RECORD OF *SAHARIDIA*, COMBAZ, A LATE CAMBRIAN-TREMADOCIAN INDEX FOSSIL FROM KROL-E BEDS OF MUSSOORIE SYNCLINE, INDIA

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ABSTRACT

Abundant and well-preserved forms of *Saharidia*, Combaz, an acritarch, are recorded from Krol-E sediments, exposed at PPCL mine near Maldevata village in Mussoorie Syncline of Garhwal Lesser Himalaya. Two Species, *S. downiei* and *S. fragilis* have been recognized. *Saharidia* is considered as an index fossil of late Cambrian-Tremadocian (Cambrian-Ordovician boundary) age and its characteristic occurrence in Krol-E sediments suggests a similar age to these beds.

INTRODUCTION

The age of the Blaini-Krol-Tal succession of the Krol Belt of the Lesser Himalaya has been a subject of serious debate. Traditionalists believe Permo-Carboniferous age to this succession as they correlate "Blaini Boulder Bed" with the "Talchir Boulder Bed" of Peninsular India. Recently, late Precambrian to Cambro-Ordovician age has been strongly advocated by some workers[1-15].

Abundant Cambro-Ordovician conodonts have been recorded by Azmi *et al*[4] and Azmi[7] from the chert phosphorite member of the Lower Tal Formation, and Tommotian (Lower Cambrian) conodonts and other shelly microfossils from the upper Krols (Krol-D) by Azmi and Pancholi[6]. The reproducibility of conodonts has been proved[16] from the same horizon of Lower Tal Phosphorites. However, a Tommotian age was favoured for this phosphatic member of Lower Tal. Recently, Vendian acritarchs were recorded[15] from the Lower Tal Phosphorites exposed at Dhurmala from where earlier Tommotian conodonts were recorded[6]. Tiwari[8,9] recorded the occurrence of late Precambrian (Vendian/Yudomian) and early Cambrian (Tommotian) stromatolites from the Krol-D and Lower Tal Phosphorites respectively in Mussoorie Syncline. Recently, primitive brachiopods and gastropods of Atdabanian age have been reported[10,11] from the calcareous member of the Lower Tal and Quartzitic member of the Upper Tal. Trilobite impressions of Tommotian age have been recorded[14] from the arenaceous member of the Tal formation. *Archaeocytha* of Lower Cambrian age has also been recorded[12,13] from the Upper Krol Limestones of Maldevata. All these studies suggest that Blaini-Krol-Tal succession (except shell limestone) ranges in age from late Precambrian to early Ordovician with minor differences in defining the precise age limits of different litho units of this succession. Azmi and Joshi[5], based on the discovery of Tommotian and Cambro-Ordovician conodonts and shelly microfossils from Upper Krols (Krol-D) and chert phosphorite member of Lower Tal respectively, suggested that basal Cambrian begins from the Krol-D yielding Tommotian microfauna and the Ordovician begins from the chert phosphorite member of Lower Tal. On the other hand, some believe[8-10,12-15] that Tommotian begins from the chert phosphorite member of Lower Tal and the entire Tal sediments (except shell limestone of Cretaceous age) are deposited within the Lower Cambrian.

In the context of the present minor differences of opinion about fixing the exact age limit of different litho units of Blaini-Krol-Tal succession of Lesser Himalaya, the discovery of *Saharidia*, an index fossil of late Cambrian-Tremadocian age, from Krol-E beds is extremely significant to clearly define the upper age limit of Krol Formation. Palynological samples were collected from the grey limestones of Krol-E, 30 m below the first audit level (M.S.L. = 876 m) of P.P.C.L. Mine near Maldevata (figure 1). Simple Schulz's method was applied for the recovery of microfossils. Two species of *Saharidia*, *S. downiei*, Combaz and *S. fragilis* (Downie) Combaz are identified.

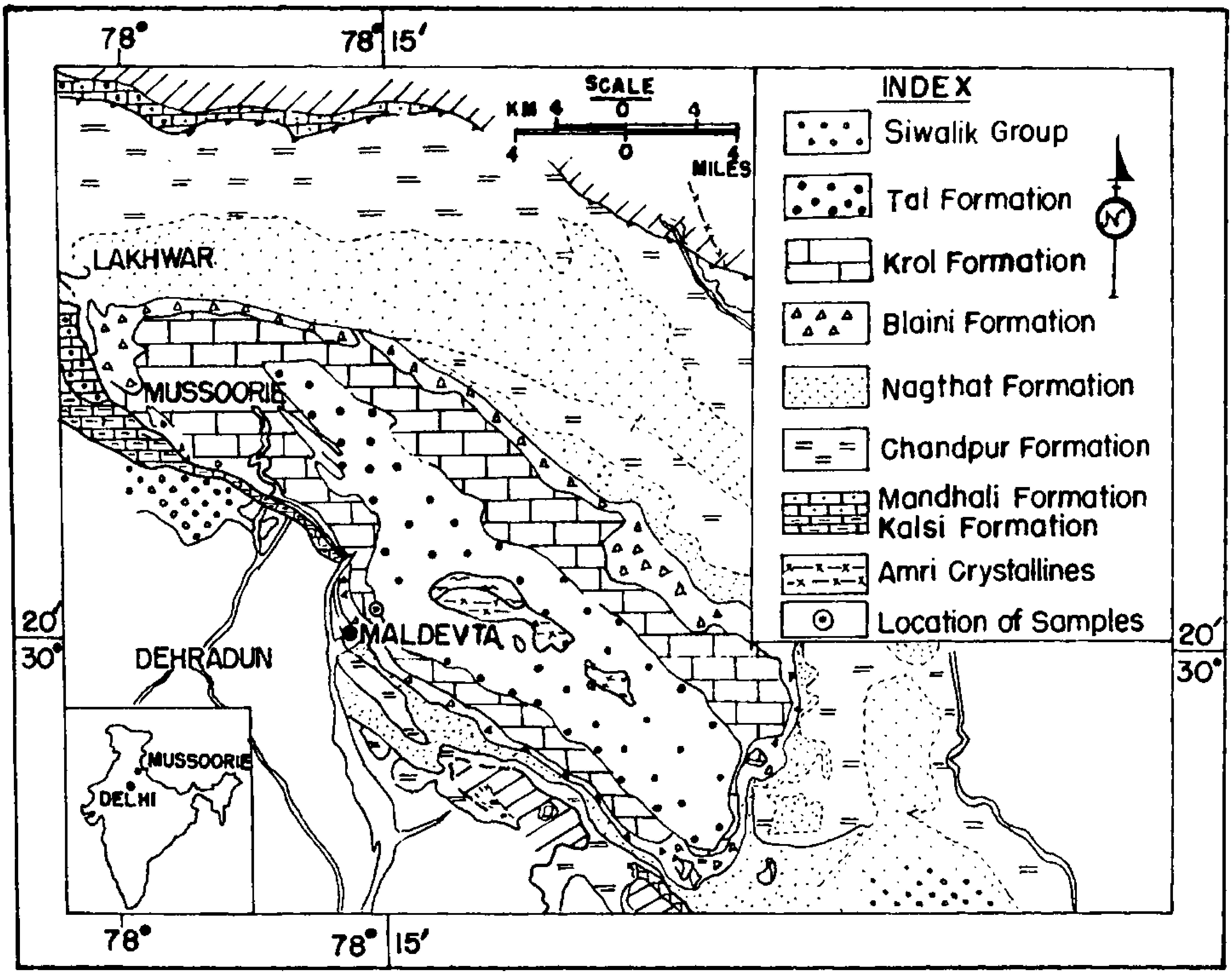


Figure 1. Location and sketch geological map of part of Mussoorie Syncline (after Auden and Shanker) showing sample locality.

SYSTEMATIC DESCRIPTION

Group: Acritarch Evitt, 1963
Subgroup: Sphaeromorphitae Downie, Evitt and Sarjeant, 1963
Genus: Saharidia Combaz, 1967
Genotype: *Saharidia downiei* Combaz, 1967

Saharidia downiei Combaz, 1967 (figures 2 and 3)

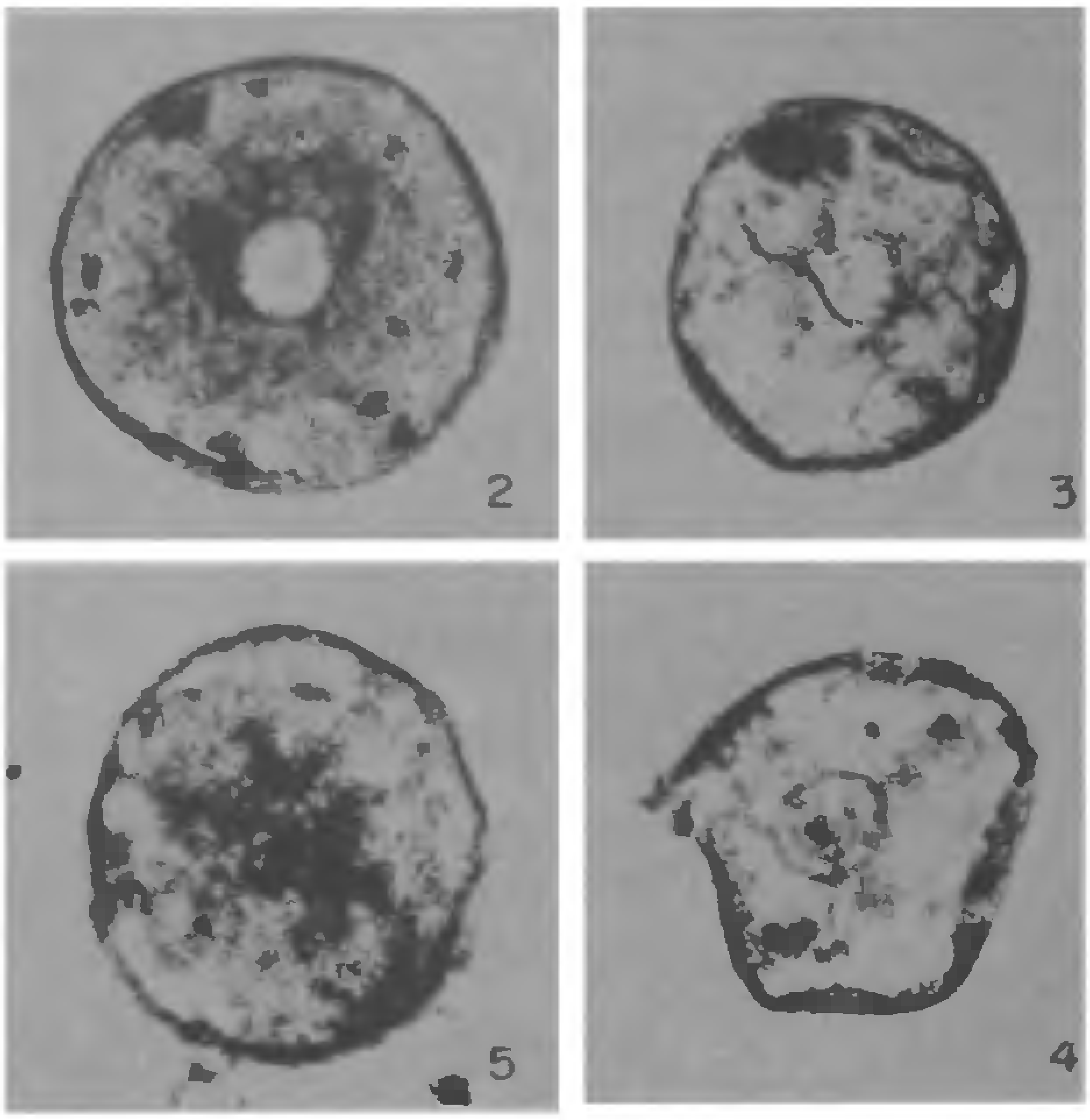
Description: Vesicle circular, measuring 95–105 μm in diameter; with a central circular pylome, measuring 23–26 μm, which are usually 1/4 of the vesicle diameter; central pylome encircled by 20–22 μm wide exinal thickening; exine finely granulate to scabrate and bears exinal folds around central as well equatorial region.

The present forms compare with *Saharidia downiei* Combaz, 1967 (Plate 2, figures 35–36) described from the late Cambrian-Tremadocian beds of Algerian Sahara of North Africa.

Saharidia fragilis (Downie) Combaz, 1967 (figures 4 and 5)

Description: Vesicle subcircular to spherical, measuring 70–90 μm, vesicle bears 17–22 μm wide, circular pylome; thickening around pylome absent; exine thin, granulate with irregular exinal folds.

These specimens compare with the *S. fragilis* Combaz, figured by Downie[18] (Plate 17, figure 6) from the Shineton Shale (Tremadocian) of Shropshire, England.



Figures 2–5 (× 300) **2, 3.** *Saharidia downiei* Combaz; **4, 5.** *Saharidia fragilis* (Downie) Combaz.

DISCUSSION

Combaz[17] instituted the generic name *Saharidia* for the sphaeromorphs having central circular pylome in vesicle from the late Cambrian-Tremadocian beds of Algerian Sahara in North Africa. Two species of *Saharidia* viz *S. downiei* and *S. fragilis* have been recorded by him. *S. fragilis* (*Leiosphaeridia fragile* of Downie[18]) was earlier recorded from the Shineton Shales (Tremadoc) of Shropshire, England. Combaz[17], further, opined that the *Saharidia* has its characteristic appearance in late Cambrian-Tremadoc time and restricted only up to this. Rasul and Downie[19] established an acritarch zonation of the Shineton Shales close to the Tremadoc stratotype and subdivided the sequence into 8 acritarch assemblage zones and opined that *Saharidia* represents the basal most assemblage zone of the sequence and has a very restricted vertical occurrence and found to occur only in late Cambrian-early Tremadoc, close to the Cambrian-Ordovician boundary. Martin[20] and Jardine *et al*[21] also recorded it from the late Cambrian-Tremadoc beds of Southern France and Algerian Sahara respectively. Cramer and Diez[22], while reviewing the Lower Palaeozoic acritarch, opined that *Saharidia* is a marker genus for the late Cambrian-Tremadocian and suffice it to show the enormous geographical extension (England, France, Belgium and Algerian Sahara) and short vertical range. They argued that its greatest abundance falls in the very late Cambrian. Keeping in view the short vertical stratigraphic range and wide geographical distribution of *Saharidia* in late Cambrian-Tremadoc time, its characteristic occurrence in Krol-E sediments reveals a late Cambrian-Tremadocian age to these beds. Further, the present finding also reveals the fact that Krol-E sediments were deposited at the closing phase of Cambrian period with of course encroaching basal most Ordovician. It also supports the contention of Azmi and Joshi[5] who also favour late Cambrian-Tremadocian age for Krol-E beds of Mussoorie Syncline.

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NEWS

THE PYRAMIDS OF ZEISS

Carl Zeiss of Oberkochen, West Germany, has launched a new range of microscopes for scientific and industrial use. The five basic models are the Axioplan A and D, the Axiophot A and D and the Axiotron.

The Axioplan A and D can be used for observation in reflected and transmitted light and can be extended for incident-light fluorescence microscopy.

The Axiophot A and D models are photomicroscopes having two 35 mm cameras. A large format sheet-film camera for metallographic standard magnifications, a TV or a cine camera can be mounted on the instrument for simultaneous documentation. The photographic system is micro-processor controlled.

The Axiotron model has a wide working area and a large specimen stage, which make it very useful for wafer inspection in the semiconductor industry. Thermal influences are excluded by a cold light source with a fibre optic light guide. Other features include a motorised nosepiece, a lever to change between bright and dark fields and a large shield, which prevents dirt from falling into the working area. This microscope is also available as a wafer inspection station with automatic wafer loading and autofocus systems.

The performance of a microscope depends primarily on its optics. Zeiss has computed and designed a new infinity colour-corrected optics system. One main advantage of this 'infinity-corrected' system is that it is possible to include any number of opto-analytical accessories between the objective and the tube lens without the need for additional lenses. Also, about 56 per cent more information can be derived from the exceptionally wide field of view than from a normal field. The image seen through the eyepieces has no colour fringes and is visible to its very edges, even for spectacle wearers.

The microscopes have pyramid-shaped, modular design stands. All the components for microscopy and photography are integrated in the stand and are thus protected from external influences, damage and dust. The design ensures high mechanical and thermal stability. (*Chemistry in Britain*, Vol. 22, No. 4, April 1986, p. 299; The Royal Society of Chemistry, Burlington House, London W1V 0BN–01 4378656) (VEB Carl Zeiss JENA, Foreign Trade Division, DDR-6900 Jena, Carl Zeiss Str. 1).