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CRETACEOUS AND LOWER CENOZOIC CHAROPHYTA FROM PERU

BY RAYMOND E. PECK AND CARL C. REKER¹

INTRODUCTION

Cenozoic charophyte oogonia have been described from North America, England, central Europe, and India. Cretaceous forms outside of North America have received no detailed study and have been included in paleobotanical works merely to complete the study of a more extensive flora.

Charophyte oogonia present in the sediments of South America are mentioned only incidentally in the literature of that continent. Two species of the fresh-water plant have been described by Fritzsche (1924) from the Cretaceous of northern Argentina; the occurrence of additional forms elsewhere in South America has been noted; but in the main the South America charophyte flora has been neglected.

Through the courtesy of Dr. Norman D. Newell of the American Museum of Natural History, the writers have had the opportunity of examining a large collection of charophytes from the Cretaceous and Cenozoic of Peru. Two of these forms are referred to described species from known horizons; the remainder are new.

The vertical ranges of many species of Charophyta are as yet undetermined, and the stratigraphic value of the plant must depend in some cases on a knowledge of its evolutionary history. This knowledge is admittedly sketchy and therefore inadequate to provide a conclusive stratigraphic statement. But the evolution of the plant, as far as it is known, does indicate some correlation between the developmental stage of the organism and the age of the enclosing strata. Certain characters of the oogonia, such as tubercles and calcified coronula cells in place, appear to be re-

stricted to Cenozoic forms throughout the world. Tubercles have been reported on one Jurassic species, *Chara bleicheri* Saprota, from France, but the interpretation of this species' characters is subject to doubt.

The writers are confident in placing in the lower Cenozoic a Peru assemblage in which one form has prominent tubercles, and in which another form is very large and has calcified coronula cells in place. Another assemblage from Peru not possessing these characters seems properly assigned to the Upper Cretaceous. Lower Cretaceous and earlier species are distinct, and similar or related forms are not present in the Peru samples in our possession. These conclusions pertaining to the geologic age of the sediments from which the Peru charophytes were obtained are in agreement with conclusions based on other stratigraphic evidence, according to a letter from Dr. Norman D. Newell.

The photographs comprising the text figures were retouched and arranged by Mrs. Vaona Hedrick Peck. Complete synonyms of the two previously described species are given by Groves (1933).

COLLECTING LOCALITIES

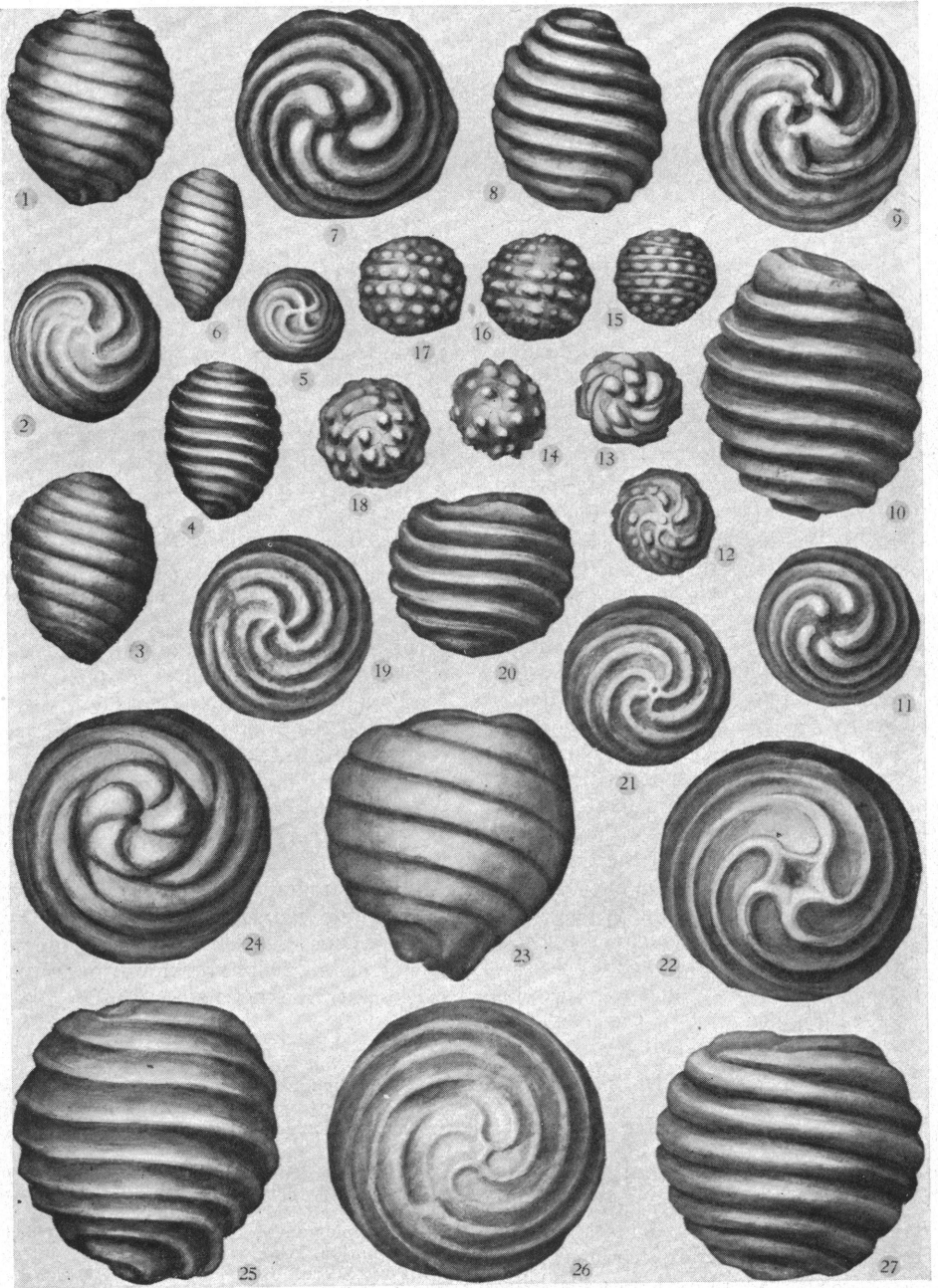
Lower Cenozoic

1. 16.5 km. N. 57 E. of Contamana Cemetery, Loreto, Peru. From just above marine Coniacian.

Cretaceous

2. Sample number 18B. Huayllabamba formation, 2.5 km. northeast of Cuzco, Peru.
3. Sample number 59. Bed *d* of Vilquechico formation, 1 km. southeast of Vilquechico, Puno, Peru. The horizon is 1700 meters above bed *f* of the Moho group.
4. Sample number 60. Base of bed *f*, Moho group, 4 km. southeast of Moho, Puno, Peru (Lake Titicaca). Horizon is 387 me-

¹ University of Missouri.



ters above marine Ayavacas formation of Aptian-Albian age.

5. Sample number 155. Same horizon as

sample number 59. Bed *d* of Vilquechico formation, 4 km. east-southeast of Putina, Puno, Peru.

SYSTEMATIC DESCRIPTIONS

CHAROPHYTA

Family Characeae

GENUS CHARA VAILLANT, 1719

Chara ovalis Fritzsche

Figures 7-11

Chara ovalis FRITZSCHE, 1924, Neues Jahrb., vol. 50, suppl. vol., p. 28, pl. 2, fig. 2; Cretaceous, northern Argentina.

Chara ovalis GROVES, 1933, Fossilium catalogus, II, Plantae, pars 19, p. 27.

Oogonia ellipsoid to ovoid with greatest diameter at or below the middle, size variable, ranging from 0.70 mm. to 1.30 mm. in length and 0.63 mm. to 1.04 mm. in width. Spiral ridges prominent, intercellular in position, eight or nine (rarely seven or 10) visible in lateral view. Spirals fail to join at summit, leaving small opening into oogonium, base round.

REMARKS: The above description is based on the study of more than 100 specimens procured by crushing the fine-grained limestone matrix. Not all of the 100 specimens are well preserved, and many of them are not completely free of matrix.

The illustration of *C. ovalis* given by Fritzsche is a generalized drawing to which many species of oogonia might be referred. Although the specific identity of the Peru forms is therefore uncertain, we can see no satisfactory means by which they may be differentiated without further knowledge of the type.

The illustrations of *Chara stantoni* Knowlton from the Bear River formation of Wyoming closely resemble our specimens

of *C. ovalis* in that Knowlton shows the greatest diameter as occurring below the middle. Examination of abundant topotype representatives of *C. stantoni* in our possession indicates that Knowlton orientated his specimens incorrectly and that the greatest diameter is above the middle.

The specimens under consideration show considerable variation in size and shape, but the study of abundant material has revealed sufficient gradation to allow us to include the specimens under the one species.

TYPES: Location of Fritzsche's types unknown. Figured specimens: A.M.N.H. Nos. 26406:1, 26406:2, and 26406/1:1-26406/1:3.

OCCURRENCE: Cretaceous, sample 18B, Huayllabamba formation, 2.5 km. north-east of Cuzco, Peru; samples 59 and 155, bed *d* of Vilquechico formation, 1 km. southeast of Vilquechico, Puno, Peru, and 4 km. east-southeast of Putina, Puno, Peru; sample 60, base of bed *f*, Moho group, 4 km. southeast of Moho, Puno, Peru.

Chara perlata, new species

Figures 19-21

Oogonia almost spherical, slightly broader than long, length 0.78 mm. and width 0.81 mm., with only slight variations in dimensions. Spiral ridges intercellular in position, seven or eight visible in a lateral view. Summit and basal areas broadly rounded to almost flat.

REMARKS: The above description is

Figs. 1-6. *Chara strobilocarpa* Reid and Groves. 1, 3, 4, 6. Lateral views. 2, 5. Summit views. All from locality 1.

Figs. 7-11. *Chara ovalis* Fritzsche. 7, 11. Summit views, samples 155 and 59. 8, 10. Lateral views, samples 59 and 155. 9. Basal view, sample 155.

Figs. 12-18. *Chara monilifera*, new species. 12, 13. Basal views of paratypes. 14, 18. Summit views of paratypes. 16, 17. Lateral views of paratypes. 15. Lateral view of holotype. All from locality 1.

Figs. 19-21. *Chara perlata*, new species. 19, 21. Summit and basal views of paratypes. 20. Lateral view of holotype. All from sample 59.

Figs. 22-27. *Aclistochara supraplana*, new species. 22. Basal view of paratype. 23, 25, 27. Lateral views of paratypes. 24. Summit view of holotype. 26. Summit view of paratype. All from locality 1.

All figures $\times 28.5$. All figured specimens are in the American Museum of Natural History.

based on the study of 17 specimens which were removed from a limestone matrix by crushing. *Chara perlata* is distinguished from the associated *C. ovalis* and from most other species by possessing a greater width than length. Other recorded species possessing that character, *C. compressa* Knowlton, *C. oehlerti* Dollfus, and *C. rajahmundrica* Sripada Rao and Narayana Rao, are all Cenozoic coronulate forms well over 1 mm. in diameter.

TYPES: Holotype, A.M.N.H. No. 26407: 1. Paratypes, A.M.N.H. Nos. 26407:2, 26407:3; U.M.¹ No. 31020-1.

OCCURRENCE: Cretaceous, samples 59 and 155, bed *d* of Vilquechico formation, 1 km. southeast of Vilquechico, Puno, Peru, and 4 km. east-southeast of Putina, Puno, Peru.

Chara monilifera, new species

Figures 12-18

Oogonia small, spherical, ranging from 0.42 mm. to 0.52 mm. in length and width. Spiral ridges low, intercellular in position, and partially obscured by prominent, regularly arranged tubercles. Seven or eight spirals visible in lateral view. Base on most specimens marked by small, centrally placed node, summit area by five tubercles arranged in a circle or ellipse.

REMARKS: The above description is based on approximately 100 well-preserved specimens which are remarkably uniform in size, shape, and development of tubercles. The few individuals that lack the tubercles appear to be worn.

Chara monilifera is a distinctive species and may be differentiated from all other recorded species of *Chara* by the small size, spherical shape, and extensive development of tubercles. *Chara bleicheri* Saporta from the Jurassic of France is described as tuberculate and resembles *C. monilifera* in size and shape. As previously stated, *C. bleicheri* is the only described species of charophyte from rocks older than Cenozoic that possesses tubercles. Groves (1933, p. 12) lists the species, but had evidently never seen it. Considering the size of *C. bleicheri* and the Jurassic age, we suggest that

the species probably should be referred to the Clavatoraceae Pia. Weathered specimens of *Clavator* with the utricle partially exfoliated may be pitted to an extent to resemble a tuberculate form (Peck, 1941, pl. 42, fig. 30).

TYPES: Holotype, A.M.N.H. No. 26408: 1. Paratypes, A.M.N.H. Nos. 26408:2-26408:7; U.M. No. 31020-2.

OCCURRENCE: Eocene, possibly Oligocene, 16.5 km. N. 57 E. of Contamana Cemetery, Loreto, Peru.

Chara strobilocarpa Reid and Groves

Figures 1-6

Chara strobilocarpa REID AND GROVES, 1921, Quart. Jour. Geol. Soc. London, vol. 77, p. 187, pl. 5, figs. 7, 8.

Chara strobilocarpa GROVES, 1933, Fossilium catalogus, II, Plantae, pars 19, p. 31.

Chara strobilocarpa SRIPADA RAO AND NARAYANA RAO, 1939, Mem. Geol. Surv. India, vol. 29, mem. 2, p. 7, pl. 1, fig. 7, pl. 2, fig. 7.

Oogonia of medium size, 0.63 mm. to 0.94 in length, and 0.48 mm. to 0.76 mm. in width, obovoid, with broadly rounded summit and fairly sharp taper to the base. Spiral ridges cellular or intercellular, on most specimens flattened and inconspicuous, nine or 10 visible in a lateral view. The spirals broaden and become slightly concave near the summit terminus, meeting at a conspicuous apical point.

REMARKS: The above description is based on approximately 150 well-preserved specimens. The specimens conform closely to Reid and Groves' description of the type from the Lower Headon Beds of England, but do not resemble the single specimen referred to this species by Sripada Rao and Narayana Rao. Distinguishing characters are the size, the distinct taper towards the base from a broadly rounded summit, and the meeting of the spirals at the summit in an apical point. The majority of our specimens are more completely calcified and show a smoother surface than the type illustrated by Reid and Groves.

The specimens we are referring to this species vary considerably in size and slightly in shape. The smallest specimens are slender and elongate, and the larger are distinctly obovoid. All gradations between the two extremes were found.

¹ University of Missouri.

TYPES: The primary types are probably in the British Museum (Natural History). Figured specimens: A.M.N.H. Nos. 26409:1-26409:6.

OCCURRENCE: Eocene, possibly Oligocene, 16.5 km. N. 57 E. of Contamana Cemetery, Loreto, Peru.

GENUS ACLISTOCHARA PECK, 1937,
EMEND. 1941

GENOTYPE: *Aclistochara bransoni* Peck from the Morrison of Wyoming.

Fossil charophyte oogonia can be divided into two large groups on the basis of summit characters. In one group the spiral units ascend to the area of junction at the summit with no apparent change in size or shape. Such fossil oogonia conform closely to the oogonia of modern Charophyta and are generally referred to the genus *Chara*. In the second group the spirals ascend to the summit periphery in a normal manner, then become abruptly narrowed and either concave or flattened. They continue as narrow, flattened spirals for a short distance, then turn abruptly in to the center of the summit and expand in width. On many well-preserved forms of this second group the summit area is occupied by five small triangular to oval nodes arranged in a circle and forming a collar around a small apical depression. These summit nodes have been observed only on fossil oogonia, and they have been variously interpreted. Reid and Groves (1921), Groves (1926, 1933), Sripada Rao and Narayana Rao (1939), and others have considered them as simply terminal expansions of the spiral cells. Dollfus and Fritel (1919), Peck (1937, 1941, 1944, 1946), Rasky (1941), and others have considered the nodes as true coronula cells that have calcified. The genus *Aclistochara* was defined by Peck (1937, emend. 1941) to include the oogonia with truncate summits not caused by breakage or with collars of five summit nodes interpreted as calcified coronula cells.

In the detailed work on the charophyte oogonia considered in this paper and in a companion study of abundant oogonia from the North American Eocene (in press), the characters of the genus *Aclistochara* have been subjected to a critical review.

We are unable to prove that the five collar-like nodes on the summits of the oogonia are separate from the calcareous spirals as true coronula cells should be. We are also unable to prove that the five nodes are simply terminal expansions of the regular spirals. We do find that the combination of characters, including the truncate summit, the narrowing and flattening of the spirals at the periphery of the summit, and the presence of summit nodes (coronula cells) on well-preserved specimens, allows us to differentiate readily the one group of oogonia from the other group on which the spirals ascend to the summit junction with no change in size or shape.

***Aclistochara supraplana*, new species**

Figures 22-27

Oogonia large, broadly obovoid to almost spherical, 1.08 mm. to 1.35 mm. in length and 1.06 mm. to 1.31 mm. in width. Summit truncate, the spirals narrowing and becoming abruptly flattened at the summit periphery, then widening and remaining flat or becoming slightly swollen near the point of junction in the center of the summit, many specimens distinctly coronulate. Spirals on most specimens gently convex, on a few flattened or slightly concave, eight or nine (rarely seven or 10) visible in lateral view, no evidence of tubercles. Base strongly projecting on most specimens.

REMARKS: The above description is based on approximately 100 well-preserved specimens. The large size, almost spherical shape, truncate summit, projecting base, and spirals visible in a lateral view are well-established characters that make *A. supraplana* an easily recognized species. *Chara helicteres* Brongniart (*sensu stricto*) as described by Dollfus and Fritel (1919, p. 247) resembles *A. supraplana* in shape, but is larger, is not so nearly spherical, and lacks the projecting base. No other recorded species is closely related.¹

TYPES: Holotype, A.M.N.H. No. 26410:1. Paratypes, A.M.N.H. Nos. 26410:2-26410:6; U.M. No. 31020-3.

OCCURRENCE: Eocene, possibly Oligocene, 16.5 km. N. 57 E. of Contamana Cemetery, Loreto, Peru.

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