kiangsi Province, and which is also characterized by a dominant assemblage of the *Dictyophyllum-Clathropteris* flora, comprises many important elements of the Yenchang flora, namely: *Equisetites sarrani, Neocalamites carrerei, Cladophlebis raciborskii, Bernoullia zeilleri, Ctenopteris sarrani* etc. It is also highly possible that Zeiller's *Noeggerathiopsis hislopi* is identical with *Glossophyllum? shensiense* in the Yenchang flora and his *Cladophlebis* (*Todites*) *roesserti* is identical with our *Cl.* (*Todites*) *shensiensis.* In addition, Zeiller's *Podozamites distans* recalls also *Podozamites lanceolatus* from the Yenchang formation. It is striking that the Yenchang flora has eight species in common with the Rhaeto-Liassic flora of Tonking. This surprising result may suggest the view that the upper part of the *Danaeopsis-Bernoullia* flora is probably equivalent in age to the lower part of the *Dictyophyllum-Clathropteris* flora. The species *Bernoullia zeilleri* is represented in the Tonking flora by very few small fragments which were described by Zeiller as *Bernoullia* sp. In Northern Shensi, this species occurs also very rarely in the basal part of the Lower Jurassic Wayaopu Coal Series which seems conformably to overlie the Yenchang formation. The deposition of these two formations in Northern Shensi appears to be continuous without interruption.

The plant remains from Nariwa District in Japan were first described by Yokoyama in 1891. In 1932, the late Prof. Ôishi described more than 80 species systematically and again in 1938, Ôishi and Huzioka added to the Nariwa flora a certain number of new species. The Rhaeto-Liassic aspects of the Nariwa flora in Japan is on the whole very strong as is shown in the analysis of the flora in comparison with the *Lepidopteris* and *Thaumatopteris* zones of Eastern Greenland (see Ôishi 1938 l. c.). According to the present writer, the Nariwa flora is nearly equivalent in geological age to the Tonking flora of Indo-China as well as to the Pinghsiang flora of Central China. It is also characterized by a dominant assemblage of the *Dictyophyllum-Clathropteris* flora. The writer is in complete agreement with Prof. Ôishi that the lower part of the Nariwa flora is of the Rhaetic age and that the upper part of it may belong to the Liassic. It should be pointed out that our Yenchang flora has also 5 or 6 species in common with the Nariwa flora, they are: *Cladophlebis gigantea, Cl. raciborskii, Neocalamites carrerei, Swedenborgia cryptomerioides, Podozamites lanceolatus* and probably also *Stenorachis* (*Ixostrobus?*) *konianus.* All these identical forms are confined to the upper part of the Yenchang formation.

Finally, it is of special interest to point out that the Yenchang flora in Northern Shensi comprises also a few identical forms of the Hsiangchi flora in western Hupeh of the Lower Jurassic age. The identical species of the two floras are: *Equisetites sarrani, Neocalamites carrerei, Ginkgoites magnifolia, Podozamites lanceolatus* and *Swedenborgia cryptomerioides.* Except the species *Ginkgoites magnifolia,* all other identical forms are found only in the upper part of the Yenchang formation. From the Hsiangchi Coal Series of Szechwan, there has been found another important identical species, *Cladophlebis raciborskii.*

Taken as a whole, the Yenchang flora of North and Northwest China is most closely related to the Middle Keuper floras of Europe and Northern America. It corresponds to the Lunzer Keuper of Austria, the Basler Keuper of Switzerland and the Virginia-Keuper of North America. The palaeobotanical evidence points generally to the conclusion that the fossil flora at present known from the Yenchang Formation is of the Upper Triassic age. It might indeed be classed as Keuper-Rhaetic, as Dr. P'an advocated.

IV. THE AGE OF THE MESOZOIC FORMATIONS OF NORTHERN SHENSI

The Mesozoic stratigraphy of Northern Shensi has been divided by Dr. C. H. P'an (1936, p. 7) into five formations in acsending order:—

(1) The Shihchienfeng Series, formed under arid conditions and composed of red-brown or chocolate-coloured claystones, sandy clays, marls and red brown sandstones. The thickness is estimated at about 750—1000 metres. The geological age of this series has been regarded by Dr. P'an in 1936 as possibly Permo-Triassic. In 1954, he agreed with the present writer that this series should be placed in the Upper Permian.

(2) The Yenchang Formation, consisting of essentially gray or grayish green cross-bedded sandstones intercalated with a few gray or grayish sandy shales and occasionally with oils. No workable coal seams have been found from this formation. The thickness, as has been estimated by P'an in 1936, is ca. 1000 metres. Recent field studies in Ichün District have shown that the thickness of this formation exceeds 1175 m. On the evidence of fossil plants, this formation is approximately equivalent to the Middle Keuper of Europe and North America. Dr. P'an designiated the age of this formation as Keuper-Rhaetic and with this view, one can well agree. The evidence on the geological age furnished by the fossil plants has been dealt with at some length in the foregoing chapters and will be briefly considered below.

(3) The Wayaopu Coal Series, consisting of gray sandstones, shales and black shales with coal seams in the lower part. The sandstones are not so frequently cross-bedded as in the underlying Yenchang Formation. The whole thickness is about 800 m. The evidence of fossil plants shows that this formation is equivalent to the Lower Jurassic coal series of North China. The upper part of the series can be regarded as possibly belonging to Middle Jurassic.

(4) The Anting Formation, consisting of red sandstones and shales in the lower part and thin-bedded argillaceous limestone in the upper part. It occurs in Hengshan, Chingpien, Anting, Fushih etc., forming a narrow belt in north-south direction. The total thickness is not greater than 100 m. The age of the formation is generally regarded as Upper Jurassic based ón the fish fossils (*Pholidophorus*). According to Mr. H. H. Lee, the Anting Formation of Northern Shensi is probably of the uppermost Middle Jurassic age.

(5) The Paoan Series, consisting of massive cross-bedded red sandstones intercalated with a few red shales at the lower part, and red sandstones and shales intercalated with green sandstones and shales at the upper part. The thickness of this formation is about 2000 m. In this series no fossil-remains have been observed. According to Dr. P'an, the series may be correlated with the Szechwan Series of the Szechwan red basin, and its age is Cretaceous.

Let us first briefly consider the age of the Yenchang Formation which has yielded the fossil plants described in the present memoir. As has been discussed in the foregoing chapters,the palaeobotanical evidence points to the conclusion that the fossil flora at present known from the Yenchang Formation is of Upper Triassic age. On the evidence of fossil plants, the Yenchang flora is more or less contemporaneous with the floras of Lunzer Keuper of Austria, the Basler Keuper of Northwestern Switzerland, and the Virginia-Keuper of North America. It is possible that the lower part of this formation may represent the beginning of the Triassic in North and Northwest China and the uppermost part of this formation may represent the Rhaetic age. The Yenchang Formation might indeed be appropriately classed as Keuper-Rhaetic. The formation occurs only in Northern Shensi, Eastern and Western kansu and very recently it has been found also in Inner Mongolia (a part of former Ninghsia Province). As has been pointed out by the writer in the foregoing chapter, the Yenchang Formation of North and Northwest China can also be correlated with the Upper Triassic floras described by Dr. Brick in 1951 from Western Kazakstan. The recent discovery of the Yenchang Formation in Inner Mongolia is thus a matter of considerable importance, for this is a region between Kazakstan and North China.

The age of the Wayaopu Coal Series: Having placed the Yenchang Formation at the Upper Triassic, we should be quite safe in concluding that the overlying Wayaopu Coal Series is not older than Lower Jurassic. The species described by Dr. C. H. P'an are as follows (at the right are the revised names accepted in the present work).

Neocalamites cf. *carrerei* Zeiller=*Neocalamites carrerei* (Zeiller) Halle.
Neocalamites cf. *carcinoides* Harris =*Neocalamites carcinoides* Harris.
Equisetites cf. *sarrani* Zeiller=*Equisetites sarrani* Zeiller.
Coniopteris hymenophylloides Brongn.
Baiera cf. *lindleyana* (Schimper).
"Danaeopsis" hughesi Feistm. = *?Protoblechnum hughesi* (Feistm.) Halle (? sp. nov.).
Thinnfeldia nordenskiöldi Nathorst.

According to Dr. P'an (1936, p. 37 and Chinese Summary p. 4). the plant fossils described by Sze (1933, p. 77—86) from Fu-Ku District were found from the lower part of this series. The species discriminated by Sze are as follow:-

Sphenopteris diamensis (Seward) Sze.
Coniopteris hymenophylloides Brongn.
Coniopteris sp.
Cladophlebis (*Eboracia*) *lobifolia* (Phill.).
Cladophlebis cf. *arguta* (L. & H.) Halle.
Cladophlebis sp.
Phoenicopsis aff. *angustifolia* Heer.
Podozamites lanceolatus (L. & H.) Braun.
Elatocladus manchuricus (Yok.) Yabe.
Ctenis sp.
Nilssonia sp.

One of the most important species of the Wayaopu Coal Series is *Coniopteris hymenophylloides* Brongn. which occurs both in the lower and the upper parts of this series. No single fragment of this species has been hitherto found from the underlying Yenchang Formation. The species is the most important cosmopolitan Jurassic species. It persists through the whole Jurassic period and has a world-wide distribution. *Baiera lindleyana* is also one of the most important Jurassic index fossils. It was first described from the Inferior Oolite (Middle Jurassic) of Yorkshire, England, and was subsequently found from the Lias and Bathonian (Middle Jurassic) in various parts of the world. *Cladophlebis* cf. *arguta* and *Phoenicopsis* aff. *angustifolia* are also very typical Jurassic species and have not yet been found from any formations below the Jurassic. *Cladophlebis* (*Eboracia*) *lobifolia* is also a very characteristic Jurassic species. *Eladocladus manchuricus* is one of the most abundant Upper Jurassic plants of Northern Manchuria. In an unstudied collection coming to the writer's hand from the Upper Jurassic Chi-Si Coal Series of N. Manchuria, there is a great amount of beautifully preserved specimens of this characteristic species. But this species may have persisted through the whole Jurassic period in Eastern Asia. *Neocalamites carcinoides* is formerly known only in the *Thaumatopteris* zone of Eastern Greenland which is regarded by Harris to be mainly of basal Liassic age. It occurs also in the Liassic beds of Scania, Sweden. This species is now known also in the upper part of the underlying Yenchang Formation. Like *N. carcinoides*, the species *Thinnfeldia nordenskiöldi* occurs both in the upper part of the Yenchang Formation and the lower part of the Wayaopu Coal Series. This species is also a characteristic Liassic one. It was first described from the "Rhaetic" of Palsjo, in Sweden and later it was found from the Lower Liassic beds in Austria-Hungary. The "Rhaetic" beds of Palsjo have now been generally held to be definitely of the Liassic age. Other species found both from the upper part of the Yenchang Formation and the lower part of the Wayaopu Coal Series are *Neocalamites carrerei*, *Equisetites sarrani*, *Podozamites lanceolatus* and *?Protoblechnum hughesi*. Except the species *Podozamites lanceolatus* which is a very common Mesozoic species with a wide vertical range, extending from the Upper Triassic to the Lower Cretaceous, the species *Neocalamites carrerei*, *Equisetites sarrani* and *?Protoblechnum hughesi* are almost exclusively confined to the Rhaetic and the Liassic. Summing up the palaeobotanical evidence as to the age of the Wayaopu Coal Series, we may admit that it is quite sufficient to prove a Lower Jurassic age. The present writer is therefore not quite prepared to agree with Dr. P'an that the lower part of this coal series is probably of Rhaetic, while the upper part of it is undoubtedly of Lower Jurassic age and that the age of this coal series as a whole may be designated as Liassic-Rhaetic (P'an, 1936, p. 37). The Wayaopu Series can be regarded as corresponding to the Tatung Series of North Shansi and to the Mentoukou Series of Peking, which it resembles in making the maximum of coal-formation in the Jurassic period of North China.

Particular interest in the subject was aroused by Mr. S. V. Wang's recent finding of a great disconformity between the Wayaopu Coal Series and the overlying Yen-An Sandstone Series in Northern Shensi. Wang named the horizons below this disconformity the Yenchang series including the Wayaopu Series, and the horizons above this disconformity the Yen-An Series. In recent years, Mr. P. Chen has also found a disconformity, though in somewhat smaller measure, in the Wayaopu Series in the district of Ichün. Chen therefore named the horizons above the disconformity the Ishihtsun Coal Series which is the upper part of the original Wayaopu Series, and the horizons below the disconformity the Wayaopu Series in the restricted sense. The field investigation made by Messrs. T. S. Lee and C. S. Ma (1953, p. 32—34) supports this step. Lee and Ma further stated that "it would be natural to parallelize the Ishihtsun Coal Series of the Ichün District with the Yen-An Series of Yen-An District. Both formations are characterized by the presence of *Coniopteris hymenophylloides* Brongniart and because this species is an important index fossil of the Middle Jurassic of Europe, the Ishihtsun Series and the Yen-An Series might probably belong to this age." There is also a more or less distinct formation about 130 m in thickness between the overlying Anting Formation and the underlying Yen-An Series in Northern Shensi. Some geologists named this formation the Chihlo Series, which is characterized by the presence of disconformities both above and below. This series consists of sandstones and shales interbedded with each other at the upper part and whitish quartzose sandstone at the lower part, while the basal part of this series is of somewhat conglomerate appearance. The top part of this series is characterized by a bed of oil shale. According to Dr. P'an, there is no sufficient ground to separate this series from the Yen-An Series. In a paper published in 1954 (written in Chinese), Dr. P'an has come to the conclusion that the lower part of the Wayaopu Coal Series (i.e. Wayaopu Series in the restricted sense) may be placed in the so-called "Yenchang Series" in view of the fact that the species *Coniopteris hymenophylloides* seems to be confined only to the Ishihtsun Coal Series which is the equivalent of the Yen-An Series and which is the upper part of the Wayaopu Series in the broad sense. The following revised table of the Mesozoic stratigraphy of Northern Shensi was given by P'an in 1954:

<table>
<tr><th>Divitions according to P'an (1936)</th><th colspan="2">Divitions accord. to China Petroleum Admr. (1950)</th><th colspan="2">Divitions according to P'an (1954)</th><th>Geological age</th><th>Thickness</th></tr>
<tr><td>Anting Formation</td><td colspan="2">Anting Series</td><td colspan="2">Anting Formation</td><td>U. Jurassic</td><td>50m.</td></tr>
<tr><td rowspan="3">Wayaopu Coal Series</td><td colspan="2">Chihlo Ser. (130m.)</td><td colspan="2" rowspan="2">Yen-An Series.</td><td rowspan="2">Lower Jurassic</td><td rowspan="2">470m.</td></tr>
<tr><td>Yen-An Ser.</td><td>Ishihtsun Coal. Ser. (Ichün dist.)</td></tr>
<tr><td colspan="2" rowspan="2">Yenchang Series</td><td rowspan="2">Yenchang Series</td><td>Wayaopu Coal Ser.</td><td rowspan="2">Upper Triassic</td><td rowspan="2">1400m.</td></tr>
<tr><td>Yenchang Formation</td><td>Yenchang Formation</td></tr>
<tr><td>Shihchienfeng Series</td><td colspan="2">Shihchienfeng Series</td><td colspan="2">Shihchienfeng Series</td><td>Permian</td><td>1080m.</td></tr>
</table>

It should be however pointed out in this connection that the opinion expressed by Dr. P'an in 1936 regarding the stratigraphical position of the fossil plants of Fu-Ku District in Northern Shensi is somewhat in contradiction with his later view expressed in 1954. He said in 1936 for instance: "The fossil plants described by Sze from Fu-Ku District are apparently derived from the lower part of the Wayaopu Series." And again in 1954, he stated: "The exact stratigraphical position of the Fu-Ku specimens is not quite certain, but according to the species, they are possibly found from the Yen-An Series." Mr. H. H. Lee lays stress on three opposite points of view: (1) According to the Jurassic coal-bearing deposits and the uniformity of the Jurassic fossil plants in whole North China, the Ishihtsun Coal Series (=the upper part of the Wayaopu Series in the broad sense) and its corresponding Yen-An Series in Northern Shensi are very possibly equivalent to the Yun-Kang Series of Northern Shansi (=upper part of the Tatung Coal Series), the Lung-Meng Series of Peking (=upper part of the Mentoukou Coal Series), and to the Chaokou Series (=upper part of the Shih-Kuai Coal Series) of the Tachingshan Range. They all belong to the Middle Jurassic. And the name Wayaopu Series should be accepted and retained for the Lower Jurassic coal series, its stratigraphical position nearly corresponding to the lower part of Tatung Series, the lower part of the Mentoukou Series (=Yao-Po Series), and the lower part of the Shih-Kuai Series (=Wutangkou Series). (2) The only positive evidence to back Dr. P'an in placing the Wayaopu Coal Series in the so-called "Yenchang Series" is the occasional presence of the species *Danaeopsis fecunda* in the basal part of this coal series. This is, of course, not a sufficient reason for supporting such a step, because *Danaeopsis fecunda* has been hitherto found only in Scania of Sweden and in a few localities of China. It is not quite impossible that this species occurs also in a slightly higher horizon than the Rhaetic, i. e. in the basal part of the Lower Jurassic in Northern Shensi. There are also a few other species which have been found both from the Yenchang Formation and the basal part of the Wayaopu Series, e. g. *Neocalamites carrerei, Neocalamites carcinoides, Equisetites sarrani, ?Protoblechnum hughesi* etc. We cannot be of course based only on these reasons to place the Wayaopu Series in the Uppermost Triassic, since some forms like *N. carrerei* and *Equisetites sarrani* etc. have also been known from the definite Lower Jurassic formations in Eastern Asia, e. g. the Hsiangchi Coal Series in Hupeh and Szechwan, and the species *N. carcinoides* Harris is known aside from the Yenchang Formation in China, hitherto only from the *Thaumatopteris* zone (=Liassic) of its type locality of Eastern Greenland and from the Lower Jurassic formation in Scania, Sweden. Furthermore, there are a great number of typical specimens of *Cladophlebis raciborskii* found from the Yenchang Formation and this is a characteristic Jurassic species. Very recently, this species has been found from the Middle Jurassic Yun-Kang Series in the Tatung Coal Field (Lee 1954, p. 35; Pl. 1, figs. 2—8). Can we on the evidence of this occurrence place the Yenchang Formation in the Lower or the Middle Jurassic? (3) The single negative evidence of Dr. P'an for placing the Wayaopu Coal Series (sen. restr.) in the Uppermost Triassic is that there are no specimens of *Coniopteris hymenophylloides* hitherto observed in this coal series, and this species occurs only in the overlying Yen-An Series (=Ishihtsun Coal Series). This important negative evidence is, according to Lee, also quite untenable, because Lee has found at least in Mr. T. S. Ho's collection many well-preserved specimens of *Coniopteris hymenophylloides* found from the lower part of the Wayaopu Series of Ichün District. And the same is the case in the lower part of Huating Coal Series of Kansu, which is an equivalent of the Wayaopu Series. The correlated table of the Mesozoic stratigraphy of North China given by Lee is as follows:—

<table>
<tr><th>Age</th><th colspan="2">W. Hills (Peking)</th><th colspan="2">Tatung, (Shansi)</th><th colspan="2">Tachingshan (Inner Mongolia)</th><th>N. Shensi</th><th colspan="2">E. Kansu</th><th>Cent. Kansu</th></tr>
<tr><td>Overlying beds</td><td colspan="2">Tiaochishan Ser (U. Jura. or L. Cret.)</td><td colspan="2">Hungyuan Ser. (U. Cret.?)</td><td colspan="2">Gravel and loess (Quart.)</td><td>Ichün Conglomerate (Cret.)</td><td colspan="2">Liupanshan Ser. (L. Cret.)</td><td>Kansu Ser. (Tertiary.)</td></tr>
<tr><td rowspan="3">M. Jura.</td><td colspan="2">? Chiulungshan Ser.</td><td>U.</td><td rowspan="3">Yunkang Ser.</td><td colspan="2">Tachingshan Ser.</td><td>Anting Ser</td><td colspan="2">Kungtungshan Ser.</td><td>Tiehyehkou Formation</td></tr>
<tr><td rowspan="2">Lungmen Ser.</td><td rowspan="3">Mentoukou Coal Ser.</td><td>? M.</td><td colspan="2">? Changhankou Ser.</td><td>Chihlo Ser.</td><td rowspan="2">U.</td><td rowspan="3">Huating Coal Ser.</td><td rowspan="2">Hoshangpu Coal Series</td></tr>
<tr><td>L.</td><td rowspan="2">Shihkuai Coal Ser.</td><td>Chaokou Ser.</td><td>Ishihtsun Coal Ser.</td></tr>
<tr><td>L. Jura.</td><td>? Yaopu Ser.</td><td colspan="2">Tatung Coal Ser.</td><td>Wutangkou Ser.</td><td>Wayaopu Coal Ser.</td><td>L.</td><td>Akanchen Coal Ser.</td></tr>
</table>

The table shows the correlation of the Jurassic coal-bearing formations of different provinces of North China and the succession in the succeeding subdivisions. This does not of course mean that the depositions of different regions are synchronous in a strict sense. The point of view that the upper part of all these coal-bearing formations might belong to the Middle Jurassic is probably correct. In connection herewith, it must be kept in mind that Lee's proposal and subdivisions are based purely on the lithological conditions and a few slight hiatus between the sedimentations. There are absolutely no floral differences between the subdivions. The boundary or separation of the different subdivisions is approximate only and by no means definite. This is all the more clear, when we look over the fossil flora described by Lee in 1954 from Yun-Kang Series i. e. the upper part of the Tatung Coal Series of Northern Shansi, which has been regarded by Lee as Middle Jurassic and which shows absolutely no difference from those found from the lower part of this series. The following species were described:—

Coniopteris hymenophylloides Brongniart.
Cladophlebis cf. *raciborskii* Zeiller.
Podozamites lanceolatus (L. & H.) Braun.
Czekanowskia cf. *rigida* Heer.
Cf. *Ginkgo* sp.

All these forms are very common species with a wide vertical range. They occur generally from the Lower to Middle Jurassic. However, the present writer is quite prepared to agree with the view that the lower part of Jurassic coal-bearing formations in North China may belong to the Lower Jurassic and that the upper part of these formations is probably of the Middle Jurassic age.

Since the publication of the writer's memoir "Beiträge zur Liasischen Flora von China" in 1931, the writer has received many important letters from Professor Kryshtofovich of the USSR and Professor Ôishi of Japan, stating that the species *Coniopteris hymenophylloides* Brongn. is one of the most important index species of Middle Jurassic in Yorkshire, and that in Eastern Siberia and in Japan as well, the *Coniopteris*-bearing formations seem to belong to the Middle Jurassic. It seems clear that Prof. Kryshtofovich and Prof. Ôishi are strongly inclined to the view that the *Coniopteris*-bearing formations in China, especially in North China might belong also to the Middle Jurassic. The present writer is, now as before, in complete accord with Prof. Gothan that although the species *C. hymenophylloides* is an important Middle Jurassic index fossil of England, it may occur in Eastern Asia in the Lower Jurassic and may persist to the Middle Jurassic. In correlating the Mesozoic continental deposits of two too widely separated regions as England and China, undue weight should not be attached to one or two fossils only. The fact is all the more clear, when we correlate the younger Mesozoic formations in Eastern Asia. We find that two important index fossils of the Wealden formations in England, *Ruffordia* and *Onychiopsis*, occur in Eastern Asia both in the Lower Cretaceous and Upper Jurassic. In Japan, these two important forms have been found from the Lower Cretaceous Ryôseki Series as well as from the Upper Jurassic Tetori Series (Ôishi 1940, p. 168, p. 231—232, p. 240—241). In Korea, they occur in the Upper Jurassic Rakuto Bed. In China, they have been discovered from the Lower Cretaceous Pantou Series as well as from the Upper Jurassic Chi-si Coal Series of Northern Manchuria. Up to the present, the writer is in complete agreement with Prof. Gothan in believing that "an verschiedenen Fundorten in Ostasien die Kohlenbildung vielleicht schon im Rhät begonnen haben, und stellenweise über die Lias-Zeit heraus fortgedauert haben kann. Hierüber sind aber vorläufig im einzelnen keine Aussagen zu machen. Nur genauere Untersuchungen der Schichten Folgen an den einzelnen Fundpunkten, können vielleicht später hierüber Auskunft geben." (see Sze 1931, p. 71—72). It should be finally once more pointed out that the present writer does agree with Mr. H. H. Lee to place the Ishihtsun Series of Northern Shensi, the Yunkang Series of the Tatung Coal Field, the Chaokou Series of the Tachingshan Range, the Lungmeng Series in the Mentoukou Coal Field and the Hoshangpu Coal Series of Kansu Province to the Middle Jurassic, and to retain the Wayaopu Coal Series (sen. restr.), the Mentoukou Coal Series (sen. restr.), the Tatung Coal Series (sen. restr.), the Shihkuai Coal Series (sen. restr.) and the Akanchen Coal Series (in Kansu) in the

Lower Jurassic. All these formations contain the typical species *Coniopteris hymenophylloides* Brongniart.

The species *Coniopteris hymenophylloides* Brongn. occurs very abuntantly in the Fangtze Coal Series of Eastern Shantung. On the evidence of the floral assemblage, the Fangtze Series in Shantung apparently corresponds to the Mentoukou Series in the vicinity of Peking. Whether the upper part of the Fangtze Series can also be assigned to the Middle Jurassic is a question that remains to be settled.

There are also some good specimens of *Coniopteris hymenophylloides* found from the Hsiangchi Coal Series in Western Hupeh. But this series contains many important characteristic species of the Tonking Coal Series in Indo-China, e. g. *Equisetites sarrani* Zeiller, *Neocalamites carrerei* Zeiller, *Dictyophyllum nathorsti* Zeiller, *Clathropteris meniscioides* Brongniart, *Pterophyllum inconstans* Braun, *Pterophyllum tiezei* Zeiller, *Pterophyllum portali* Zeiller, *Pterophyllum nathorsti* Schenk, *Cycadolepis corrugata* Zeiller etc. The Tonking Coal Series was held by Zeiller to be Rhaetic. Some geologists and palaeozoologists even believe that the age of this series is probably of the Pre-rhaetic. According to the present writer, this coal series in Indo-China is equivalent to the Anyuan Coal Series in Pinghsiang District of Kiangsi and belongs apparently to the *Dictyophyllum-Clathropteris* Series in the sense accepted in the present memoir
196. The Tonking Coal Series might therefore be classed as Rhaetic-Liassic. As stated above, the Hsiangchi Coal Series of Western Hupeh contains so many important forms of the Tonking Series in Indo-China that the whole series can not be regarded as belonging to a period younger than the Lower Jurassic. On the other hand, the Hsiangchi Series consists also of many important elements of the *Thaumatopteris* Zone in Eastern Greenland, and these elements have been assigned by Harris to the Liassic age. They are: *Equisetites sarrani*, *Marattiopsis münsteri*, *Dictyophyllum nilssoni*, *Clathropteris meniscioides*, *Sphenopteris modesta*, *Ginkgoites* cf. *hermelini*, *Czekanowskia* sp., *?Ctenopteris* sp., *Swedenborgia cryptomerioides*. . . .etc. The species *Swedenborgia crytomerioides* occurs also in the Yenchang Formation. And from the same coal series in Szechwan, we found another important Lower Jurassic species of Eastern Greenland: *Scoresbya dentata* Harris (Sze & Lee 1952, p. 1, p. 15). All things considered, the Hsiangchi Flora cannot be said to prove that this coal series extends to the Middle Jurassic; while it may fall entirely within the Lower Jurassic. In view of the fact that the Hsiangchi Series contains also the species *Coniopteris hymenophylloides* Brongniart, it is evident that the Wayaopu Series (sen. restr.) of Northern Shensi cannot be placed in the Uppermost Triassic purely on the ground of the absence of this species. If this species is really absent in the Wayaopu Series (sen. restr.), its absence in this series may have an edaphical or phyto-geographical explanation. It is clear that the distribution of the species may be quite different in different regions; one species may occur rather abundantly in one region, but may be quite rare and even entirely absent in other regions. According to Mr. Lee, the species *Coniopteris hymenophylloides* Brongn. is, in fact, present in the Wayaopu Series (sen. restr.) in Ishün District of Northern Shensi.

V. MAJOR DIVISIONS OF THE CHINESE MESOZOIC FROM THE VIEWPOINT OF FLORAL EVOLUTION

It is long known that the geological classification of all the complexes during geological history relies altogether upon the faunal evolution, which does not always coincide with the floral evolutions. Such major divisions of the whole geological column as Palaeophytic, Mesophytic and Cainophytic have been proposed by Prof. Gothan from the viewpoint of floral evolution, but have not universally been accepted among palaeontologists and geologists.

In fixing the geological age of the Chinese Mesozoic formations, the application of major divisions from the viewpoint of floral evolution is very convenient and useful, because of the absence of the widely spread marine deposits since the beginning of the Triassic and especially since the beginning of the Jurassic. Such a larger proportion of our fossiliferous strata in Mesozoic are freshwater and continental deposits with plants as the chief basis for correlation. As a tentative scheme, a proposal is here advanced for a major division of the Chinese Mesozoic strata solely from the viewpoint of floral evolution. The major divisions are proposed as follows:—

Major Floral Divisions	*Formations*	*Geological Age*
Ruffordia-Onychiopsis Series	Upper part: The Pantou Series and its corresponding Formations	Wealden
	Lower part: The Chi-Si Coal Series and its corresponding Formations	Dogger-Malm
Coniopteris-Phoenicopsis Series	The Mentoukou Coal Series and its corresponding Formations, such as the Tatung Series, etc.	Liassic-Dogger
Dictyophyllum-Clathropteris Series	The An-Yuan Coal Series and its corresponding Formations, such as the I-Ping-Long Series in Yunnan and the Tonking Series in Indo-China.	Rhaetic-Liassic
Danaeopsis-Bernoullia Series	The Yenchang Formation in North and Northwest China	Keuper-Rhaetic

The characteristic elements of the *Danaeopsis-Bernoullia* Series are *Danaeopsis fecunda, Bernoullia zeilleri, Glossophyllum? shensiense, Cladophiebis shensiensis, Cl. szeiana* etc., all of them being closely related to the important species of the Middle Keuper floras of Europe and North America namely, the Basler Keuper of Switzerland, the Lunzer Keuper of Austria, and the Virginia-Keuper of North America. The characteristic elements of the *Dictyophyllum-Clathropteris* Series are tropical to sub-tropical ferns such as Dipteridaceae and Marattiaceae. The characteristic genera are *Dictyophyllum, Clathropteris* and *Marattiopsis*. Seed plants are also represented by many important genera, namely, *Pityophyllum, Otozamites, Pterophyllum, Nilssonia, Ctenis, Podozamites* etc. This series would include the geological age between the Upper Triassic and Lower Jurassic. All species of this series are closely related to the *Lepidopteris* and *Thaumatopteris* zones of Sweden, Germany and Eastern Greenland. The *Coniopteris-Phoenicopsis* Series is characterized by a dominant assemblage of *Coniopteris, Phoenicopsis, Czekanowskia, Ginkgoites, Baiera, Cladophlebis whitbyensis, Cl. denticulata* and many other plant fossils which are closely related to the Middle Jurassic Yorkshire elements of England. This series would include the geological age between Lower and Middle Jurassic epochs. The Hsiangchi Coal Series of West Hupeh belongs evidently to the Lower Jurassic. The lower part of the Tatung Coal Series in N. Shansi and the Mentoukou Series near Peking belongs to Lower Jurassic, and the upper part of these formations is probably of Middle Jurassic age. The lower part of the Tatung and the Mentoukou Series is equivalent to the Wayaopu Coal Series (sens. restr.) of N. Shensi which overlies almost conformably the Yenchang Formation. The Ishihtsun Coal Series of N. Shensi which overlies the Wayaopu Coal Series, (s. restr.) corresponds to the upper part of the Tatung and the Mentoukou Series. The *Ruffordia-Onychiopsis* Series is the uppermost major floral division of the Chinese Mesozoic hitherto known in China. This Series can be divided into two parts. The upper part is called the Pantou Series exposed near the city of Yungan in Fukien. The characteristic elements of this series are *Ruffordia, Onchyiopsis, Cladophlebis browniana, Cl. dunkeri, Ptilophyllum boreale, Otozamites klipsteinii* and many other characteristic conifer species such as *Brachyphyllum obesum, Sphenolepidium elegans,* and *Pagiophyllum gracile.* There is among the plants a fossil fish more or less comparable to *Lycoptera sinensis* Smith-Wood. The flora of the Pantou Series is apparently allied to or identical with the Wealden flora of Europe and with the Older Potomac flora of North America. The equivalent beds of the Pantou Series have been found in the vicinity of Touli and Tahuichang of Fangshan District, southwest of Peking. The Pantou Series in Fukien is undoubtedly equivalent to the Laiyang Formation in Shantung which is also characterized by many conifer remains with a characteristic fossil fish *Lycoptera sinensis,* and it is highly probable that the fish beds with *Lycoptera* in other parts of China and those of Mongolia and Transbaikalia are of the same age. The lower part of *Ruffordia* and *Onychiopsis* Series occurs in Northern Manchuria. The formation is now called the Chi-Si Coal Series formerly known as the Mou-lin Series. The Chi-si Coal Series in N. Manchuria is now considered to be of Upper Jurassic age. It contains *Ruffordia, Onychiopsis, Elatocladus manchuricus* and many *Cladophlebis* remains closely allied to the Lower and Middle Jurassic species. It is interesting that the species of the two genera *Ruffordia* and *Onychiopsis* which are two important index fossils of the Wealden in Europe, are present in the Upper Jurassic of China, Korea and Japan.

For further information pertinent to the subject, the reader is referred to the discussions written in the Chinese text.

VI. RELATIONS BETWEEN THE YENCHANG FLORA AND THE GONDWANA FLORA

As has been stated in the opening pages of this memoir, the specimens described by Krasser in 1900 (l. c. p. 7; Pl. II, figs. 2--4) from Northern Shensi under the names of *Danaeopsis hughesi* Feistm. and Cordaitaceenblätter (*?Noeggerathiopsis hislopi (Bunbury)* Feistm.) have long been the cause of speculation on the occurrence of a gondwana flora in Northern China. These specimens were collected by the great and venerable geologist, Prof. W. A. Obrutschew in 1893—1894 from the Mesozoic formation in the vicinity of Suite District, Northern Shensi, which has now been definitely proved to be the Yenchang Formation of the Upper Triassic age. These specimens are however too imperfect for accurate determination, as already repeatedly discussed by many authors (e. g. Gothan 1915, p. 270; Halle 1927, p. 138; Sze 1931, p. 7; Sze 1933c, p. 77). In any case, the points of resemblance between the Mesozoic floras of Gondwana Land and Northern Shensi as expressed in the number of such indeterminable fragments are quite insignificant. Since the publication of Dr. Pan's important memoir "Older Mesozoic Plants from North Shensi" in 1936, the relation between the Yenchang flora and the Gondwana flora has again become a most fascinating problem. In addition to the two species described by him under the names of *"Danaeopsis" hughesi* and *?Noeggerathiopsis hislopi,* Dr. P'an added another important Gondwana species *?Schizoneura gondwanensis* to the Yenchang Formation of Northern Shensi. The "Relation to the Indian Gondwana Flora" is dealt with at some length in a special chapter by Dr. P'an at the end of his memoir. It seems that Dr. P'an is rather inclined to the view that there was actually some intermingling of the Gondwana elements with the elements of Northern China during the Upper Triassic time. He said for instance (1936, p. 38, 39): "From what has been stated above the evidence as to the existence of the Gondwana species in the North Shensi basin, it is evident that in post Lower Permian time the *Gigantopteris* flora region would have provisionally been connected to the Indian Gondwanaland to permit Gondwana flora northward migration. Since the discovery of the *Glossopteris* flora in the Upper Permian of Northern Russia the view has grown that between the Northern and Southern continents there must have been some means of communication for the spread of land plants. Dr. Zalessky has suggested that there must have been either an isthmus or a dense archipelago across the old Mediterranean Sea, and he speaks of a possible Angaro-Gondwana continent, but the data are insufficient to show the lateral extent of the connection. Prof. Sahni (1926, p. 240) said: 'So far as our present knowledge goes, Kashmir lay on the main route of the northward migration. But possibly there were other routes through China.' If our determination of the Gondwana species in correct, it is another proof that the Angaro-Gondwana continent would have existed in the post Lower Permian time, and the route of the northward migration of the Gondwana flora would have been through China."

As has been pointed out on p. 2 of this memoir, the Gondwana affinities of the Yenchang flora are not conspicuous. It is almost impossible to point to a single species which is unquestionably identical with a member of the *Glossopteris* flora. The most important forms in this respect are *?Schizoneura gondwanensis* Feistm. *?Noeggerathiopsis hislopi* Bunbury and *"Danaeopsis" hughesi* Feistm. The single specimen described by P'an as *?Schizoneura gondwanensis* is too imperfect for accurate determination. This specimen shows a portion of a leaf-sheath amplexically attached to the stem at the node. This portion of leaf-sheath is preserved as a single lobe on the right side of the stem. The lobe is about 7.3 cm long and about 1.4 cm broad and seems to be composed of four segments which are coherent for nearly the whole length. Each segment is transversed by a median nerve. The apex of the lobe appears to be slightly dissected. This specimen bears indeed a resemblance to the Gondwana species, but the resemblance may equally well be accidental. Among the large material at the writer's hand, there are many specimens of *Neocalamites carcinoides* Harris which occasionally show the coherent segments for nearly the whole length forming more or less long distinct lobes on both sides of the stem. Many similar specimens with coherent segments occur also in Dr. P'an's collection. P'an determined these specimens also as *Neocalamites* cf. *carcinoides* Harris (see P'an 1936, Pl. III, figs. 6—9). It is therefore highly possible that in regard to the size and shape of the segments, the specimen described by P'an as *?Schizoneura gondwanensis* may belong to *Neocalamites carcinoides*. It is very doubtful whether it has any real affinity to the genus *Schizoneura*. The specimens described by P'an as *?Noeggerathiopsis hislopi* (Bunb.) Feistm. have been referred to a new species here described as *Glossophyllum? shensiense* which is closely related to *Glossophyllum florini* Kräusel from the Middle Keuper of Europe. The European species may belong to the Ginkgoales based on the epidermal and stomatal structures. In connection herewith, it should be pointed out that the specimens described by Zeiller as *Noeggerathiopsis hislopi* from the Tonking Coal Field, which has been placed by P'an in the same synonym of his species, were believed by Seward and Sahni to be of no relation to the Gondwana species (see Coggin Brown 1938, p. 540, 541; Sze, 1949, p. 52). Prof. Kräusel, is of the opinion that the Tonking specimens might also belong to his new genus *Glossophyllum* (Kräusel, 1943, p. 62, 72). The determination of the species *"Danaeopsis" hughesi* Feistm. from the Yenchang Formation was considered by P'an to be valid. He said for instance: "The species *Danaeopsis" hughesi* from Shensi has been suggested by Prof. Halle that it may be identical with his *Protoblechnum wongii*. But as the large material has been obtained from North Shensi the species *"Danaeopsis" hughesi* described by Krasser seems to be actually identical with the Indian species rather than *Protoblechnum wongii*." It seems to the present writer that, though the resemblance to the Indian species is so great that there may be a question of specific identity, the few specimens known at present do not give sufficient information on the manner of bifurcation of the frond. Furthermore, we have found very recently a few specimens of *Protoblechnum wongii* with bifurcated frond from the Upper Shihhotze Series of Shansi. If future investigations will show that the species from the Upper Triassic beds from Northern Shensi is characteristized also by a bifurcated frond, the question of specific indentity will remain still open whether they belong to the Chinese species *Protoblechnum wongii* Halle or to the Indian species *Protoblechnum hughesi* (Feistm.) Halle or belong to yet another species of this genus. It is impossible, without additional material, to form any opinion regarding the possible relation to the fragments found from the Yenchang Formation.

After a careful study of the subject, the writer has arrived at the conclusion that the affinity of our Yenchang flora to the Gondwana flora is indeed very slight and quite insignificant. But it should be remembered that the present status of our Upper Triassis flora is merely momentary, for the number of the related or similar Gondwana species will assuredly be greatly increased as the result of further search, with the probable discovery of the species now known in Gondwana-Land and in other continents, and any new forms of evolutionary and geographical interest.

There remains the question whether there were any relationships between the flora of the Gondwana-Land and those in other parts of Eastern Asia during the Older Mesozoic time. Since the publication of Zeiller's excellent work of the Tonking Flora in 1903, many geologists have seemingly believed that in Tonking and Yunnan, there are actually some important Gondwana elements e. g. *Glossopteris* and *Noeggerathiopsis* intermingled with the Rhaeto-Liassic floras. Prof. Gothan was of the opinion that the presence of such elements in the Rhaeto-Liassic beds of Tonking and Yunnan might be regarded as residual remains of the Palaeozoic flora of the Gondwana-Land and that the region of Tonking and Yunnan was one of the typical "Assylen" or refuge areas of the *Glossopteris* floras. He said in his Lehrbuch published in 1921 (p. 448) as follows:—

"In der Jurassischen Flora (die wir hier mit der rhätischen zusammenfassen können) haben wir einige sehr interessante Reliktengebiete. Diese sind das Gebiet von Tonkin (China) und neuerdings auch Mexiko. An beiden weit voneinander entfernten Stellen treten hier inmitten einer echt liassischen Flora Relikte der älteren Gondwana-flora auf, in Tonkin nach ZEILLER *Glossopteris* und *Noeggerathiopsis*, in Mexiko nach WIELAND ebenfalls *Glossopteris* und *Noeggerathiopsis*, z. T. in denselben Arten wie wir sie aus der permotriassischen Gondwanaflora konnen. Man wird kaum fehl gehen, wenn man diese Vorkommen als Relikte auffasst; merkwürdigerweise haben diese Pflanzen als letzte Zufluchtsorte Gebiete gefunden, die ausserhalb der eigentlichen früheren Gondwanagebiete gelegen zu haben scheinen."

In this connection, it should be pointed out that Prof. Jongmans seemed to be of the opposite view. He said for instance (1937a, p. 336): "Eine Schwierigkeit gegen die hier vorgetragenen Annahmen wäre die *Glossopteris*-flora aus den Rhät-Lias-Schichten von Tonkin, welche ZEILLER beschrieben hat. Wenn man jedoch die Abbildungen betrachtet und mit denen vergleicht, welche ZELESSKY und WHITE für die Angara- und die Hermitflora veröffentlicht haben, so kann man die Tonkin-Exemplare sehr gut z. B. mit *Gangamopteriopsis* Zal. und mehreren weiteren Formen vergleichen." And again in another important paper published in the same memoir in 1937 (1937b, p. 359), Prof. Jongmans stated: "The only possible proof of a succession in later periods of a Cathaysia-flora by a Gondwana-flora would be ZEILLER'S *Glossopteris*-flora in Tonking. However, as the writer pointed out in his paper (in this volume) on Synchronism and Stratigraphy, the *Glossopteris*-flora from the Rhät-Lias beds of Tonking is based on some leaves, which Zeiller named *Glossopteris,* but which can also be compared with some leaves, which White and Zalessky published from the Angara-flora and the Hermit-shales, f. i. *Gangamopteriopsis* of Zalessky." The present writer is in complete accord with Prof. Jongmans that the point of view of the intermingling of the Gondwana elements in the Rhaeto-Liassic beds of Tonking and Yunnan does not appear to rest on adequate grounds. It might indeed be questioned whether the determination of such fragmentary specimens of *Glossopteris* should be regarded as valid. Regarding the incorrect determination of the *Noeggerathiopsis* specimens of the Tonking Coal Field, it should be once more pointed out that Seward and Sahni had already referred these specimens to a new species of *Pelourdea,* and that, according to them, the specimens found from Tonking and Yunnan have no true affinities to the Gondwana species. In his important account published in 1943 (p. 62) Prof. Kräusel said: "Man sieht aus diesen Angaben, wie gut Krasser's Vergleich mit den Blättern aus der Trias von Tonkin war, die Zeiller (wohl zu Unrecht!) zu *Noeggerathiopsis hislopi* gestellt hat." In the same paper (p. 72), Kräusel further pointed out: "Aber wenigstens soll noch einmal auf die Reste aus dem Rhät von Tonkin hingewiesen werden, die Zeiller zu *Noeggerathiopsis hislopi* Bunb. stellt (1903, 149, Taf. 40, Figs. 1—6). Krasser's Vergleich trifft durchaus zu, denn von allen mir bekannten Fossilien kommen sie hinsichtlich der äusseren Gestalt *Glossophyllum* am nächsten. Das darf aber nicht ohne weiteres auf alle unter jenem Namen vereinigte Formen übertragen werden. Diejenigen der indischen Gondwanaschichten z. B. weichen nach Gestalt, Nervenverlauf und anatomischen Bau sehr davon ab und sind bestimmt keine Ginkgophyten (Seward & Sahni 1920, 4, Taf. 1). Wahrscheinlich haben die Blätter von Tonkin damit gar nichts zu tun. Ob es sich bei ihnen wirklich auch um eine *Glossophyllum*-Art handelt, bleibt zu prüfen."

The present writer is quite prepared to agree with the view of Prof. Kräusel that the specimens described by Zeiller as *Noeggerathiopsis hislopi* from the Tonking Coal Field and those found from the Yenchang Formation of Northern Shensi described by P'an under the same specific name might be referred to the genus *Glossophyllum,* a new generic name created by Kräusel in 1943 for more or less similar specimens found from the Lunzer Keuper in Austria. The specimens described by Zeiller as *Danaeopsis* cf. *hughesi* Feistm. (1903, p. 57, Pl. IX, fig. 1) from the Tonking Coal Field are also too imperfect for definite determination. It appears that this specimen might be a fragment of *Taeniopteris* resembling very much those of *Taeniopteris* cf. *mac*c*lellandi* O. & M. from the same Coal Field. Yokoyama (1906, p. 15, Pl. 5, fig. 2) figured also a specimen of *Glossopteris* found from Yunnan Province. This specimen, according to Sze (1931, p. 7, Footnote) is "aber ein unklares stück" and is too imperfect for accurate determination ("... das leider zur Bestimmung zu unvollständig ist").

Finally, it should be pointed out that the specimens discovered from Szechwan by Prof. Obrutschew in 1893-1894 and determined by Krasser in 1900 (Krasser 1900, p. 146, Pl. 3, figs. 1—3a) as Equisetaceenreste (*Schizoneura*) are also indeterminable. According to Grabau (1923—1924 Stratigraphy of China, Part I, p. 407), these specimens were later referred to *Schizoneura krasseri* Seward. Seward's paper is unfortunately not accessible to the writer, but judging solely from the illustrations given by Krasser, these specimens might very possibly belong to the genus *Neocalamites,* as has been already pointed out by Sze in 1931 (Sze 1931, p. 7). In Grabau's Stratigraphy of China, Part II, p. 326, there is another specimen figured as *Schizoneura hoerensis* found from the Jurassic of South Manchuria. This specimen was determined by Yokoyama and might either belong to *Neocalamites hoerensis* (Schimper) or to *Neocalamites carrerei* Zeiller. It has actually nothing to do with the Gondwana genus. The specimens described by Sze in 1931 (l. c. p. 5, Pl. 3, fig. 1; Pl. 4, fig. 1) as *Macroglossopteris leeiana* from the Rhaeto-Liassic beds of the Pinghsiang Coal Field, Kiangsi have been referred by Florin and later by Harris to the genus *Anthrophyopsis*. Despite of the fact that the type-specimens of Nathorst's *Anthrophyopsis** are very fragmentary and might represent more than one genus and despite of the fact that the generic identity of *Anthrophyopsis* and our *Macroglosopteris* is still open to discussion (see also Sze 1931, p. 6), the former conjecture of Gothan and Sze that this species can be regarded as "weiteres Residum der älteren Gondwana Flora" (see Sze 1931, p. 7) might be ruled out.

From what has been said above, it appears clear that not only are the Gondwana affinities of the Yenchang flora of Northern China very inconspicuous, but all the Older Mesozoic floras of Eastern Asia have no noteworthy resemblance to the *Glossopteris* flora. Geologists must own to a certain scepticism regarding the possibility of explaining the problem whether the route of the northward migration of the Gondwana floras would have been through China, etc.

VII. THICKNESS AND LITHOLOGICAL CHARACTER OF THE YENCHANG FORMATION, NORTHERN SHENSI

As has been stated above, the thickness of the Yenchang Formation in Northern Shensi was estimated by Dr. C. H. P'an as 1000 metres. Recent field investigations by the geologists of China Petroleum Administration have shown that this formation may at least in the area from the locality Kaoyenti of the Tungchuan District to the locality Shihlangmiao of the Ichün District exceed 1175 metres. The investigations were partly made with help of the boring methods in some localities. The whole formation is divided into 170 beds (not including the Wayaopu Series) according to the lithological character. The general columnar section will be published in this memoir. It should be pointed out that the specimens described in the present memoir from the locality T'anhokou, near Shihlangmiao have been found from Bed 168 and those of the locality Chimochiao, near Hsinshüping was derived from Bed 166. The specimens of locality Kaoyenti might have been discovered from Bed 18.

The stratigraphical sequence of the Yenchang Formation, N. Shensi is given below in ascending order.

1. Diagonal or cross bedded sandstone containing Feldspar, upper part yellow-greenish, lower part clay-yellowish and the uppermost part gray-greenish .... 11.20 m.
2. Brown argillaceous sandstone interbedded with purple sandstone .... 5.65 m.
3. Gray-greenish and brown-purple sandy shale .... 1.10 m.
4. Gray-greenish and gray micaceous sandstone .... 8.00 m.
5. Light-grayish argillaceous sandstone and thin-bedded glimmerate intercalated with shaly sandstone and shale clay-sandstone .... 1.10 m.
6. Yellow-greenish, gray-yellow-greenish and purple sandy shale intercalated with shaly sandstone .... 6.40 m.
7. Light grayish argillaceous sandstone intercalated with sandy shale at the upper part and purple-grayish sandstone at the lower part .... 6.05 m.
8. Yellow-greenish, gray-greenish shale and sandy shale intercalated with carbonaceous shale containing plant fossils .... 3.60 m.
9. Light-gray-purple and gray-greenish agrillaceous sandstone intercalated with gray-greenish shale at the lower part .... 2.20 m.
10. Yellow-greenish, micaceous, thin-bedded argillaceous sandstone at the upper part; gray-green-purple shale and sandy shale at the lower part .... 4.50 m.

*Most of Nathorst's type-specimens belong definitely to *Ctenis*, a few specimens belong almost certainly to *Sagenopteris* and another few specimens are indeterminable fragments. The generic name *Anthrophyopsis* should therefore be discarded. The relation of *Macroglossopteris* to *Glossopteris* is in the writer's opinion just like that of *Macrotaeniopteris* to *Taeniopteris*, *Macroalethopteris* to *Alethopteris*, *Protoblechnum* to *Blechnum*, *Protolepidodendron* to *Lepidodendron*, *Palaeoweihselia* to *Weichselia*, etc. suggesting a relationship with another genera which certainly does not exist. The validity of these form-genera have not been doubted by many palaeobotanists.

11. Brown-red, gray-blue, gray-green, yellow-blue micaceous argillaceous sandstone intercalated with sandy shale at the upper part .... 3.65 m.
12. Purple-reddish arenaceous shales and yellow-greenish argillaceous sandstones intercalated with oil shales .... 8.50 m.
13. Yellow-greenish, greenish, felspathic sandstone intercalated with mudstone at the upper part .... 6.70 m.
14. Gray-green, gray-blue felspathic diagonal bedded sandstone intercalated with conglomerates at the upper part .... 13.90 m.
15. Gray-blue, yellow-green, gray-green sandy shale, intercalated with thin-bedded oil shale, with a sandstone bed at the top part .... 4.35 m.
16. Yellow-greenish argillaceous sandstone containing calcic concretions, with a thin-bedded oil shale at the top part .... 3.75 m.
17. Yellow-greenish diagonal or cross bedded sandstone containing *Neocalamites* and intercalated with a thin bed of conglomerate at the basal part .... 9.55 m.
18. Yellow-green, purple-gray sandstone, with gray-greenish sandy shale containing plant fossil at the top part .... 3.35 m.
19. Yellow-greenish, fine-grained, thin-bedded micaceous sandstone .... 5.65 m.
20. Yellow-greenish argillaceous sandstone with sandy shale intercalated with yellow-greenish sandstone at the top part .... 9.75 m.
21. Gray-yellow-greenish, gray-greenish, yellow-greenish diagonal bedded sandstone .... 5.30 m.
22. Gray-greenish, micaceous, thin-bedded argillaceous sandstone, with diagonal and waving structures at the upper part .... 2.25 m.
23. Gray, gray-yellow-greenish fine-grained and thin-bedded sandstone with sandy shale intercalated with argillaceous sandstone at the basal part .... 11.70 m.
24. Gray, gray-green, gray-yellow-green argillaceous sandstone and shale intercalated with oil shale at the upper part .... 10.90 m.
25. Gray, quartziferous diagonal bedded argillaceous sandstone .... 1.90 m.
26. Gray-green, gray-yellow-green sandy shale and shale intercalated with argillaceous sandstone and black marl .... 2.30 m.
27. Gray-green fine-grained sandstone and yellow-green sandy shale .... 7.00 m.
28. Yellow-gray-green, fine-grained, compact sandstone at the upper part and yellow-green sandy shale at the lower part .... 2.60 m.
29. Gray-green, gray, fine-grained sandstone intercalated with oil shale at the middle part .... 10.15 m.
30. Green-gray, fine-grained sandstone, with blue-gray and yellow green sandy shales at the middle and lower part .... 6.30 m.
31. Gray-green, quartziferous sandstone interbedded with blue-gray, yellow-blue sandy shale .... 2.25 m.
32. Gray-green, fine-grained, diagonal bedded sandstone containing felspar and mica, with a bed of sandy shale at the basal and top parts respectively .... 9.20 m.
33. Light gray, blue-gray, thin-bedded argillaceous sandstone, intercalated with light-gray, yellow-gray-green sandy shale .... 2.80 m.
34. Yellow-green, gray-black shale intercalated with yellow-green, micaceous sandstone .... 3.25 m.
35. Light-gray, micaceous and quartziferous sandstone .... 2.30 m.
36. Gray, gray-green, feldspathic, diagonal-bedded sandstone intercalated with sandy shale and oil shale at the basal part .... 1.75 m.
37. Gray-yellow-greenish conglomerate 0.80 m.

38.	Dark gray-greenish shale	1.10 m.
39.	Light yellow-green-gray, fine grained sandstone intercalated with blue-gray argillaceous sandstone	5.40 m.
40.	Gray, gray-black sandy shale	1.25 m.
41.	Yellow-gren, light blue-green, micaceous, thin-bedded sandstones intercalated with yellow-greenish shale	5.30 m.
42.	Compact, micaceous argillaceous sandstone interbcdded with gray, blue-grayish sandy shale	9.60 m.
43.	Dark-gray-greenish argillaceous sandstone	3.15 m.
44.	Green, pinkish- brown-yellow, feldspathic sandstone	7.65 m.
45.	Blue-gray-green, fine-grained, thin-bedded sandstone inter-bedded with argillaceous sandstone	1.30 m.
46.	Blue-gray sandy shale and sandstone at the middle upper parts; dark-gray fine-grained sandstone at the lower part	3.30 m.
47.	Gray and dark grey sandstone and sandy shale	3.70 m.
48.	Gray-green, massive, feldspathic sandstone intercalated with thin-bedded sandy shale	6.25 m.
49.	Dark-gray sandy shale intercalated with sandstone of the same colours, and with black shale at the top part	2.70 m.
50.	Gray-green, massive sandstone intercalated with black shale	2.00 m.
51.	Gray-green, gray, blue-gray sandstone and sandy shale	4.75 m.
52.	Gray-green, feldspathic diagonal-bedded sandstone	4.10 m.
53.	Blue-gray-green sandy shale intercalated with thin--bedded black paper shale at the basal part	1.70 m.
54.	Gray-green, fine-grained, massive sandstone and thin-dedded sandy shale	1.40 m.
55.	Dark green-gray sandy shale	6.00 m.
56.	Gray-green, gray sandstone containing feldspar	5.30 m.
57.	Blue-gray sandstone intercalated with yellow-green-gray feldspathic sandstone, with thin bedded sandy shale at the top part	3.10 m.
58.	Yellow-green, gray-green micaceous argillaceous sandstone, with yellow-green-gray sandy shale at the top part	3.15 m.
59.	Brown-yellow, feldspathic, compact sandstone	1.75 m.
60.	Gray-green conglomerate	1.20 m.
61.	Brown-yellow, feldspathic, massive sandstone	17.00 m.
62.	Blue-gray, yellow, yellow-green thin-bedded argillaceous sandstone interbedded with dark-gray sandy shale	4.85 m.
63.	Gray-green thin-bedded argillaceous sandstone interbedded with gray-green, yellow-green sandy shale and intercalated with oil shale	2.60 m.
64.	Thin-bedded, micaceous sandstone	0.80 m.
65.	Gray, gray-green compact argillaceous sandstone interbedded with gray-green-yellow sandy shale	8.15 m.
66.	Gray-green, yellow-green quartziferous massive sandstone	1.50 m.
67.	Gray, gray-green, yellow-green argillaceous sandstone intercalated with gray sandy shale and with oil shale	7.55 m.
68.	Brown-yellow, massive, feldspathic sandstone intercalated with argillaceous sandstone and with oil shale at the top part	18.00 m.
69.	Yellow-greenish, massive, feldspathic sandstone	3.40 m.
70.	Gray, gray-green, fine-grained sandstone intercalated with sandy shale containing fossils	6.60 m.
71.	Yellow-green fine sandstone interbedded with sandy shale	6.50 m.
72.	Gray-greenish, feldspathic, massive sandstone	10.70 m.
73.	Green-gray shale interbedded with light-green micaceous sandstone	12.90 m.

74. Yellow-green, massive, diagonal bedded sandstone .... 15.00 m.
75. Light-green sandstone and blue-gray or greenish argillaceous sandstone .... 5.40 m.
76. Blue-black or blue-gray, very fine grained and compact sandstone, with gray-green sandy shale at the basal part .... 6.45 m.
77 Blue, gray, yellow-green, micaceous sandstone, with gray shale and sandy shale containing plant fossils at the upper part .... 21.20 m.
78. Greenish sandstone interbedded with greenish compact sandy shale .... 3.00 m.
79 Light-gray, yellow-green, fine grained, calcic sandstone intercalated with yellow-green or gray-green sandy shale .... 13.00 m.
80. Yellow-green fine-grained sandstone interbedded with yellow green argillaceous sandstone containing plant fossils .... 3.70 m.
81. Light-green, yellow-green, fine-grained thin-bedded sandstone intercalated with argillaceous sandstone at the upper part, and with yellow shale at the lower part .... 9.93 m.
82. Light green, yellow-green, massive sandstone interbedded with gray, calcic shale .... 4.00 m.
83. Light green or yellow green calcic sandstone containing mica .... 7.25 m.
84. Greenish micaceous sandstone interbedded with gray-green argillaceous sandstone and sandy shale .... 7.30 m.
85. Dark green, calcic shale intercalated with green argillaceous sandstone and green sandstone .... 9.65 m.
86. Light green shale and sandy shale intercalated with three beds of sandstone .... 17.73 m.
87. Upper part: grey or blue-gray massive shale and argillaceous sandstone with lenticular concretions; Lower part: calcic sandstone intercalated with sandy shale; Basal part: blue-green- black shale containing rich fossils .... 3.80 m.
88. Light green, fine grained thin-bedded and shaly sandstone, the lower part containing mica, compact, and intercalated with very thin shale .... 8.40 m.
89. Green-yellow, light green thin-bedded or shaly sandstone intercalated with green-yellow, light green or gray shale .... 6.13 m.
90. Light green argillaceous sandstone interbedded with gray-green sandy shale .... 6.40 m.
91. Fine grained, massive, micaceous, calcic sandstone .... 2.70 m.
92. Light green and dark green shale and sandy shale intercalated with argillaceous sandstone .... 14.00 m.
93. Light green sandy shale and shale .... 3.80 m.
94. Massive, micaceous sandstone .... 5.80 m.
95 Green-yellow, light green, calcic shale intercalated with compact and fine sandstone, ca. 20 cm. in thickness .... 5.40 m.
96. Light green, thin-bedded micaceous sandstone and argillaceous sandstone. Basal part: light brown-yellow sandstone .... 2.90 m.
97. Dark-gray, calcic shale .... 2.80 m.
98. Light green sandstone intercalated with light green shale .... 12.35 m.
99. Brown, golden yellow, fine grained, micaceous sandstone, gradually forming shaly sandstone to the upper part .... 7.00 m.
100. Light green shale intercalated with dark green sandstone .... 11.05 m.
101. Whitish gray or gray, fine grained sandstone .... 2.70 m.
102. Whitish, fine fire clay or refractory clay .... 0.60 m.
103. Yellow-gray, golden yellow sandstone containing mica at the upper part .... 15.30 m.
104. Black and purple-black oil shale with a few beds of lenticular, thin-bedded sandstone .... 23.70 m.
105. Gray-black or black shale intercalated with gray-whitish fine grained sandstone .... 15.00 m.

106.	Whitish-gray, fine grained, micaceous sandstone inter-bedded with black paper shale	3.90 m.
107.	Gray, brown-yellow, fine grained sandstone intercalated with black, gray-black shale	8.50 m.
108.	Gray, fine-grained sandstone	2.50 m.
109.	Gray-whitish, gray-yellow, fine grained sandstone intercalated with gray-black shale	16.50 m.
110.	Dark-green, light-brown, gray-green, fine grained sandstone. Top part: black shale and sandy shale containing fossils	2.60 m.
111.	Gray, green-yellow, fine grained sandstone interbedded with black and gray shale and sandy shale	4.50 m.
112.	Upper part: Light-green, dark green, gray sandstone;Lower part: light-green, dark green, gray thin-bedded shale and sandy shale	6.40 m.
113.	Light brown-yellow, green-yellow, light-green fine grained, massive sandstone	1.70 m.
114.	Green-yellow, light green sandstone interbedded with black dark-green shale	7.00 m.
115.	Whitish-gray, fine-grained, thin-bedded, sandstone inter-bedded with black-gray sandy shale	19.10 m.
116.	Light brown-yellow to yellow, massive, calcic and micaceous sandstone intercalated with whitish-gray sandy shale	4.00 m.
117.	Whitish-gray, calcic sandstone	3.00 m.
118.	Green-yellow, golden yellow, shaly sandstone interbedded with gray sandy shale	10.00 m.
119.	Gray shale and sandy shale interbedded with whitish-gray fine grained, micaceous sandstone	10.00 m.
120.	Yellow, dark-green, fine grained, massive, calcic sandstone interbedded with thin black shale	6.50 m.
121.	Gray-black, light brown-yellow, yellow, black shale, intercalated with light green thin-bedded micaceous sandstone at the lower part	3.00 m.
122.	Yellow, gray, dark green, shale intercalated with green-yellow, light brown thin-bedded micaceous sandstone at the middle and upper parts	8.00 m.
123.	Light brown-yellow, calcic sandstone containing felspar, intercalated with sandy shale	2.00 m.
124.	Light green, gray, brown, golden yellow shale and paper shale. Upper part containing lenticular sandstone	4.50 m.
125.	Light brown-yellow, fine grained, micaceous sandstone intercalated with light brown-yellow, sandy shale and shale	5.00 m.
126.	Golden yellow, gray, green-yellow sandy shale and shale intercalated with gray sandstone and argillaceous sandstone	11.00 m.
127.	Yellow-green, micaceous, calcic sandstone containing iron concretions	2.00 m.
128.	Gray sandstone containing mica interbedded with black shale	3.60 m.
129.	Whitish-gray to light green, fine grained, massive, micaceous sandstone intercalated with golden yellow shale. Basal part: Intercalated with argillaceous sandstone	7.00 m.
130.	Light yellow shale	3.90 m.
131.	Brown-yellow, massive, micaceous sandstone containing Plagioclase and Muscovite	7.90 m.
132.	Green-yellow, yellow-brown, golden yellow, light blue-gray, papery shale	8.50 m.
133.	Whitish-gray, light-green, massive micaceous sandstone	4.50 m.
134.	Green-yellow, whitish-gray, gray sandy shale and papery shale	3.40 m.
135.	Yellow-green, massive, calcic sandstone containing mica, with a bed of sandy shale at the middle part	5.00 m.
136.	Light-green, micaceous, calcic sandstone	9.70 m.
137.	Green-yellow, micaceous shale and sandy shale intercalated with shaly sandstone at the middle part	4.30 m.
138.	Gray marls interbedded with gray shale, and intercalated with a bed of very compact sandstone	3.20 m.
139.	Gray, brown, yellow, brown-yellow shale occasionally with papery shale, and containing iron concretions at the upper part	22.00 m.

140.	Light-green, fine-grained, micaceous sandstone	6.50 m.
141.	Dark green, Light-green, gray, brown-gray sandy shale and shale intercalated with gray, thin-bedded sandstone. Basal part: Calcic shale	17.50 m.
142.	Upper part: Dark green, fine-grained sandstone; Lower part: argillaceous sandstone interbedded with sandy shale	3.50 m.
143.	Green-yellow shale	5.00 m.
144.	Green-yellow, light-yellow sandy shale and shale, intercalated with shaly sandstone at the upper part and with lenticular sandstone at the lower part	15.00 m.
145.	Dark-green, light-green, micaceous, calcic and papery sandstone intercalated with gray calcic shale	2.00 m.
146.	Green-yellow shaly sandstone interbedded with green-yellow and gray sandy shale and shale	13.30 m.
147.	Light-green sandy shale and shaly sandstone occasionally intercalated with papery shale and marls	10.55 m.
148.	Light-green, fine grained, micaceous sandstone. Lower part: the sandstone is calcic and porous	1.65 m.
149.	Yellow-green argillaceous sandstone with good bedding plane	3.30 m.
150.	Yellow-green sandy shale interbedded with yellow-green shaly sandstone, argillaceous sandstone and marls	5.90 m.
151.	Yellow-green, light green, micaceous, papery sandstone	6.00 m.
152.	Light-green, micaceous, shaly sandstone intercalated with light-green sandy shale	17.50 m.
153.	Upper part: green-yellow, fine-grained, sandstone containing mica; Middle part: green-yellow, calcic, argillaceous sandy shale containing Mica; Lower part: shaly sandstone and micaceous fine sandstone; Basal part: light-green, micaceous fine-grained sandstone	10.80 m.
154.	Light-green shale, shaly sandstone and sandy shale	15.00 m.
155.	Upper part: light-green sandy shale and thin sandstone intercalated with calcic, massive shale; Lower part: light-green, fine grained thin-bedded, argillaceous, compact sandstone	5.50 m.
156.	Dark-green, light-green sandy shale and shale interbedded with dark-green, light-green shaly sandstone	34.30 m.
157.	Light-green fine-grained, micaceous sandstone intercalated with a bed of argillaceous sandstone	10.20 m.
158.	Light green, calcic, micaceous sandstone interbedded with light green sandy shale	5.00 m.
159.	Yellow-green, micaceous sandy shale and shale interbedded with sandstone	12.20 m.
160.	Gray, gray-green, grass-green fine grained, massive, calcic sandstone and sandy shale at the upper part; yellow-green, fine-grained, micaceous sandstone at the middle part; gray-green sandstone intercalated with sandy shale at the lower part	19.60 m.
161.	Light-blue-gray, yellow, papery shale	2.50 m.
162.	Light-green, yellow-gray, fine grained, thin-bedded sandstone at the middle and upper parts; gray-whitish, fine-grained, massive sandstone containing mica at the lower part	8.80 m.
163.	Light-blue-gray, yellow massive shale interbedded with papery shale	3.40 m.
164.	Light-gray-green, fine grained, massive sandstone containing Biotite and Muscovite and intercalated with calcic shale	4.20 m.
165.	Light gray-green, blue-gray, fine-grained, micaceous sandstone interbedded with gray and black papery shale or sandy shale, containing fragments of fossils	11.50 m.
166.	Light gray-green, gray-green, gray, black shale containing plant fossils and interbedded with light gray-green, light yellow-gray, fine grained sandstone containing mica	8.50 m.
167.	Light gray-green, micaceous sandstone intercalated with thin bedded sandy shale	9.50 m.
168.	Sericite, fine-grained sandstone interbedded with brown or gray shale, containing plant fossils	4.50 m.
169.	Gray-green, fine-grained, sandstone occasionally intercalated with thin bedded shale	8.00 m.
170.	Light-green, fine-grained, diagonal or cross bedded, calcic sandstone carbonaceous	

fragments and gray shale fragments .... 8.80 m.

The Yenchang Formation overlies disconformably the Shihchienfeng Series and underlies disconformably the Wayaopu Coal Series. The Wayaopu Coal Series has been recently divided into two parts, the lower part being called the Wayaopu Coal Series (sens. restr.) and the upper part now named the Ishihtsun Coal Series. Both species are characterized by an assemblage of the *Coniopteris-Phoenicopsis* flora of the Liassic-Dogger age. Regarding the characteristic flora of the Liassic-Dogger formations of Northern Shensi, the present writer intends to write a separate paper which will be published in the Acta Palaeontologica Sinica. The plant-localities and the vertical distributions of the Yenchang flora have been dealt with at some length in the second chapter of the conclusion of this memoir. Up to the present, there are about 36 localities of the Yenchang flora distributed in Northern Shensi and on the Shensi-Shansi border. A few localities are distributed in Western and Eastern Kansu (Sze & Lee 1951, p. 86—91). Very recently, a Mesozoic continental formation exceeds 1000 metres without any coal seams has been found in Inner Mongolia (former Ninghsia Province). According to the lithological characters, this formation belongs evidently to the Yenchang Formation (Chow & Chang, 1956, p. 58). Only two species, namely *Neocalamites carcinoides* and *Cladophlebis raciborskii* have hitherto been found from the Yenchang Formation of this part of China. Future explorations of the localities in Inner Mongolia for many more characteristic Yenchang elements are eagerly awaited. Up to the present, the best exposure of stratigraphical sections of this formation is in the region from the localities Matsekou and Kaoyenti of Tungchuan District to the locality Shihlangmiao of the Ichün District. The present writer wishes to express his deep gratitude to China Petroleum Administration and its director Mr. S. Chang, under whose directorship, the field work of this region was inaugurated, and Messrs. K. Chang, P. Chen, geologists of the Administration. The writer wishes to add his own sincere thanks to Messrs. J. S. T'ang and T. S. Kuan for accompanying him in a field trip to Northern Shensi in 1951 and collecting a large number of valuable material in the field.

The general columnar section published at the end of the Chinese text of this memoir was placed at the writer's disposal by the director and the geologists of the Petroleum Administration. The plant fossils described in this memoir have been collected from Beds 166 and 168, i. e. two uppermost plant-bearing horizons of the formation. According to this very detailed geological section, we know that the horizons of Beds 8, 17, 18, 77 and 80 contain plant fossils, and that those of Beds 70, 87 and 110 contain fossils, too. It is possible that future investigations of this important region will reveal many other plant-bearing horizons of this sections. As stated above (p. 182 of this memoir), the localities which belong to the lower part of the Yenchang Formation yield also abundant and well-preserved specimens of *Danaeopsis, Neocalamites, Equisetites* and *Ginkgoites magnifolia, Cladophlebis shensiensis, ?Protoblechnum hughesi, ?Sphenobaiera furcata,* etc. The names of these localities may be mentioned: Kaochian and Chiaoshang of Suite District, Taweiping and Yükou of the Chiahsien District and Machiawan and T'ipapao of Linhsien District (Shansi), Lichiayao of Hsinghsien District (Shansi), Chuanchiaochen of Shihlou District (Shansi), Santzuhokou of Chungyang District (Shansi) and Wumeng of Yungho District (Shansi). The writer is firmly convinced that future explorations in these localities may reveal a great many impressive fossil plants of the Yenchang Formation. Furthermore, the localities belonging to the Middle part and those belonging to the unknown stratigraphical position of this formation also deserve special attention in the future investigations.

Finally, it should be remarked that the material described in the present memoir represents only a part of the fossil plants actually occurring in the Yenchang Formation. We may confidently predicate that additional evidence will be forthcoming to prove the existence of many more important elements of the Yenchang flora in our localities. The study of the fossil plant-remains must necessarily be of considerable importance for the exploration of the vast oil-bearing sedimentary Yenchang Formation of Northern Shensi which is now being carried out by China Petroleum Administration and the Ministry of Geology of China. It has been the writer's good fortune to have been permitted to take part in this work. He hopes to be able to publish a second memoir and probably a third one on this important flora of North and Northwest China.

EXPLANTION OF PLATES (I–LVI)

The great majority of the illustrations are unretouched photographs by Mr. L. T. Liu. If not otherwise stated, the figures are in natural size. The original specimens are kept in the Institute of Palaeontology, Academia Sinica.

Plate I

Figs. 1, 1a. *Neocalamites carcinoides* Harris
Fig. 1a. Part of the same specimen × 2.
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate II

Figs. 1, 1a. *Neocalamites carcinoides* Harris.
Fig. 1a, Part of the same specimen × 2.
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 2. *Neocalamites carcinoides* Harris
Locality: Ch'ilitsun Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 3. *Neocalamites* sp.
Locality: Hsukoutsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 4. ***Equisetites sthenodon*** sp. nov.
Locality: Tipapao Linhsien District, Shansi.
Horizon: The basal part of the Yenchang Formation.

Fig. 5. *Equisetites sarrani* Zeiller
Locality: Ch'ilitsun Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate III

Fig. 1–3. *Neocalamites carcinoides* Harris
Fig. 1. Locality: Ch'ilitsun Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 2, 3, Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate IV

Fig. 1. *Neocalamites carcinoides* Harris
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 2, 2a. *Neocalamites carrerei* Zeiller
Fig. 2a, Part of the same specimen 2.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3, 3a. ***Equisetites deltodon*** sp. nov.
Fig. 3a. Part of the same specimen × 2.

Figs. 4, 5, 5a. *Equisetites sarrani* Zeiller (Fig. 5a, × 2).
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate V

Figs. 1, 1a. *Equisetites brevidentatus* sp. nov.
Fig. 1a. Part of the same specimen × 2.
Locality: Tipapao, Linhsien District, Shansi.
Horizon: The lower part of the Yenchang Formation.

Figs. 2, 2a, ***Equisetites acanthodon*** sp. nov.
Fig. 2a. Part of the same specimen × 3.
Locality: T'anhokou near shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 3. *Neocalamites brevifolius* sp. nov.
Locality. Ch'litsun, Yenchang District, Shensi.

Horizon: The upper part of the Yenchang Formation.

Fig. 4. *Equisetites* sp. (Strobili of *Equisetites*)
Locality: Ch'ilitsun Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate VI

Figs. 1, 1a, 2. *Equisetites sthenodon* sp. nov.
Fig. 1a. Part of the same specimen shown in fig. 1 × 2.
Locality: Fangêrhshang, Yaohsien District, Shensi.
Horizon: Unknown.

Figs. 3–5 5a. *Equisetites sarrani* Zeiller, (Fig. 5a, × 3).
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 6. *Neocalamites carrerei* Zeiller
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 7. *Neocalamites carcinoides* Harris
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 8. *Neocalamites* sp. (*Neocalamites carcinoides* Harris)
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate VII

Figs. 1, 1a, 2, 2a. *Neocalamites?* sp.
Figs. 1, 2. The lateral view of the pith-casts, showing the longitudinal ribs and furrows.
Figs. 1a, 2a. The top view of the same specimens, showing the nodal diaphragms of the pith-casts.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3, 4, 4a. *Equisetites?* sp. (Cf. *E. rogersi* Schimper, (Fig. 4a, × 3).
Locality: Kaoyenti, Tungchuan District, Shensi.
Horizon: The basal part of the Yenchang Formation.

Figs. 5–7, 7a. *Equisetites* sp. (Strobili *Equisetites*), (Fig. 7a, × 2).
Figs. 5, 6. Locality: Ch'ilitsun, Yenchang District, shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 7. Locality: Lichiayao, Hsinghsien District, Shansi.
Horizon: The lower part of the Yenchang Formation.

Plate VIII

Figs. 1–3, 1a. 3a. *Neocalamites rugosus* sp. nov.
Fig. 1a. part of the same specimen shown in fig. 1 × 2, showing a node with branch-scars and the zig-zag ornamentation of the outer surface of the cortex. Notice the characteristic longitudinal ribs of the *Neocalamites* type on the right side of the stem.
Locality: Hungchiatsunkou, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 2, 3, 3a. Part and Counterpart, fig. 3a × 3, showing the zig-zag structure of the outer surface of the cortex. Notice the detached linear leaves of the *Neocalamites* type.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate IX

Fig. 1. *Neocalamites carcinoides* Harris
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 2, 2a. *Neocalamites carcinoides* Harris
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3, 4. *Cladophlebis* cf. *gigantea* Ôishi
Fig. 3. Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. .4 Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 5, 5a. *Sphenobaiera crassinervis* sp. nov.

Fig. 5a. Part of the same specimen.
Locality: Huanglung District, Shensi (exact locality unknown).
Horizon: Unknown.

Plate X

Figs. 1–5. *Cladophlebis shensiensis* P'an (Figs. 1a, 2a, × 2).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XI

Figs. 1–3. *Cladophlebis shensiensis* P'an
Locality: T'anhokou near Shihlangmiao. Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XII

Figs. 1–5. *Cladophlebis shensiensis* P'an
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XIII

Figs. 1–4. *Cladophlebis shensiensis* P'an
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XIV

Figs. 1–5. *Cladophlebis shensiensis* P'an
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XV

Figs. 1–17. *Cladophlebis shensiensis* P'an (Figs. 1a, 2a, 3a, × 3).
Figs. 1–16. Fertile pinnae; Fig. 17. A detached, small, rounded sterile pinnule.
Localities: Ch'ilitsun, Yenchang District, Shensi; T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XVI

Figs. 1–4. *Cladophlebis szeiana* P'an (Figs. 1a, 2a,· × 3).
Figs. 1, 1a, 4. Sterile pinnae; Figs. 2, 2a, 3. Fertile pinnae; Figs. 1, 3. Specimens with entire or slightly lobed ultimate pinnae.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 5. *Cladophlebis shensiensis* P'an
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XVII

Figs. 1–5. *Cladophlebis szeiana* P'an (1a, 4a, × 3; 3a, ×2).
Figs. 1, 1a, 2, 2a Sterile pinnae; Figs. 3, 3a, 4, 4a, 5. Fertile pinnae; Fig. 1. Specimens with entire or slightly lobed ultimate pinnae; Figs. 2, 2a, showing the thick secondary veins attaining the same strength as the midrib; their branches retaining almost the same thickness the whole way to the margin, where they appear rapidly cut off, or even widen a little towards the margin.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XVIII

Figs. 1–5. *Cladophlebis shensiensis* P'an
Localities: Fig. 1. Ch'ilitsun, Yenchang District, Shensi; Figs. 2–5. T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 6. *Cladophlebis* sp. a
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon The upper part of the Yenchang Formation
Figs. 7–9. *Cladophlebis suniana* sp. nov
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi
Horizon: The upper part of the Yenchang Formation

Figs. 10–11. *Cladophlebis ichünensis* sp. nov.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XIX

Figs. 1, 1a, 2. *Cladophlebis kaoiana* sp. nov. (Fig. 1a, × 2).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 3–4. *Cladophlebis shensiensis* P'an
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XX

Figs. 1–3. *Cladophlebis kaoiana* sp. nov. (Figs. 1a, 2a, × 3).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXI

Figs. 1–4. *Cladophlebis stenophylla* sp. nov. (Figs. 1a, × 3; 3a, × 5).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 5. *Cladophlebis shensiensis* P'an
Locality: Chienhokou, Huating District, Kansu.
Horizon: The upper part of the Yenchang Formation.
Fig. 6. *Cladophlebis szeiana* sp. nov.
A small fragment of fertile pinna.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 7. *Cladophlebis raciborskii* Zeiller
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXII

Figs. 1, 1a. *Cladophlebis kaoiana* sp. nov. (Fig. 1a, × 3).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 2, 2a. *Cladophlebis paralobifolia* sp. nov. (Fig. 2a, × 2).
Locality: Yen-An District, Shensi (Exact locality unknown).
Horizon: Unknown.
Figs. 3, 3a. *Cladophlebis raciborskii* Zeiller (Fig. 3a, × 3).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXIII

Fig. 1. *Cladophlebis paralobifolia* sp. nov.
Part of the same specimen shown in pl. XXII, fig. 2 × 3.
Figs. 2, 2a. *Cladophlebis grabauiana* P'an (Fig. 2a, × 3).
Specimen reproduced by P'an 1936 (Figs. 1, 1a, pl. IX).
Locality: Yenchiaping, Suite District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 3, 3a. *Cladophlebis* cf. *gigantea* Ôishi (Fig. 3a, × 3).
Specimens reproduced by P'an 1936 (Figs. 1, 1a, pl. VII). Notice the thrice dichotomising secondary veins and the crenated margins of the pinnules.
Locality: Shatanping, Suite District, Shensi.
Horizon: The middle part of the Yenchang Formation.

Plate XXIV

Figs. 1, 1a, 2, 2a. *Cladophlebis graciles* sp. nov. (Figs. 1a × 2; 2a × 3).
Specimen of a frond or a penultimate pinna, showing the comparatively stout main-rachis and the oppositely attached linear-lanceolate ultimate pinnae with acute apex.
Fig. 2. A counterpart of the specimen shown in fig. 1.
Fig. 2a. Part of the same specimen shown in fig. 2, showing the characteristic venation.

Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXV

Figs. 1–4. *Cladophlebis graciles* sp. nov. (Figs. 2a, × 6; 3a, × 3; 3b, × 8).
Fig. 1. Specimen of an upper part of a frond (Penultimate pinna), showing the almost confluent pinnules of the ultimate pinnae at the top part of the frond.
Figs. 2a, 3a, 3b showing the characteristic venation.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXVI

Figs. 1–7. *Cladophlebis raciborskii* Zeiller (Fig. 1a, × 2).
Fragments of ultimate pinnae, showing the constantly twice dichotomising secondary veins and the dentate margins at the upper portion of the pinnules.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXVII

Figs. 1–5. *Cladophlebis raciborskii* Zeiller (Fig. 1a, × 2).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 6. *Cladophlebis shensiensis* P'an
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 7, 7a. *Phlebopteris? linearifolia* sp. nov. (Fig. 7a, × 3).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 8, 8a. *Sphenopteris* sp. (Cf. *Sph. arizonica* Daugherty), (Fig. 8a, × 2).
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXVIII

Figs. 1, 1a, 2. *Cladophlebis ichünensis* sp. nov. (Fig. 1a, × 2).
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 3, 3a. *Sphenopteris? chowkiawanensis sp.* nov. (Fgi. 3a, × 3).
Locality: Chowkiawan, Yenchang District, Shensi.
Horizon: Unknown.
Figs. 4, 4a. *Cladophlebis* sp. b. (Fig. 4a, × 2).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 5, 6. Undetermined Sterile Pinnae.
Locality: Taweiping, Chiahsien District, Shensi.
Horizon: The lower part of the Yenchang Formation.
Figs. 7, 8. Problematicum a.
Locality: Ch'ilitsun, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXIX

Figs. 1, 2. *Danaeopsis fecunda* Halle (Figs. 1a, 1b, × 2).
Figs. 1a, 1b. Parts of the same specimen shown in Fig. 1, showing the characteristic secondary veins which are anastomosed at the margin of the pinna.
Localities: Fig. 1. Taweiping, Chiahsien District, Shensi; Fig. 2. Machiawan, Linhsien District, Shansi.
Horizon: The lower part of the Yenchang Formation.
Figs. 3, 3a. *Bernoullia zeilleri* P'an (Fig. 3a, × 3).
Specimen of a pinna, showing the characteristic secondary veins which are repeatedly bifurcated, forming more or less separated fascicles.

Plate XXX

Figs. 1–4. *Danaeopsis fecunda* Halle
Fig 1. Specimen of a big pinnated frond, showing the very broad rachis (ca 2.5 cm) and the non-decurrent base of the

pinnae.
Locality: South of Hsiaomaho, Yaohsien District, Shensi.
Horizon: Unknown.
Figs. 2, 2a, 3. Fragments of pinnae; figs. 2, 2a showing the pinnae with the decurrent base.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 4. Fragments of pinnae, showing the characteristic venation.
Locality: Pingti, Shunhwa District, Shensi.
Horizon: Unknown.

Plate XXXI

Fig. 1, 1a–f. *Danaeopsis fecunda* Halle
Fig. 1. Impression of a fertile pinna reproduced by Sze & Lee 1952 (Pl. I, fig. 5), showing the carbonized remains of sporangia.
Fig. 1a-f. Part of the same specimen; Fig. 1a, × 3; fig. 1b, × 8; fig. 1c, 1d, 1e, × 15; fig. 1f, × 30. Sporangia partly opened.
Locality: Nanyungerh, Wuwei District, Kansu (Coll. by Mr. S. H. Li).
Horizon: The upper part of the Yenchang Formation.

Plate XXXII

Figs. 1–3. *Bernoullia zeilleri* P'an (Fig. 1a, × 2).
Impressions of sterile fronds, showing the secondary veins which are dichotomising into more or less separated fascicles.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 4. ?*Thinnfeldia major* Raciborski
Specimen of the top part of a leaf (or pinna), showing a long terminal segment.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXXIII

Figs. 1–3. *Bernoullia zeilleri* P'an (Figs. 1a, 1b, 1c, × 3).
Figs. 1, 2. Part and counterpart of a fertile frond, showing the arrangement of the sporangia and the comparatively thick rachis; Fig. 3. Fragment of a sterile frond, showing the characteristic venation.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 4. ?*Danaeopsis* sp.
Fragment of a young frond probably belonging to *Danaeopsis*.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXXIV

Figs. 1–4. *Bernoullia zeilleri* P'an (Fig. 3a, × 3).
Figs. 1, 2. Impressions of sterile fronds; Figs. 3, 3a, 4.
Fragment of sterile pinnae, showing the characteristic venation.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 5, 5a. *Thinnfeldia rhomboidalis* Ettingshausen (Fig. 5a, × 2).
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 6. *Thinnfeldia alethopteroides* sp. nov.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXXV

Figs. 1, 1a. *Sagenopteris spatulata* sp. nov.
Fig. 1a. Part of the same specimen shown in fig. 1, × 2, showing four spatulate leaflets attached palmately to a common petiole.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Figs. 2, 2a. *Sagenopteris* sp. (Fig. 2a × 2).
Fragment of a leaflet, showing a distinct midrib and the the repeatedly anastomosed secondary veins forming the elongated and polygonal meshes.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3, 3a, 4. *Ctenopteris sarrani* Zeiller (Fig. 3a, × 2).
Fragments of the top portion of sterile pinnae, showing the characteristic segments and venation.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 5. *Danaeopsis feunda* Halle
Fragment of a sterile pinna, showing the venation.
Locality: Pemafang, Lingyü District, Shensi.
Horizon: Unknown.

Plate XXXVI

Figs. 1, 1a, 1b, 2. *Sphenozamites changi* sp. nov.
All figures are in natural size. Fig. 1. Portion of a frond, showing two sets of lateral pinnae stretched deeply into the matrix of hard sandstone and forming an angle of 30° with each other; Fig. 1a showing the pinnae at the right side of specimen. Fig. 1b showing the pinnae at the left side of the specimen. Fig. 2. A detached pinna, showing the venation.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXXVII

Figs. 1–5. *Sphenozamites changi* sp. nov.
Detached pinnae, showing the venation, all figures are in natural size.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 6–8. *?Thinnfeldia nordenskiöldi* Nathorst
Detached terminal segments in natural size. Fig. 8. Specimen reproduced by P'an 1936 (Pl. XII, fig. 6).
Localities: Ch'imochiao, near Hsinshüping, Ichün District; Yenchiaping, Suite District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 9. *Bernoullia zeilleri* P'an
Impression of the upper portion of a frond, showing a terminal pinnule.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXXVIII

Figs. 1–3. *Sphenozamites changi* sp. nov.
All figures are in natural size.
Fig. 1. A fragment of a frond, showing two rhomboidal pinnae attached almost oppositely to the rachis, Fig. 2. A detached large rhomboidal pinna, showing the venation.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 4, 4a. *Glossophyllum? shensiense* sp. nov.
Fig. 4. Impression of a leaf, showing the very narrow leafbase; Fig. 4a, Part of the same specimen, × 2, showing the venation.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XXXIX

Figs. 1–3. *Sinozamites leeiana* gen. et sp. nov.
Fig. 1. A fragment of a frond, showing the almost oppositely attached linear leaves with dissected and truncated apex; Fig. 1a. Part of the same specimen, × 2, showing the stalk-like leaf-base and the venation.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XL

Figs. 1, 1a, 2. *Drepanozamites? p'ani* sp. nov.
Fig. 1. A fragment of a frond, showing the pinnae which are broadest at the base and attached at basal corner; Fig. 1a. Part of the same specimen × 2, showing the vaguely defined midrib and the dichotomising secondary veins.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3 *Ginkgoites choui* sp. nov.
A fragment of a leaf in natural size, showing the venation and the folding surface of the leaf.

Figs. 4–6. *[illegible]* sp. nov.
Three fragments of stem, showing the zigzag ornamentation of the outer surface of the cortex.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XLI

Figs. 1–3. *Thinnfeldia rigida* sp. nov. (Fig. 1a, × 2).
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XLII

Figs. 1, 2, 2a. *Thinnfeldia rigida* sp. nov. (Fig. 1 × 2; Fig. 2a, × 2).
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 3. *Thinnfeldia major* Raciborski
Impression of the upper portion of a pinna, showing the long terminal segment.
Locality: Yen-An District, Shensi (Exact locality unknown).
Horizon: Exact horizon unknown.

Plate XLIII

Fig. 1. *Danaeopsis fecunda* Halle
Specimen reproduced by P'an 1936 (Pl. X, fig. 3). Sterile frond with remains of seven pinnae, showing the non-decurrent pinna-base and the characteristic venation. This specimen agrees in all respects with the type-specimen found from Scania, Sweden (Halle 1921, Pl. 1, fig. 1).
Locality: Yenchiaping, Suite District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 2. *Bernoullia zeilleri* P'an
Sterile frond with remains of ten pinnae, showing the comparatively broad rachis with a distinct median ridge and flat, wing-like flanks.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3, 4. *Thinnfeldia rigida* sp. nov.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XLIV

Figs. 1–4. *Thinnfeldia laxusa* sp. nov. (Fig. 1a, × 3).
Sterile fronds, showing the distantly attached pinnae with strongly decurrent base.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 5, 5a, 6. *Bernoullia zeilleri* P'an
Fig. 5. A fragment of detached sterile pinna. Fig. 5a, × 2, showing the venation.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.
Fig. 6. A fragment of sterile frond, showing the short ovoid, oblong and ellipsoid pinnae and the characteristic venation.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XLV

Figs. 1, 1a, 2. *Thinnfeldia alethopteroides* sp. nov. (Fig. 1a, × 2).
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3, 3a, 4. *Thinnfeldia laxusa* sp. nov. (Fig. 3a, × 3).
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XLVI

Figs. 1–3. ?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)
Specimens reproduced by P'an 1936 (Pl. IX, figs. 2, 4; Pl. X, fig. 1).
Figs. 1, 2. Locality: Yaoping, 1 li south of Panlungchen, Anting District, Shensi.
Horizon: The basal part of the Wayaopu Coal Series.
Fig. 3. Locality: Yehchiaping, Suite District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 4–6. ?*Protoblechnum hughesi* (Feistm.) Halle (?sp. nov.)
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XLVII

Fig. 1. *Ginkgoites magnifolia* (Fontaine)

Specimen reproduced by P'an 1936 (Pl. XII, fig. 9).
Locality: Kaochiaan, Suite District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 2. *Ginkgoites chowi* sp. nov.
Impression of a shovel-shaped leaf, showing the truncated leaf-base and the venation.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 3, 4. *Ginkgoites* sp.
Locality: Ch'imochiao near Hsinchüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 5. *Psygmophyllum*? sp.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 6, 6a, 6b. ?*Sphenobaiera furcata* (Heer) Florin
Fig. 6 shows a lamina of leaf with long and narrow ultimate segments. Figs. 6a, 6b show the cuticular structure of the lamina, 6a, × 100; 6b, × 250.
Locality: Lichiayao, Hsinghsien District, Shansi.
Horizon: The lower part of the Yenchang Formation.

Plate XLVIII

Figs. 1–3. *Glossophyllum*? *shensiense* sp. nov.
Three long leaves in natural size, broken both at the apex and at the base.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate XLIX

Figs. 1–6. *Glossophyllum*? *shensiense* sp. nov. (Fig. 5a, × 3).
Figs. 1–4. Impressions of leaves; Figs. 5, 5a, 6. Fragments of twigs, showing the densely and spirally arranged eye-shaped leaf-scars.
Figs. 1, 2. Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Figs. 3–6. Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate L

Figs. 1, 1a, 2, 2a, 3. *Glossophyllum*? *shensiense* sp. nov. (Figs. 1a, 2a, × 3).
Fig. 1. Specimen reproduced by P'an 1936 (Pl. XIII, fig. 1).
Locality: Shatanping, Suite District, Shensi.
Horizon: The middle part of the Yenchang Formation.
Fig. 2. Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Fig. 3. Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 4. *Sinozamites leeiana* sp. nov.
Part of the same specimen shown in pl. XXXIX, fig. 3, × 2, showing the venation and the dissected upper portion of the leaf.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate LI

Figs. 1–3. *Swedenborgia cryptomerioides* Nathorst
Fig. 1. Impression of a cone, showing the cone-scales and two detached seeds (S). Fig. 1a, 1b. Parts of the same specimen × 3.
Fig. 1. Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Figs. 2, 3. Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 4–6. ?*Stenorachis* (*Ixostrobus*?) *konianus* Ôishi & Huzioka.
Figs. 4, 5. Part and counterpart of a "cone".
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate LII

Fig. 1. *Podozamites lanceolatus* (L. & H.) Braun
A leaf-bearing shoot reproduced by P'an 1936 (Pl. XV, fig. 1).
Locality: Yenchiaping, Suite District, Shensi.
Horizon: The upper part of the Yenchang Formation

Fig. 2. *Thinnfeldia rigida* sp. nov.
A fragment of a bipinnate frond, showing a very broad main-rachis and a ultimate pinna with remains of three segments (or pinnules).
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 3. *Bernoullia zeilleri* P'an
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 4. *Danaeopsis fecunda* Halle
A fragment of a detached pinna, showing the obtuse or subacute apex of the pinna.
Locality: Lichiayao, Hsinghsien District, Shansi.
Horizon: The lower part of the Yenchang Formation

Plate LIII

Fig. 1. *Podozamites lanceolatus* (L. & H.) Braun
A leaf-bearing shoot reproduced by P'an 1936 (Pl. XV, fig. 3).
Locality: Yenchiaping, Suite District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 2. *Bernoullia zeilleri* P'an
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation

Fig. 3. *Cladophlebis raciborskii* Zeiller
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 4. *Chadophlebis ichünensis* sp. nov.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 5. *Sinozamites leeiana* gen. et sp. nov.
Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 6. *Desmiophyllum* sp.
Locality: Wangchiahsü, Chinchien District, Shensi.
Horizon: The middle part of the Yenchang Formation.

Fig. 7a. *Danaeopsis?* sp.
A young pinnate frond, showing the comparatively broad main-rachis and the small Taeniopteroid pinnae attached almost oppositely to the main rachis.

Fig. 7b. *Glossophyllum? shensiense* sp. nov.
A part of the same specimen shown in Pl. XLIX, fig. 5, showing a slender twig with characteristic eye-shape leaf-scars.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Plate LIV

Figs. 1, 1a. *Taeniocladopsis rhizomoides* gen. et sp. nov.
Fig. 1a. Part of the same specimen × 2, showing a distinct "midrib" and the short, slender and linear appendages.
Locality: Chowkiawan, Yenchang District, Shensi (Exact locality unknown).
Horizon: Unknown.

Plate LV

Figs. 1–4. *Taeniocladopsis rhizomoides* gen. et sp. nov.
Figs. 1–3, show the bases of the "axes" attached to the rhizomes of the *Neocalamites* type, with very short internodes and the longitudinal ribs.
Locality: Chowkiawan, Yenchang District, Shensi (Exact locality unknown).
Horizon: Unknown.

Fig. 5. *Glossophyllum? shensiense* sp. nov.
A small, spatulate leaf agreeing fairly well with the small leaf figured as *Glossophyllum florini* by *Kräusel* in 1943 (Taf. VIII, fig. 1) from the Lunzer Keuper of Austria. Kräusel designated his specimen as an "anormal geformtes löffelfömiges Blatt".

Figs. 6, 6a. Insect-wing (Fig. 6a, × 3).
Locality: Huanglung District, Shensi (Exact locality unknown).
Horizon: Unknown.

Plate LVI

Figs. 1, 2. *Thallites* sp. (Fig. 1a, × 3).
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 3. *Conites* sp.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Fig. 4. Problematicum b.
Locality: Kiaochiaping, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 5, 5a. Problematicum c. (*Muscites* sp.), (Fig. 5a, × 3).
Notice the distinct "Polsterbildung" or "Polsterwuchs" of the "axis".
Locality: In the vicinity of the Yenchang City, Yenchang District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 6, 7. *Radicites* sp.
Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

Figs. 8–14. *Carpolithus* spp. (Figs. 8a, 9a, 10a, 11a, 12a, 13a, 14a, × 3).
Fig. 8, Locality: Ch'imochiao near Hsinshüping, Ichün District, Shensi.
Figs. 9–14, Locality: T'anhokou near Shihlangmiao, Ichün District, Shensi.
Horizon: The upper part of the Yenchang Formation.

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