New gymnosperms from the Lower Cretaceous of the Primor'ye

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ABSTRACT: A new species of Caytonia, C. orientale, and a new genus and species Chankanella vachrameevi are described from Neocomian-Aptian coal bearing strata in the Primor'ye Territory, Suifun basin. The new species of Caytonia is differentiated from C. sewardii Thomas and C. canadensis (Berry) Bell on the basis of size and slight morphological variances. Only one specimen of a megasporophyll was available for study. Leaves found in the same stratum and attributed to the new species differ from other species of Sagenopteris chiefly in the greater length of the petioles of the leaflets. Chankanella vachrameevi is described as a Sagenopteris-like leaf. It differs from Sagenopteris in having a larger number of leaflets and in lacking anastomoses of veins in the leaflets. It is compared with Lesleva Lesquereux. Its leaflets are compared with Thinnfeldia pinnae, and the leaves of Tersiella Radczenko, Linquifolium and Protophyllocladus. – F. M. Hueber.

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In this paper two gymnosperms of an unusual type are described, one of them a new species of the genus Caytonia Thomas, 1925; the other is considered to be a member of a new genus, possibly belonging to a special, hitherto little studied group of gymnosperms similar to the Caytoniales.

At present only a few species of Caytonia are known, mainly from the Jurassic deposits of England and Greenland. Only one species, C. canadensis (Berry) Bell is known from the Cretaceous. The new species C. orientale sp. nov. comes from the Lower Cretaceous deposits of the Suifun coal basin, which consists of coal measures concordantly overlapping strata of tuffaceous sandstones. From the fossil plants contained in them the coal-bearing strata are dated as Neocomian-Aptian and the tuffaceous deposits above them as Albian (Vakhrameyev, 1961). We found C. orientale at the top of the coal deposits and in the tuffaceous sandstones.

The plant belonging to the new genus Chankanella was found in strata of tuffaceous siltstones and acid tuffs on the west shore of Lake Hanka. For a long time these tuffaceous deposits were thought to be Tertiary, until Vakhrameyev (1959), after studying plant remains collected from them, proved their age to be Early Cretaceous.

The numerous fossil plants we collected from the tuffaceous strata on the west bank of Lake Hanka enable these strata to be correlated with the tuffaceous sandstones lying above the coal in the Suifun basin and date these strata as Albian.

The material described is in the Far Eastern Geological Institute of the Far Eastern Branch of the Siberian Division, U. S. S. R. Academy of Sciences (FEGI).

Genus Caytonia Thomas, 1925

Caytonia orientale Krasilov, sp. nov.

Plate I (original Plate XVI), Illus. 1, 2

Holotype: FEGI, No. 14/31; Primor'ye Territory, Suifun basin, left bank of the 2nd Krest'-yanka river, opposite the village of Il'ichevko; Lower Cretaceous.

Diagnosis: Megasporophyll consists of a thin axis, dichotomous at the apical point, from which small, egg-shaped cupules are suspended by very short petioles. The leaves are palmatisected, the pinnae equipped with a long petiole. They are of oval or oblong shape in their entirety, with the apical point blunt or acuminate and the base asymmetrical. The median vein is thick and can be traced as far as the apical point of the pinna. The lateral veins emerge at an acute angle, are dichotomous and anastomotic.

Description: The megasporophyll has a slender and, to judge from the state of preservation, flexible axis about 1 mm thick, covered with longitudinal valleculae (plate I, illus. 1). At the apical point the axis is dichotomous, forming very slender, arcuate branches about 1 cm long. A cupule attached to the end of one of the branches has been preserved. This obviously undeveloped cupule is ovate in shape and of somewhat angular outline. Its length is 2 mm and its width 1 mm. Only one of the cupules attached to the axis below the branching point has been preserved. This was attached by a very short petiole and hung downwards. It too is egg-shaped, gradually dilating from the base towards the rounded distal end. Its length is 4.5 mm, width 3 mm. The cupules have been preserved as molds reflecting only the character of their outer surface; it is impossible to tell what the

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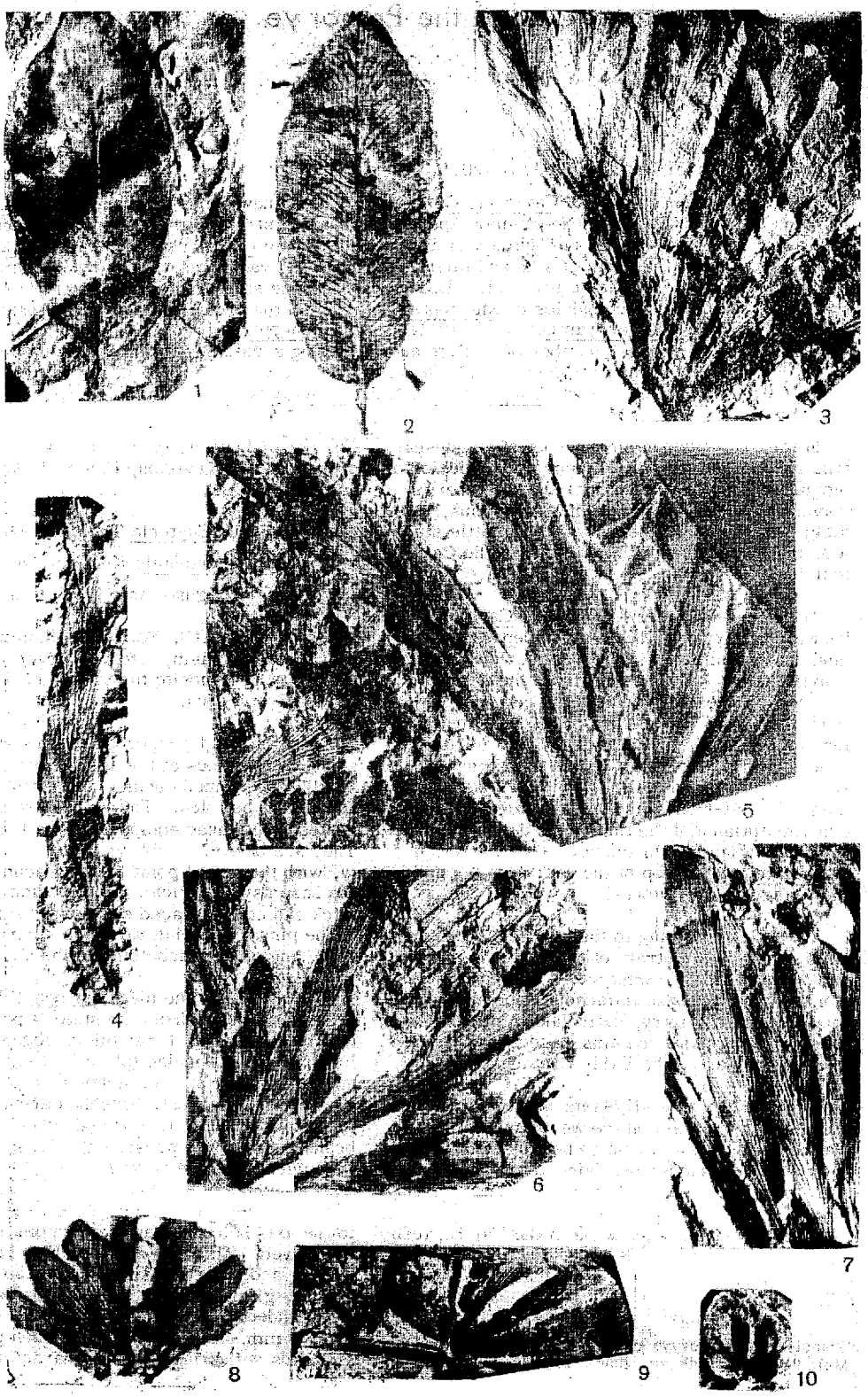

Plate I (original Plate XVI)

internal structure was like. Slight convexities, obviously impressions of the seeds which were inside the cupule, can be seen on the surface. No traces of the so-called stigma could be detected. In one layer Sagenopteris leaves, obviously belonging to the same plant, were found along with the megasporophyll just described. In one of the specimens (no. 14/28) impressions of two pinnae have been preserved, the petioles of which were attached to a common base. These pinnae, the smallest of those found, are oblong-oval in shape, the apical point is blunt and the base slightly asymmetrical. They are 2.5 cm long and 1.2 cm wide; the length of the pinna is 1 cm. In most cases scattered pinnae occur. Plate I, illus. 2 shows a medium-sized pinna (specimen no. 14/30) of oval shape, with complete margin, acuminate apical point and asymmetrical base. Length of pinna 5 cm, width 2.5 cm. The petiole is about 1 mm thick and more than 1 cm long (the whole length has not been preserved). The largest pinnae are more than 8 cm long and 3.5 cm wide. Venation in all cases monotypic. Median vein thick, reaching the apical points of the leaf. Lateral veins comparatively thin, emerging at an angle of about 60° and 1 mm apart from one another, dichotomous at the base, after which both branches again split two or three times. Anastomotic, forming a simple network with oblong-shaped cells. These gradually become smaller towards the leaf margin and at the margin itself are 1.5 mm long and about 1 mm wide.

Comparison: The C. orientale megasporophyll outwardly resembles that of C. sewardii Thomas (1925) but is distinguished by the ovate, instead of rounded shape of the cupules, which are, as it were, suspended from the axis instead of directed upwards, as in C. sewardii and other Jurassic members of this genus. More detailed comparison is impossible, since the material is not in sufficiently good condition to permit study of the anatomical structure. The megasporophyll of C. canadensis (Berry) Bell (Bell, 1956) is similar, except that the axis is thicker, the cupules are much larger and the petiole is comparatively long.

The chief characteristic of the leaves in the new species is that the pinnae have long petioles. In the Jurassic members of the genus Sagenopteris Presl, 1938, the pinnae are usually sessile or have a very short petiole, as in S. colopodes Harris (1940). The Sagenopteris leaves in which the pinnae are equipped with a long petiole, occur as a rule in Cretaceous deposits. Of these, the most similar are S. williamsii (Newb.) Bell (Bell, 1956). The difference is that in this species the pinnae are very broad, almost round. S. petiolata Oishi (1940), also has pinnae with petioles, but they are very small and obovate instead of oval.

Geologic and geographic range: Lower Cretaceous; South Primor'ye; Suifun basin.

Material: One impression of a megasporophyll and 10 impressions of leaves, collected from the top of coal-bearing deposits found on the left bank of the 2nd Krest'yanka river opposite the village of Il'ichevko. Three impressions of leaves were found in tuffaceous sandstones on the left bank of the 3rd Krest'yanka river, 2.5 km above its mouth.

Genus Chankanella Krasilov, gen. nov.

Type species: Ch. vachrameevi sp. nov.; Lower Cretaceous; South Primor'ye.

Diagnosis: Small leaves, palmatisected, with long petiole, consisting of 10-12 pinnae. Pinnae sessile, entire, oblong. Venation pinnate; median vein distinctly expressed in the inferior part of the pinna, disappearing outside the apical point. Lateral veins emerge at a very acute angle, splitting usually three times. No anastomosis.

Species composition: Type species.

Comparison: By comparing the material with plants possessing similar morphological characteristics we can try to reach some conclusions in regard to the systematic position of the new genus. The compound leaves of Chankanella are similar in general appearance, shape of pinnae and character of venation to the Caytonia leaves described under the generic name Sagenopteris Presl, 1938. The difference consists in the large number of pinnae making up the compound leaf in Chankanella and in the absence of anastomoses between the veins.

The similarity between the new genus and certain late Paleozoic pteridosperms, in particular with members of the glossopterid group, must

Legend to Plate I (original Plate XVI)

Illus. 1, 2. Caytonia orientale sp. nov.

1) Holotype no. 14/31, part of megasporophyll (seen from the right) and individual pinna (x 1.5); 2) Spec. no. 14/30, fully preserved pinna with acuminate apex (x 1); 2nd Krest'yanka river, Lower Cretaceous.

Illus. 3-10. Chankanella vachrameevi sp. nov.

3) Holotype no. 25/90, leaf fragment (x 1); 4) Spec. no. 25/87, pinna fragment with preserved apex (x 1); 5) Spec. no. 25/114, fragment of large leaf (x 1); 6) Spec. no. 25/96, fragments of young leaves (x 1); 7) Spec. no. 25/115 (x 1); 8) Spec. no. 25/109, fully preserved young leaf (x 1); 9) Spec. no. 25/112, leaf with petiole preserved (x 1); 10) Spec. no. 25/120, husk with ovules (x 2); Lake Hanka, Lower Cretaceous.

be noted. The leaves of Lesleya Lesquereux, 1879, for example, are indistinguishable from those of Chankanella by the character of the venation and can be distinguished only by their much larger dimensions.

Some species of the genus Thinnfeldia Ettingshausen, 1852, for example, Th. nordenskioldii Nathorst, have compound pinnate leaves, individual segments of which are very similar in shape and venation to the Chankanella pinnae, although the structure of the leaf as a whole is quite different. Certain gymnosperms of unknown systematic position also bear a definite resemblance to Chankanella. These include the genus Tersiella Radczenko, 1960, known from the Upper Permian and Lower Triassic deposits of Siberia. This plant has leaves of similar shape and venation to the Chankanella pinnae. The difference is that in Tersiella, instead of one median vein, there is a characteristic bundle of approximate veins (Radczenko, 1960). Radczenko suggests that the Tersiella leaves were attached to the shoot spirally.

The Late Triassic genus Linquifolium Arber, 1913, has been described as having simple leaves of oblong or linquiform shape, with median venation well expressed in the inferior part of the leaf, from which dichotomous lateral veins, without anastomosis, diverge at an acute angle. It was impossible to detect any important differences between these leaves and certain Chankanella pinnae which often occur in isolation; Walkom (1919), however, showed that the Linquifolium (Phyllopteris) leaves were more probably segments of a compound pinnate leaf.

Also indistinguishable from the Chankanella pinnae are the leaves or cladodes of a possible Late Cretaceous plant, Protophyllocladus Berry, 1903, which is compared with the modern Phyllocladus Richter and therefore assigned to the conifers; but there is insufficient proof of this. Seward and Conway (1935), after studying the structure of the epidermis in Protophyllocladus subintegrifolius (Lesq.) Berry, found that they could not go beyond assigning it to the Spermophyta. It is suggested that the leaves or cladodes of Protophyllocladus were spirally attached to the shoot, but in my opinion this plant may well have had compound pinnate leaves.

Thomas (1925) showed that the palmatisected leaves of Sagenopteris could have originated as a modification of the pinnate leaves due to a reduction in the number of pinnae and of the distances between them. It is possible that the Chankanella leaves also originated in this way. If this is the case, the difference between them and the leaves of Linquifolium and Protophyllocladus may not be so profound as appears at first glance.

Plate I, illus. 10 shows a husk which seems to me to belong to the reproductive organ of Chankanella and resembles Microcheiris enigma Harris, a flattened husk with five ovules described from the Lower Liassic of Greenland (Harris, 1935). Harris at first compared Microcheiris with the husk of Cheirolepis and with the cupules of Caytonia but later came to the conclusion that Microcheiris was one of the valves of the bivalve capsule of Leptostrobus, which contains five seeds (Harris, 1951). Plants which had female reproductive organs of the Leptostrobus type and leaves of the Solenites (Czekanowskia) type belonged, as Harris showed, to a particular group of gymnosperms very similar to Caytonia and the pteridosperms. If Chankanella really belongs to this group, which has still been little studied, the similarity of its leaves with those of Caytonia and of the pteridosperms is very remarkable.

Chankanella vachrameevi Krasilov, sp. nov.

Plate I (original Plate XVI), illus. 3-10

Holotype: FEGI, No. 25/90; South Primor'ye, west bank of Lake Hanka, 2 km north of the hamlet of Kamen'-Rybolov; Lower Cretaceous.

Diagnosis: Leaves palmatisected, consisting of 10 to 12 narrow pinnae. These are oblong, sometimes almost linear, gradually constricted towards the apical point and base. The apex is prolate, narrow, blunted at the end (plate I, illus. 4). Margins of pinnae entire in all the impressions we have. Size highly variable, but average length 7-8 cm, width 1-1.2 cm. Venation pinnate. Median vein distinctly expressed in the inferior part of the leaf; at the apical point it is dichotomous, branching into slender veins which are in turn dichotomous. Lateral veins emerge at an angle of 15-20°, are straight or slightly bent at the margin. These again branch dichotomously at a very acute angle, usually three times: at the base, midway between the median vein and the margin and beyond the margin. Anastomosis lacking. Five to seven veins can be counted per 5 mm on the margin of the pinna.

Description: The available material enables the variation in shape and venation of the leaves to be traced. Illus. 8 of Plate I shows a young leaf (specimen no. 25/109) consisting of 10 partially overlapping pinnae. The pinnae here are oblanceolate in shape, narrowing gradually towards the base and more abruptly towards the blunted apex (plate I, illus. 4). Length of pinnae 2-2.5 cm, width 0.7-0.8 cm. Median vein not expressed in them: it branches dichotomously at the base of the pinna. We note the same characteristic in young Sagenopteris leaves.

Plate I, illus. 6 and 7 (specimen nos. 25/96 and 25/115) show more developed leaves, consisting of roughly 12 pinnae. Here the pinnae are oblong, almost linear in shape, comparatively narrow (0.6-0.8 cm wide) and up to 7 cm

long. The median vein is expressed at the base and usually branches slightly below the middle of the pinna. The veins on the impressions are expressed as sharp furrows or ribs.

Illus. 3 and 5, Plate I (specimen no. 25/90 and 25/114) show fully developed leaves, consisting of oblong pinnae with well expressed median vein. The largest pinnae are more than 10 cm long and 1.5 cm wide. On the impressions the pinnae overlap; they probably diverge radially from the apex of the petiole. The petiole has been preserved in a young leaf shown in Illus. 9 of Plate I (specimen no. 25/112). This is more than 2 cm long, about 3 mm thick and covered with longitudinal striae.

In one layer containing fossil leaves of the plant here described the impression of a husk with four ovules was found (plate I, illus. 10; specimen no. 25/120). The husk is circular, 6 mm in diameter. The ovules, to judge from the impressions, are oval or ovate, 3.5 mm long and 1 mm wide, with a constricted micropyle turned towards the base of the husk. Since the only other fossils found in this layer, apart from numerous Chankanella leaves, were remains of the fern Coniopteris, we can take it that this husk is most probably part of the Chankanella reproductive organ.

Geologic and geographic range: Lower Cretaceous; South Primor'ye, west bank of Lake Hanka.

Material: Thirty specimens with impressions of compound leaves and individual pinnae were collected from Lower Cretaceous tuffaceous deposits exposed on the west shore of Lake Hanka 2 km north of Kamen'-Rybolov. The impression of a husk, containing ovules, which is probably part of the reproductive organ of this plant, was found in the same place.

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