REFERENCES

AUDEN, J. B., (1946) Blaini-Talchir, *Curr. Sci*, no. 12, pp. 346-348.

——— (1951) The bearing of geology on Multiple Projects. Presidential Address. *Proc. 38th Ind. Sci. Cong.*, Pt. II, pp. 109-153.

BERTHELSEN, A., (1951) A geological section through the Himalayan Sactryk of Meddelsar fra Dansk Geologish Forening Bd. 12 Kobenbavn. pp. 102-104.

——— (1953) On the geology of Rupshu district N. W. Himalayas. *Fr. Bagges Kgl. Hofbog-trykkeri Denmark*, pp. 351-414.

FUCHS, G., (1968) The geological History of the Himalayas. *Proc. 23rd Int. Geol. Congr. Prague*, v. 3, pp. 161-174.

HEIM, A. and GANSSER, (1939) 'Central Himalayas' Memoir, Swiss Expedition 1936.

KRISHNASWAMY, V. S. and SWAMINATH, J., (1965) Himalayan and Alpine geology—A review. D. N. Wadia Commemorative Volume. *M.G.M. Institute of India*, pp. 171-195.

MCMAHON, C. A., (1877) The Blaini group and the 'Central Gneiss' in the Simla Himalayas. *Rec. Geol. Surv. India*, v. 10, pp. 204-222.

PANDE, I. C., (1966) Palaeo-tectonic evolution of the Himalaya. *Proc. 3rd Himalayan Geology Seminar, 1966, Centre of Advanced Study in Geology, P.U. Chandigarh*, pp. 107-116.

PANDE, I. C. and SAXENA, (1968) Birth and development of the Himalaya. *Publication of Centre of Advanced Study in Goelogy, P.U. Chandigarh*, no. 4, pp. 1-20.

WADIA, D. N., (1938) Structure of the Himalaya and of the North Indian Foreland. *Pres. Address. Ind. Sci. Congress, Calcutta*, Proc. v. 25, pt. 2.

WEST, W. D., (1934) Recent Advances in geology of the Himalaya. *Curr. Sci.*, v. 3, no. 6, pp. 231-232 and 286-291.

——— (1939) The Structure of the Shali 'Window' near Simla. *Rec. Geol. Surv. India*, v. 74. pt. 1, pp. 133-163.

TWO SPECIES OF *ACICULARIA* FROM THE JURASSIC OF CUTCH

AJIT KUMAR PAL
Department of Botany, University of Calcutta
AND
SUKOMAL GANGOPADHYAYA
Department of Geology, Jadavpur University, Calcutta

Introduction: The material for the present work was collected from the Chari formation developed at the Jura Dome near Jura village about 15 miles north of Bhuj in Cutch (now in Gujarat state)

The major subdivisions of the Jurassic stratigraphy of Cutch are given below.

Oomia group	Tithon group
Katrol	Kimmeridge group
Chari	Oxford group
	Kelloway group
Patcham	Bath group

The major zones of the Chari formation developed at the Jura Dome are as follows:

Dhosa
Anceps-Athleta
Upper Macrocephalus
Lower Macrocephalus.

The algae reported in the present paper are from the 2 ft. thick horizon of oxidised silty biomicrite near the base of the Lower Macrocephalus zone.

General considerations regarding the genus Acicularia: The peculiar appearance of the fossil remains of *Acicularia* calls for some discussion on the genus. The genus *Acicularia* is one of the most highly evolved dasyclads. The plant consists of a slender central stem from which develop regularly arranged whorls of primary branches. The fertile and infertile branches are segregated in separate whorls with the fertile on top. Commonly the infertile whorls develop first, then drop off, after which the fertile whorl or whorls appear.

The fertile whorl develops as a flat circular mass, suggestive of a solid wheel composed of flattened wedge-shaped spokes. These are heavily calcified. The sporangia are spherical or nearly so, and are arranged along the margins of the highly specialised primary branches (the wedge-shaped spokes of the wheel). As the spores ripen, the branches separate into wedge-shaped (flat or sometimes slightly curved) 'spicules'. These in turn may break across into circular or flattened discs.

More commonly the fossils found are the discs although sometimes the spicules or their fragments also occur (as in the majority of the present specimens). Very rarely is an entire whorl or umbrella preserved.

It is interesting to note that *Acicularia* was first discovered as a fossil and later found to be represented by a living species too. The genus was founded in 1843 by D'Archiac for certain minute longish bodies, pointed at one end, broad and emarginate at the other, found in the Calcaire Grossier (Eocene) of the Paris Basin. D'Archiac did not know the exact nature of these bodies when he named and referred them to Bryozoa. The opinion was shared by Michelin and Ruess while Carpenter placed them among the foraminifera. Munier Chalmas in 1877 recognised radial partition walls and their radially disposed habit which led him to remove *Acicalaria* from the animal kingdom and place them with the Acetabularieae. The conjecture of Munier-Chalmas, which had little to support it in the fossil material was proved, as remarked by Solms-Laubach, in the most brilliant fashion by the discovery of living species of the genus *Acicularia schenckii* Solms.

Geological history and previous Indian records of the genus: Acicularia is represented by a single living from *A. schenckii* Solms and has over 25 fossil species. Originally reported from the Eocene strata, the genus was later found to be widely distributed during the Cretaceous and it was considered that 'it makes its first appearance in the Cretaceous' (Varma, 1954, p. 30). Carozzi in 1955 discovered a Jurassic species *A. elongata,* to be followed by Johnson (1961) who reported *A. jurassica* from Upper Jurassic strata and considered the genus to have evolved during the Upper Jurassic. However, the present find from the Callovian (mid. Jurassic) of Cutch suggests that *Acicularia* had an earlier origin. Geographical distribution during the Jurassic includes Switzerland, France, Japan, Texas, Alabama and Mexico. It was widely distributed during the Cretaceous and early Tertiary.

Today the genus is restricted to tropical or near-tropical waters along the east coast of the Americas.

In India the genus has so far been reported from the Danian of Trichinopoly (Rao and Pia, 1936; Varma, 1954), the inter-trappeans (Palaeocene) of Rajahmundry (Pia, Rao & Rao, 1937), the Eocene of the Punjab Salt Range (Rao and Varma, 1950) and from the Palaeocene of Sind in W. Pakistan (Rao and Vimal, 1955).

SYSTEMATIC DESCRIPTION

Phylum: CHLOROPHYCOPHYTA Papenfuss 1946
Family: DASYCLADACEAE
Genus: *Acicularia* D'Archiac 1843

Acicularia elongata Carozzi 1955
Figs. 1, A (x 40), 2 (x 40)

A. elongata Carozzi, 1955, *Eclogae geol. Helvetiae*, Vol. 48, No. 1 p. 62-63, pl. 6, Fig. 18.

Description: Numerous fertile spicules and discs; spicules long and narrow, pointed at the proximal end and broader at the distal part. Spicules 0.9–2.4 mm long and 0.16–0.24 mm in diameter. Discs circular to sub-ovate, 0.160–0.28 mm long and 0.16–0.2 mm high. The discs show 12-14 sporangial cavities arranged around the margin. The sporangia are spherical or slightly elongated laterally. Diameter 32-40 μ.

Remarks: The present materials show clear affinity in appearance and dimensional characteristics to *A. elongata* Carozzi. The species has so far been reported from the Upper Jurassic of Switzerland and France. The presence of *A. elongata* in the Callovian of Cutch is quite interesting.

Horizon and locality: Silty oxidised biomicrite, L. Macrocephalus zone; Jura. Figured slide: M 102.

Acicularia cutchence sp. nov.
Figs. 1, B 2 (x 40)

Diagnosis: Spicules long, stout, and club shaped, about 8 times as long as broad. Circular to oval in cross section and show 10-12 sporangia in the sporangial discs.

Description: Numerous spicules cut in oblique and longitudinal section and a few cutting the spicule cross wise, expose the structure of the spicule and the typical arrangement of calcified spore cavities (gamete cavities). Spicules show a honey combed structure due to the spore cavities arranged marginally. The discs with spore cavities around the margin look like a wheel. Some of the gamete cavities, generally circular, seem to open on the surface of the spicule. The spicules of this species are long, slender and slightly curved. Length 2.4–2.5 mm and diameter 0.24–0.36 mm. Spicules possess about 10.12 rows of spore cavities, 48-56 μ in diameter.

Remarks: For systematic attribution of the present material, it was necessary to consider the 3 allied genera: *Acetabularia, Terquemelia* and *Acicularia. Acetabularia* which has similar spicules possesses calcified gametangia with uncalcified cysts and is thus ruled out since the present material shows rounded gamete cavities inside the gametangium (spicule).

Terquemella is ruled out because of the club shaped spicule in the present material. Pia (1936, p. 25) considered the difference between the two as: 'The calcareous substance contained in the compartment of the disc of *Acicularia* has the form of a spicule or a slender club. *Terquemella* is represented by calcareous bodies of a similar general structure (and with similar spore cavities), but of a spherical, discoid or tuberous form'.

Of the Jurassic species, *A elongata* Carozzi is much longer and narrower than the present material. It also differs in the number of spore cavities in the sporangial discs.

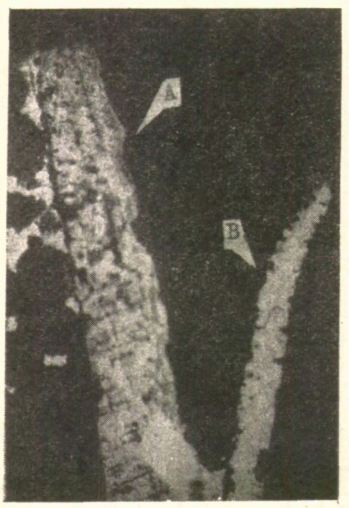

Fig. 1

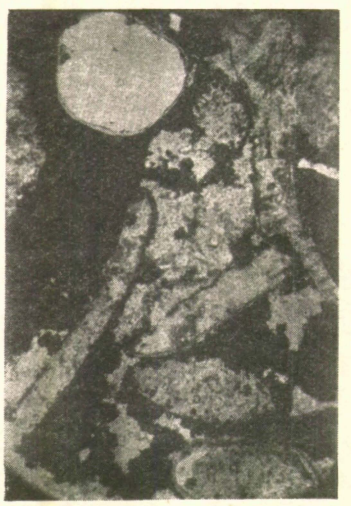

Fig. 2

Figure 1 A. *Acicularia elongata* Carozzi; B. *Acicularia cutchense* sp. nov.

Figure 2. Several transverse and oblique sections of *A. elongata* with *A. cutchense* on the left.

A. jurassica Johnson is much narrower and with smaller (13-18 μ) sporangial cavities and shows 10 sporangial cavities as compared to 12 in the discs of the present material. Of the Indian species, only 4 in number, *A. dyumatsenae* Pia is 2½ times and *A. indica* Varma 5 times as long as broad, whereas the length of the spicules of *A. cutchense* is about 8 times as long as broad. *Acicularia* sp. indet. described by Pia, Rao and Rao (1937) as possessing long, needle shaped spicules with gameto-cavities of about 70 μ in diameter is quite distinct from the present material. *Acicularia* sp. described by Rao and Vimal (1955) is about 3½ times as long as broad and shows 22 cavities in the sporangial disc.

Horizon and locality: Silty oxidised Biomicrito, L. macrocephalus zone; Jura. Figured slide: M. 102.

Acknowledgements: The authors are indebted to Prof. A. K. Ghosh, Reader in Botany, Calcutta University who guided the work, and to Dr. Karun C. Mitra, Department of Geology, Jadavpur University for valuable discussions on the geology and palaeontology of the Jurassic of Cutch. Thanks are also due to Prof. S. Deb, who took much interest in the present work.

REFERENCES

CAROZZI, A. V., (1955) Dasycladaceés du Jurassique supérieur du bassin da Genève. *Eclogae Geol. Helvetiae, 48* (1), pp. 31-67.

JOHNSON, J. H., (1961) Jurassic algae from the subsurface of the Gulf coast. *Jour. Palaeont., 35* (1), pp. 147-151.

PIA, J., (1936) Calcareous green algae from the upper Cretaceous of Tripoli (N. Africa). *Jour. Palaeont., 10* (1), pp. 3-14.

PIA, J., RAO, S. R. N. and RAO, K. S., (1937). Dasycladacéen aus Zwischenalgen des Dekkan trapps bei Rajahmundry in Sudindien. *Akad. Wiss. Wien, Abteil. 1,146* (5-6), pp. 221-236.

RAO, L. R. and PIA, J., (1936) Fossil algae from the uppermost Cretaceous beds (the Niniyur group) of the Trichinopoly district, S. India. *Pal. Ind. N.S., 21* (4), pp. 1-49.

RAO, S. R. N. and VIMAL, K. P., (1955) Fossil algae from Sind, Pakistan. *Micropalaeont., 1* (7), pp. 91-92.

VARMA, C. P. (1954) On the algal genera *Neomeris* and *Acicularia* from the Niniyur (Danian) beds of the Trichinopoly area (S. India). *Proc. Nat. Inst. Sci. Ind., 20* (3), pp. 298-304.

ON THE MINERALOGY OF COPPER ORES FROM TURAMDIH AND RAMCHANDRA PAHAR, SINGHBHUM SHEAR ZONE, BIHAR

S. C. SARKAR

Department of Geological Sciences, Jadavpur University, Calcutta

Copper mineralization in Turamdih and Ramchandra Pahar area in Singhbhum shear zone, Bihar has taken place in locally silicified and sericitized chlorite schists derived from basic volcanics, possibly tuff (Sarkar, unpublished work) belonging to the Chaibasa Stage of rocks of Dunn & Dey (1942) (Singhbhum Series of Sarkar and Saha, 1962). Mineralization here has taken place in the form of 'conformable' ore bodies of varying dimensions and ore concentration. No detailed previous work on the ore minerals of this region has been published. Preliminary results of investigations, being carried out by the writer on the ore mineralization in the area, are being presented here.

The ore minerals in the ores are chalcopyrite, pyrite, magnetite, ilmenite, marcasite, pyrrhotite, bismuthinite, wehrlite, cubanite, molybdenite, mackinawite, uraninite, allanite and the secondary minerals, native copper, chalcocite, covellite and iron hydroxides. Of these chalcopyrite, pyrite and magnetite are the most common, while molybdenite, mackinawite, and covellite are extremely rare.

Chalcopyrite occurs mostly as irregular or spotted disseminations in the ores and rarely as massive ores, common in the Mosaboni–Badia and even parts of Surda–Rakha Mines sections. It occurs as grains 1-2 mm in size. Single or multiple needles of non-isometric cubanite (orthorhombic?) are sometimes found exsolved in chalcopyrite. Very rarely mackinawite has been found to occur within the mineral as irregular veinlets. Pyrite in the ores is next to chalcopyrite in abundance amongst the sulphide minerals; and in general, it is the second most abundant ore mineral except where its place is taken by magnetite. Pyrite grains, which are mostly euhedral to subhedral, often contain poikiloblastically grains of the matrix