The Palaeobotanist, **31**(1): 45-51, 1983.

A NEW SPECIES OF PTERIDIACEAE — *PTERIDIUM DACHINGSHANENSE*

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ABSTRACT

A new fossil species, *Pteridium dachingshanense*, is described from the Early Cretaceous strata in Dachingshan Range of Neimonggol Autonomous Region (Inner Mongol), China.

The species shows some characteristics of *Pteridium*, such as the continuous marginal sorus and a true scarious indusium. It differs from the living bracken fern *Pteridium aquilinum* in its overall smaller size, more or less reduced pinnules, smaller combined terminal pinnules, and obscure venation. The secondary veins arising from the midvein near the base of the pinnules seem to form a little fan-like pattern.

New species traces the history of Pteridiaceae back to the Cretaceous period.

Key-words — Pteridiaceae, *Pteridium*, Dachingshan Range, Early Cretaceous, China.

सारांश

टेरीडिएसी की एक नव जाति – टेरीडियम् दैकिंगशानेन्से – वाँग जिकियाँग

चीन के नीमंगोल आटोनोमस क्षेत्र (आन्तरिक मंगोल) की दैकिंगशान श्रेणी में स्थित प्रारम्भिक क्रीटेशस स्तरों से एक नवीन पादपाश्मीय जाति, टेरीडियम् दैकिंगशानेन्से, का वर्णन किया गया है।

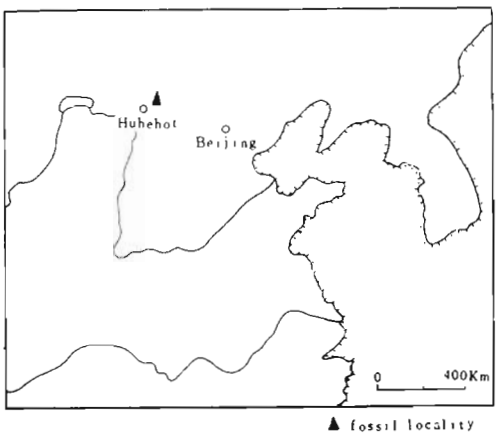
यह जाति टेरीडियम् के कुछ विशिष्ट लक्षण प्रदर्शित करती है जैसे कि अविच्छिन्न उपांतीय बीजाणुधानी एवं तद्रूप झिल्लीदार शोरसछद। वर्तमान ब्रेकन फर्न टेरीडियम् ऐक्वीलाइनम् से यह अपने छोटे आकार, प्रायः संकुचित पिच्छिकाओं, कुछ छोटी अग्रस्थ संयोजित पिच्छिकाओं तथा अस्पष्ट शिरा विन्यास के कारण भिन्न है। पिच्छिकाओं के आधार के पास मध्यशिरा से उत्पन्न द्वितीयक शिरायें छोटे पंखे की तरह का रूप धारण कर लेती हैं।

इस नवीन जाति से क्रीटेशस युग में टेरीडिएसी कुल की उपस्थिति का आभास होता है।

THE fern family Pteridiaceae was separated by Ching (1975) from the family Pteridiaceae. Its striking character is the double indusium, formed by the modified reflexed margin of pinnules (so-called false indusium) and the true indusium developing from the epidermal cells of pinnules. Initially the family was monotypic and included only one genus, i.e. *Pteridium* having a single cosmopolitan species *P. aquilinum* (L.) Kuhn (commonly called the bracken fern) with some geographical variants. Not long ago, these variants were raised to specific ranks. In 1978, Ching assigned the genus *Paesia* of Taiwan Province of China to the family.

So far the fossil records of the family are too few to learn its geological range and phylogenetic history accurately. Although a few specimens were referred to the genus *Pteridium* from the Cenozoic beds of Northern Hemisphere, none of them shows a sorus or indusium and hence their assignment to the genus is rather suspect.

During my travels to Dachingshan Range (Text-fig. 1) in Neimonggol Autonomous Region for geological survey in 1965, a number of well-preserved fossil plants, though fragmentary, were collected and examined. One of them while showing many important features of living bracken fern also shows several remarkable differences from the latter. After accurate observation and sufficient comparison the writer decides to attribute it to a new species of *Pteridium*.



TEXT-FIG. 1 — Map showing the locality.

The new species occurs in the sediments of the Early Cretaceous period dated on many important index fossil plants associated with it. From this the present writer concludes that the history of the family Pteridiaceae should be carried back to remote a past as Cretaceous. In the same way as few other ferns, the present day world-wide distribution of *Pteridium* also is relative to its rather antiquity.

DESCRIPTION

FAMILY — PTERIDIACEAE

Genus — *Pteridium* Scopoli, 1760

Pteridium dachingshanense sp. nov.

Pl. 1, figs 1-9; Pl. 2, figs 14-22; Text-figs 2, 3

Syntypes — D6-4663, D6-4829, D6-4895, D6-4888b, D6-4898, D6-4891.

Material — All the fossil specimens consist of impression and counter impression. The former (Pl. 1, figs 2, 7, 9; Pl. 2, figs 17, 20, 22, etc.) shows the ventral surface of pinnules with concave veins and their margin reflexed downwards. On the contrary, the latter (Pl. 1, figs 3, 5, 8; Pl. 2, figs 13a, b, 15, 16, etc.) shows the dorsal surface of pinnules including a continuous scarious band round a central elevation where the dorsal surface of pinnules is placed and between them, a dark-coloured, tubercular ridge which should be considered as a sorus along the margin of pinnules though the tubercles are faint in outline. Occasionally, there are few traces like the thickened cells of annulus (Pl. 2, fig. 14). Pl. 1, fig. 2 probably shows the apical region of a frond; Pl. 1, fig. 1 probably shows a basal bi-pinna of a frond with reducing pinnules; Pl. 1, figs 7, 9 may be the middle part of a frond and Pl. 2, fig. 22 shows the rachis with hairs on its dorsal surface. All these specimens, therefore, are listed as the syntypes for *Pteridium dachingshanense* sp. nov. and the reconstruction (Text-fig. 2) is made on them.

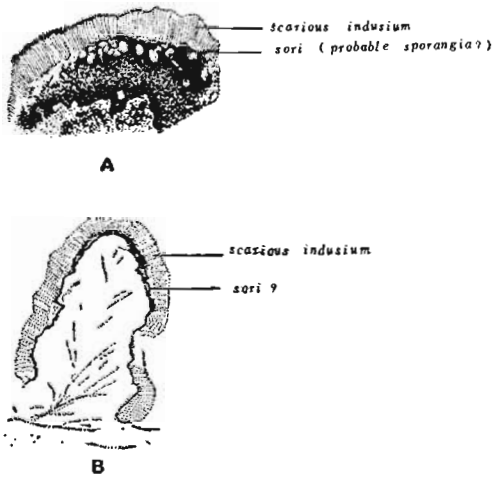
Description — Frond tripinnate at least. Apical pinnae in general, alternate to opposite, elongate to lanceolate in outline; basal pinnae often bipinnate, oval or oblong in outline, nearly 8 cm in length by 4 cm in width. All the pinnae attached to rachis at nearly right angle. Rachis delicate, slightly flexed with a smooth, grooved ventral surface and prominent dorsal surface with some hairs. Pinnules ovate to triangular with obtuse or rounded, opposite

TEXT-FIG. 2 — *Pteridium dachingshanense* sp. nov.— Reconstruction of a frond, × 1.

to alternate, closely set, gradually contiguous each other with their base toward the distal end of pinnae and eventually passing into a remarkable terminal pinnule. The margin of pinnules reflexed downward. A number of parallel, fine strips present all over surface of pinnules (in high magnifier). Mid-vein obscure, lateral veins fine, often once-formed near the base of pinnules. Sorus clearly continuous along the margin of pinnules. The more developed the sorus, the stronger the reduction of pinnules. Indusium double: a true scarious indusium covered regularly with dense fine strips in correspondence with the surface of pinnules and a false indusium (reflexed margin of pinnules). Sporangia and spores unknown.

Comparison & Discussion — Among the living ferns, a few genera, e.g. *Pteris*, *Histiopteris*, etc. of Pteridiaceae and *Aleuropteris*, *Sinopteris*, etc. of Sinopteridaceae also have continuous marginal sorus with a sorus having a scarious indusium and their sporangia as well as spores are more or less similar to *Pteridium*. But their "scarious indusium" is formed by the reflexed margin of pinnules (so-called false indusium) and differs from the true scarious indusium developing from the epidermal cells of pinnules as in *Pteridium*. The former lacks the regular microscopic sculptures of epidermal cells as latter. Pl. 2, fig. 10a shows the dorsal surface of a *Pteris* pinnule: the upper half showing veins extending onto the reflexed margin of pinnule where sorus is undeveloped; the lower half showing the scarious false indusium where the sorus develops. Certainly the rest of pinnule is no longer reflex.

In the fossil materials, it is difficult to identify the double indusium because of the poor preservation. However, on the impression a distinct scarious band may be clearly seen when the slightly reflexed margin of pinnule has been taken off (Pl. 2, fig. 16). On counter-impression, the band always occurs near the outside of marginal sorus and has no traces of veins on it (Text-fig. 3). Its surface is sculptured with many regular fine strips, not wrinkles, unlike the sinuous outline of cells in living bracken fern and in correspondence with those on the epidermal surface of pinnule itself (Pl. 2, fig. 17). Therefore, based on the features and its position in the pinnule, this kind of scarious band should be considered as a true indusium for the fossil plant rather than false scarious indusium as in *Pteris*.



TEXT-FIG. 3 — *Pteridium dachingshanense* sp. nov. showing the true scarious indusium and continuous sori; **a**, × 30 from the same specimen as Pl. 2, fig. 5; **b**, × 8 from the same specimen as Pl. 2, fig. 4.

In addition, there are some another features depending on which the present specimens may not be identified with *Pteris*. In marginal sorus being discontinuous near the apex of pinnules they differ from *Pteris*; in the opposite pinnae having stipule-like basal pinnules and anastomosing veins from *Histiopteris*; in the larger bipinnatifid basal pinnae and the ceraceous dorsal surface of pinnules from *Aleuritopteris*; in the smaller size, the digittate tri- or quinquefoliate frond, the ceraceous covering instead of hair and the dichotomous veins from *Sinopteris* and so on. So far as we know, this kind of scarious indusium does not occur in the members with synangiate sporangia of the Eusporangiatae.

In the light of the above-mentioned features, it is suitable to attribute the present specimens to the genus *Pteridium*, though the sporangia and spores are not known.

In the general features of pinnae, pinnules, rachis, sorus and indusium *Pteridium dachingshanense* is certainly like the living bracken fern, but there are some important distinctions between them. Firstly, the new species is much less than the bracken in size and has smaller terminal pinnules. Secondly, the new species often has strongly reduced

pinnules than the bracken, its fan-like venation is more obscure while the bracken fern has pinnate venation. Finally, in the new species the parallel strips on the scarious indusium also differentiate it from the sinous lines of cells in living one.

As we know, only a few specimens have been assigned to the genus *Pteridium* for example: by Straus (1952, p. 17, pl. 2, fig. 14) from the Pliocene of Germany; by Takhtajan (1963, p. 194, pl. 1, figs 6-12) from the Neogene of USSR; by Axelrod (1966, p. 61, pl. 5, figs 1-3) and by Weber (1851, p. 154, pl. 18, figs 3, 3b) as *Pteris crenata* from the Tertiary of Germany and so on. But all the specimens are fragmentary, many only an individual pinnule with neither a sorus nor an indusium. In fact, their assignation should be in doubt. From the Early Cretaceous of Siberia, a specimen described as the fertile pinna of *Arctopteris kolymensis* Samylina (1964, p. 51, pl. 4, fig. 2) and a specimen described as fertile pinna of *Tchucotopteris* (Vassilevskaya, 1977, p. 126, pl. 12, fig. 3) are somewhat similar to the new species in the more or less marginal sorus. But they clearly differ from the latter in discontinuous sorus and nothing is known about their indusium. Some specimens described by Fontaine (1889, p. 68, pl. 3, fig. 2; pl. 6, figs 10, 11a) as sterile pinnae of his *Cladophlebis constricta* from the Early Cretaceous Potomac Group are also similar to *Pteridium* in their terminal pinnules. However, without fertile pinnules it is impossible to accurately classify the American specimens.

Living bracken fern has rather wide adaptability to environment; from wetter shelter under the forest to arid grassland in the sun. In the beginning of the century, some experiments concerning the subject were conducted (Boodle, 1904). With the change in environment most of the fronds features such as size, hairs, texture, midvein, the reduced pinnules and sorus, etc. show remarkable variation, even in the same frond; the upper part exposed to the sun also appears more reduced than the lower part buried in dense grassmass. In accordance with the result of Boodle's experiments, it may be concluded that the new species lived in a rather arid environment than the living bracken fern.

Occurrence & Age — Zishaying Village, Zhuozixien District, Dachingshan Range in Neimonggol Autonomous Region, People's Republic of China (located to the east of the famous Huhehot, not far from the city).

The strata containing fossils mainly consist of yellowish-green coarse-grained continental sediments such as sandstones, conglomerates and a few mudstones, etc.

The age of the strata should be dated as the second half of Early Cretaceous based on the other fossil plants associated with the new species, such as: *Acanthopteris onychioides* (Vassil. & K.-M.), *Otozamites denticulatus* K. & P. (i.e. "Neozamites"), *Cephalotaxopsis asiatica* HBDYS, *Vitmia oblongifolia* (Zhang), and *Celatrophyllum* sp., etc.

ACKNOWLEDGEMENT

The author expresses his sincere thanks to Dr G. X. King of the Beijin Institute of Botany, Academia Sinica for his kind help in my work.

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EXPLANATION OF PLATES

All figures. × 1 unless otherwise indicated. All specimens are deposited in Tianjin Institute of Geology and Mineral Resources, Chinese Academy of Geological Sciences.

PLATE 1

1-9. *Pteridium dachingshanense* sp. nov.
1. Probable basal bi-pinna with the reducing pinnules (counter-impression), D6-4829. 1a.× 2.
2. Probable summit of a frond (impression), D6-4663. 2a.× 2.
3-6, 8. Pinnae, showing the continuous sorus along the marginal pinnules (counter-impression), D6-4896b, 4926, 4888, 4898c, 4861. 3 & 5.× 2; 6.× 4.
7, 9. The pinnae of mid-part of a frond (impression), D6-4902, 4895. All. × 2.

PLATE 2

10. A part of a pinnule from living *Pteris*.
10a. Dorsal surface, the upper half showing the unmodified reflexed margin with the branches of veins; the lower half showing many sporangia.× 8.
10b. Ventral surface, the lower half showing the scarious false indusium.× 8.
11, 12. Living *Pteridium* (bracken fern).
11a. Dorsal surface.× 2.
11b. Ventral surface.
12. Apex of a pinnule, dorsal surface, showing the outer false indusium and the inner true indusium. × 8.
13-22. *Pteridium dachingshanense* sp. nov.
13-15. Pinnules (counter-impression) showing the continuous sorus and the true scarious indusium. × 4.
13a. Showing the trace of thickened cells of annulus (under the sagittate sign).× 15.
14. Showing the regular fine strips in scarious indusium.× 30. D6-4888b, 4898, 4961.
16-18. Pinnules (impression), right showing the reflexed margin of pinnules and left exposing the true scarious indusium where the reflexed margin of pinnule has exploited, D6-4904.× 4.
17. Upper right exposing the true scarious indusium, D6-4666.× 8.
18. Unmature pinnule with a narrow scarious indusium beneath its margin, D6-4666.× 8.
19-21. The part of bi-pinnae, D6-4891, 4888d, 4888a, all × 2.
22. The dorsal surface of rachis showing hairs on it. D6-4891.× 8.

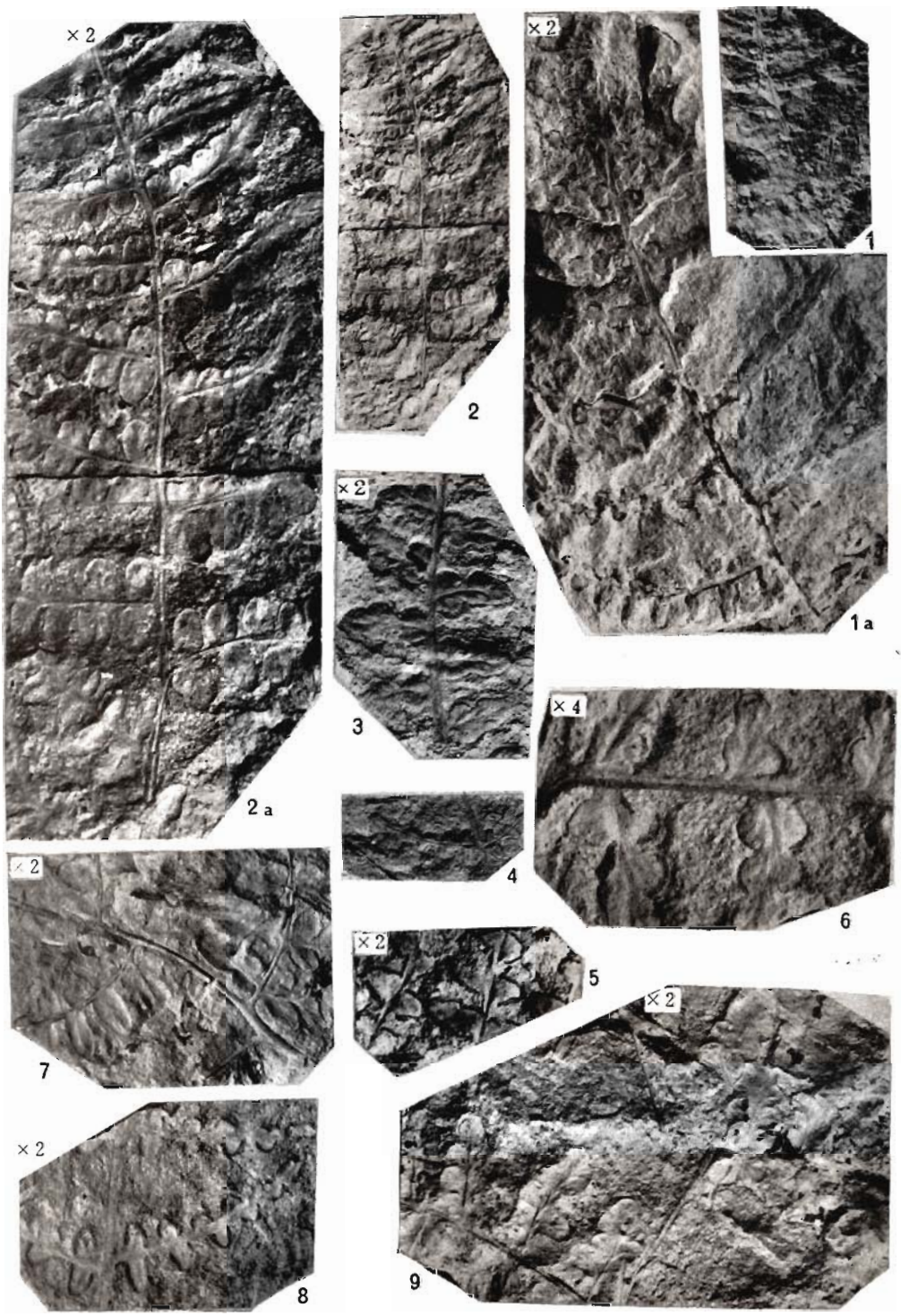

PLATE 1

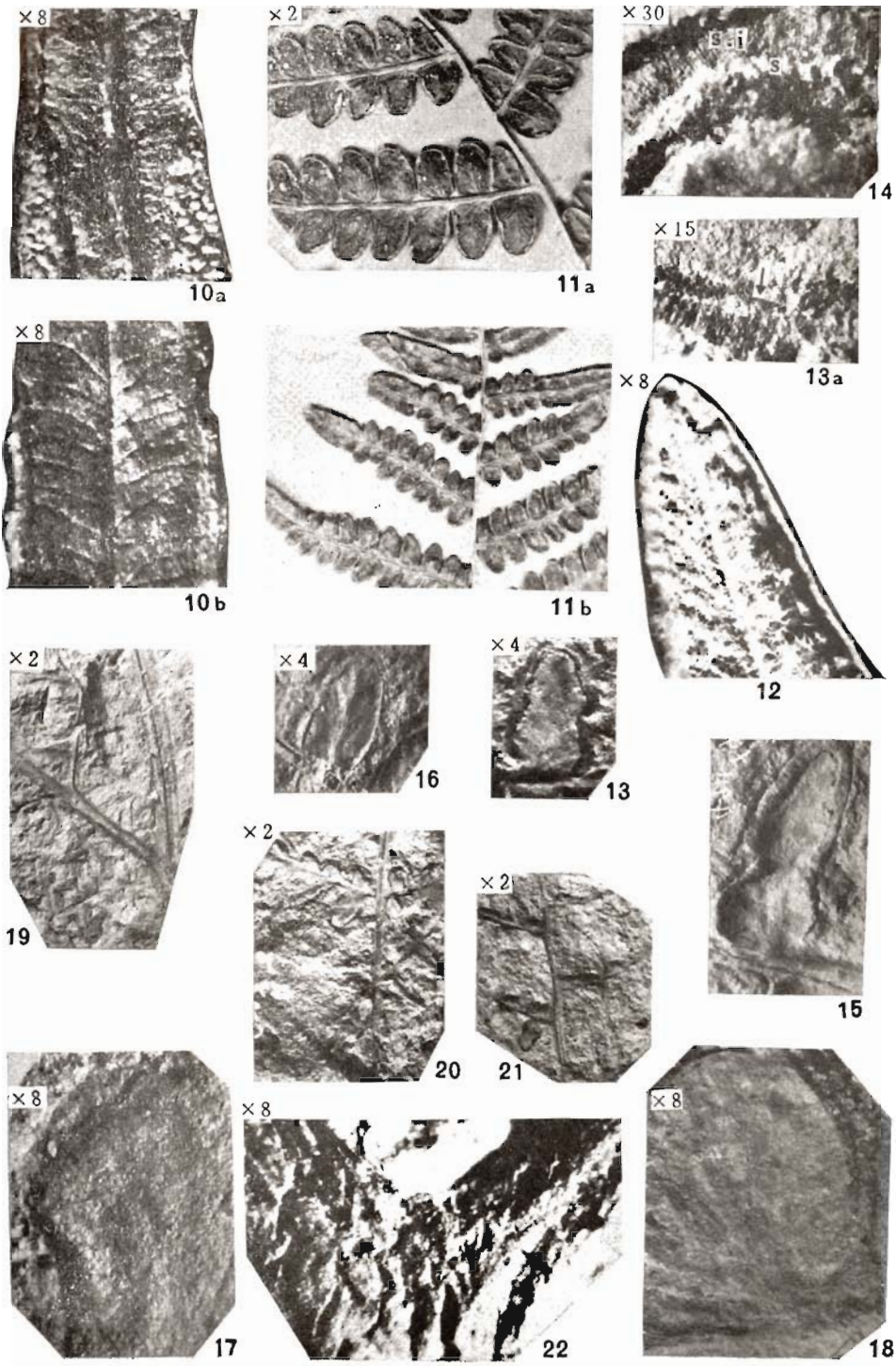
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PLATE 2