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# New thoughts on the structure and affinities of Viracarpon hexaspermum Sahni from the Deccan Intertrappean beds of India

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Abstract: A monocotyledonous infructescence Viracarpon hexaspermum Sahni from the Deccan Intertrappean beds of Mohgaonkalan, Madhya Pradesh, India has been critically re-investigated based on a number of well-preserved specimens recovered from the chert. Some significant characters not observed by earlier workers have been described. Based on this study a new reconstruction of the whole fructification as well as individual fruit has been proposed. Earlier workers suggested the affinities of the fructification with Cyclanthaceae, Araceae and Pandanaceae. However, in the light of our critical observations it has been found that the affinities of this infructiscence are not with any of the above-mentioned families and still remain unknown.

## INTRODUCTION

The Deccan Intertrappean flora of India is well known not only for the variety of its constituents but also for the different types of plant organs preserved in these fossiliferous beds of Central India. On the one hand, all the major groups of the Plant Kingdom, viz., Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms are represented, and on the other hand, practically all the plant organs, viz., roots, stems, leaves, flowers, fruits and pollen and spores are known to occur in this interesting flora of Early Tertiary age. One of the earliest known fructifications from this flora is Viracarpon Sahni. Although this generic name was coined by SAHNI for the first time in 1934 (SAHNI, 1934), as early as 1853 HISLOP and HUNTER mentioned this type of specimens as mulberry-like fruits collected from Takli near Nagpur (HISLOP, 1853).

Although SAHNI did mention briefly this genus in his publications of 1934 and 1940 (SAHNI, 1938, 1940), it was only in 1944 that he described this fossil in some detail (SAHNI, 1944). He initially recognised two species of the genus, viz., Viracarpon hexaspermum and V. elongatum differentiated mainly on the basis of length and width of the fructification. However, in his monograph on Indian fossil plants part. II (SAHNI, 1964), yet another species Viracarpon tenue was mentioned. Yet no detailed description has ever been given of this species.

It was CHITALEY (1954) who for the first time gave a detailed description of this fossil under the specific name Viracarpon hexaspermum Sahni. CHITALEY also gave the generic diagnosis of Viracarpon Sahni and the specific diagnosis of Viracarpon hexaspermum, Based on her studies she also attempted to reconstruct an individual fruit of this fructification, but her observations were not supported by photographs.

Chitaley and her co-workers (CHITALEY, SHALLOM & MEHTA, 1969) described a new species of Viracarpon, V. sahnii from the Deccan Intertrappean beds of Mahurgari near Nagpur. They differentiated it from the earlier known species mainly on the basis of absence of hairy spines on

the top of each fruit as against their presence in Viracarpon hexaspermum. Another species of Viracarpon, V. chitalevi was described by PATIL (1977) from the Mohgaon kalan beds which is more similar to Viracarpon elongatum Sahni.

Thus, so far there are in all four recognisable species of Viracarpon Sahni from the Deccan Intertrappean beds of India, viz., Viracarpon hexaspermum, V. elongatum, V. sahnii and V. chitalevi. Besides the above-mentioned species of Viracarpon, VERMA (1958) described an inflorescence under the name Shuklanthus superbum from Mohgaonkalan which is also structurally very similar to Viracarpon. However, CHITALEY und PATIL (1971) believed that Shuklanthus superbum is a fructification and not an inflorescence. They also suggested that it is a junior synonym of Viracarpon elongatum Sahni. Similarly, NAMBUDIRI and TIDWELL (1978), on the basis of their studies on Viracarpon Sahni concluded that the differences between V. hexaspermum and V. sahnii are due to differences in the preservation, and therefore their separation as different species seems anomalous. Thus, according to these authors V. hexaspermum and V. sahnii should be merged with SAHNI's original species Viracarpon hexaspermum.

Similarly to the difference of opinion regarding the correct number of species of Viracarpon, there is also a considerable difference of opinion amongst various authors regarding the actual structure of this fossil. In most of the cases the studies have been made with the help of thin sections and more than once attempts have been made to reconstruct the fossil as a whole. As mentioned earlier, the first reconstruction of an individual fruit was attempted by CHITALEY (1954) also reconstruction a single flower of Shuklanthus superbum and in recent years NAMBUDIRI and TIDWEL (1978) have also given a complete reconstruction of Viracarpon hexaspermum (Figs 1 A B C D).

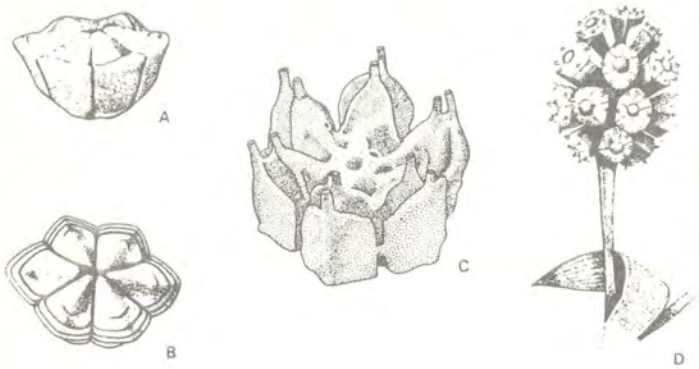



Fig. 1 AB. Reconstruction of a single fruit of Shuklanthus superbum Verma (After Verma, 1958), 1 C. Reconstruction of an individual fruit of Viracarpon hexaspermum Sahni (after Chitaley, 1954), 1 D. Reconstruction of V. hexaspermum Sahni as suggested by Nambudiri and Tidwell (1978)

As there is such a difference of opinion regarding the structure as well as the number of species of Viracarpon Sahni, when the present authors came across some well-preserved specimens of Viracarpon in their collection of fossils from Mohgaonkalan, it was thought proper to study them in detail. The main idea was first to understand the structure of the individual fruit by studying them at various level of grinding and then to attempt a reconstruction of the whole fructification. During the course of this study it was found that the structure of the individual fruit is quite different from what has been suggested by the earlier authors. As this is bound to have a direct bearing on the botanical affinities of this interesting fossil, it has been decided to present our observations in detail. However, before that is taken up it is necessary to discuss briefly the structure of this fructification as interpreted by earlier workers.

As mentioned earlier, the first description of Viracarpon was given by SAHNI (1944). SAHNI did not give any generic diagnosis of the genus but described two species Viracarpon hexaspermum and Viracarpon elongatum separately as follows:

"Viracarpon hexaspermum - Specimen apparently with a fleshy axis about 6 mm thick, length

of the fruit unknown. Six seeded groups, each evidently belonging to a single flower, closely packed around the axis. Seeds about 3 mm x ca 1 mm, form a compact ring, sessile on the axis. Several of them still covered by the remnants of the ovary wall, which on the distal end seems to have formed a 6 angular shield with a crown of long, narrow, tapering, more or less curved processes projecting outwards in a plant generally radial to the floral axis. The axis of the infructescence is almost 6 mm across and is divided into (a) a central core of lighter-coloured tissue containing scattered bundles and (b) outer darker zone with numerous crowded bundles, each enclosed in a fibre sheath."

The other species Viracarpon elongatum was described by SAHNI (1944) as a cylindrical fructification with a slender stalk only 1 mm thick, the 'fruit' itself, is ca 4 cm long and only 4 mm broad. The six seeded groups are smaller (ca 1.5 mm across) than in the type species.

Both these specimens were collected from Takli near Nagpur and SAHNI was definite that they belonged to one genus.

Based on her studies of some more specimens of Viracarpon hexaspermum, CHITALEY (1954) for the first time gave the generic diagnosis of Viracarpon Sahni as:

"Pedunculate, spiny, aggregate fructification, consisting of a central, unbranched axis continous with peduncle and bearing crowded fruits in longitudinal rows. Fruits sessile, ebracteate. Individual fruit prism-shaped 6 angular with 6 equal loculi around a central core; each loculus containing one pendulus seed. Top of ovay wall bearing projecting spines. Peduncle with monocotyledonous bundles."

CHITALEY (1954) also gave the specific diagnosis of Viracarpon hexaspermum, as:

"Peduncle 17 x 2.5 mm, body of fructification 30 x 19 mm (excluding spines). Individual fruits arranged on fructification axis in 8 or more vertical rows, each row containing at least 5 fruits. Individual fruits 5 x 5 mm in size, with a crown of 12 long, narrow, hairy, straight spines in two whorls, projecting outwards in a plane roughly radial to fructification axis; members of two adjoining whorls are opposite each other in six radial planes on the top of the fruit, fusing at base and free for rest of the length. Each spine at least 15 x 0.75 mm covered with more or less straight unicellular hair, each at least 2.5 mm in length. Fruit wall and fruit core with heavily thickened fibres. Inner epidermis of fruit wall consisting of cells with thick sinuous walls in surface view. Top of fruit marked with a central depression surrounded by 6 others in plane of septa, these also surrounded by 6 others, also in plane of septa. Seeds 3 x 1.5 mm. Inner ring of vascular bundles in peduncle comprising about nine bundles; central pith aerenchymatous."

It is obvious from the above that the structures which were described by SAHNI as "a crown of long, narrow, tapering, more or less curved processes on the top of the individual fruit" have been interpreted by CHITALEY as a crown of 12 long, narrow, hairy, straight spines in two whorls. Another character not mentioned by SAHNI but described by CHITALEY is the presence of a central depression on the top of the fruit surrounded by twelve more depressions in two rings, each of six. Based on her studies, CHITALEY although gave reconstruction of an individual fruit, her interpretations were not supported by any photographs.

The structure of the third species of Viracarpon, V. sahnii is almost the same as that of Viracarpon hexaspermum except for the fact that in V. sahnii the top of each loculè bears a hump and a short slightly curved spine for the outer stage and long hairy, spines are absent. NAMBUDIRI and TIDWELL (1978) considered these differences as due to different stages of preservation and merged the two species together. However, while giving an emended specific diagnosis of Viracarpon hexaspermum, NAMBUDIRI and TIDWELL have used the terms usually used for describing fructifications of Pandanaceae. This is obviously due to the fact that they have accepted this fossil as an extinct member of Pandanaceae. The reconstruction of the complete fructification given by them also appears to be influenced by this notion. The specific diagnosis given by them is as:

"Cephalium solitary, terminal; phalanges usually in 6 (sometimes 8 or more) vertical rows arranged spirally on the fruit axis, individual phallanges sessile, obovate hexacarpellary, completely fused or partially fused (free below and united at the tips), phalanges made of 6 fused drupes developed from concentric, centrifugal carpels; pericarp differentiated into a thin epicarp, comparatively fibrous mesocarp and a thin endocarp; seeds one per locule, endospermic; embryo large with a pseudolateral plumule and a scutellum; thin testa; cephalia arising in the axil of bracts, pericarp with a dense indumentum of glandular and non-glandular trichomes, non-glandular trichomes branched or unbranched; style hollow, stigma glandular."

PATIL (1972) described yet another species of Viracarpon, V. chitaleyi from Mohgaonkalan using the same terminology as used by CHITALEY (1954). However, VERMA (1958) while describing Shuklanthus superbum considered it as an inflorescene and interpreted the structures accordingly.

CHITALEY and PATIL (1971) on the other hand considered it as a frutification and synonym to Viracarpon elongatum Sahni. The specific diagnosis given by these authors for V. elongatum runs as.-

"Fructification 68.5 mm long, 4.5-5.2 mm thick including projections on top of the fruits, fructification axis narrow, 1.6-2.1 mm wide, tapering towards tip; fibrovascular bundles scattered, inner six large and in imperfect ring, each placed in between adjacent fruits. Fruits arranged in 6 vertical rows on axis, three at each node alternating at successive nodes. 'Fruits' hexalocular, sessile, ebracteate, each measuring 1.5-1.8 mm long and 1.6-2.1 mm wide with two whorls of perianth lobes, inner perianth members one against each locule, 1.00 mm long, 0.2 mm wide, fused below with fruit wall, free above. Loculi separated from each other, inner margins fused to form central core and outer margins rubbed, forming a hump at top of each locule. Locule drawn up into a short projection and completely filled with a single sac-like seed, 0.6 x 0.5 mm in size; seed coat thin and paperly of parenchymatous cells with embryo in endosperm. 'Fruit' wall differentiated into thin epicarp, fibrous mesocarp and stony endocarp."

PATIL (1972) differentiated Viracarpon chitaleyi from the above species only on the basis of a single character that there are only 5 vertical rows of fruits around central axis in V. chitaleyi as against 6 such rows in V. elongatum. However, as similar variations have been observed in various specimens of Viracarpon hexaspermum where this number varies from 6 to 8 or more, in this case it should also be considered as a case of variation and hence Viracarpon chitaleyi should be merged with Viracarpon elongatum Sahni.

The salient features of all these species have also been presented in a tabulated form (Table 1). In the light of the characters enumerated it can be said that there are two basic types of Viracarpon fructifications which can be differentiated mainly on the basis of shape and size. Consequently, only Viracarpon hexaspermum Sahni and Viracarpon elongatum Sahni should be recognised as two distinct species. All other species, including Shuklanthus superbum should be considered as variations within the species and due to different stages of preservation.

With this background it is now proposed to describe briefly the specimens studied during the course of this work. The data are then used to give a reconstruction of the complete fructification. The terminology used here is as given by SAHNI (1944) and CHITALEY (1954).

## MATERIAL

The material consists of four well preserved specimens collected from the Deccan Intertrappean beds of Mohgaonkalan. Out of these, two are exposed in cross sections from which two slides have been prepared. The third specimen was exposed in an oblique longitudinal plane. The fourth specimen on breaking the chert was exposed in two halves in longitudinal plane, one of them also having the peduncle. The upper portion of this specimen was lost during the preparation of slides. In all, three slides in longitudinal plane have been prepared from the fourth specimen. During the process of grinding, the section was studied at various stages and photographed so as to obtain a clear idea about the structure of individual fruits at various levels from top to bottom. The present interpretation of the fruit is mainly based on this study.

## DESCRIPTION

Even a cursory study of these specimens is enough to indicate that all of them belong to Viracarpon hexaspermum Sahni. As for generic diagnosis the specimens represent a pedunculate aggregate fructification consisting of a central unbranched axis continuous with the peduncle and bearing crowded fruits in vertical rows (Plate I, 1, 4; Fig. 2 A). Fruits sessile, ebracteate. Individual fruit 6 angular with 6 equal loculi around a central core; each loculus containing a single seed (Plate I, 3; Plate II, 10). Top of ovary weall bearing projections (Plate I, 1, 2, 4; Fig. 2 A, B). Peduncle with monocotyledonous scattered vascular bundles. The detailed structure of these specimens is also in accordance with the specific diagnosis of Viracarpon hexaspermum Sahni as given by CHITALEY (1954) and NAMBUDIRI and TIDWELL (1978), except for the structure of the individual fruit which has been discussed separately. The peduncle is about 1.5 cm, body of the fructification is about 3.5 cm long and 2.5 cm in width. Individual fruits are arranged on the fruiting axis in

8-10 vertical rows, each row consisting of about 6 fruits, central axis with monocotyledonous vascular bundles.

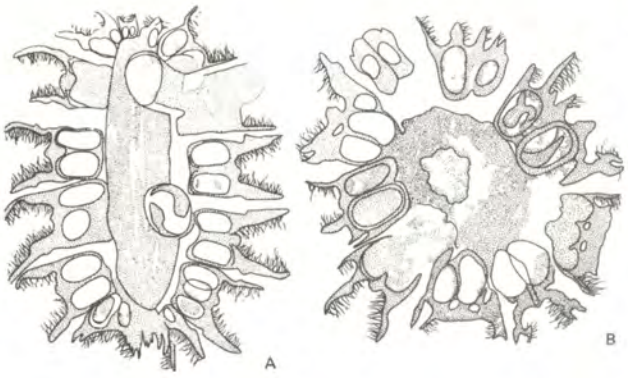



Fig. 2 A. Longitudinal section of V. hexaspermum Sahni showing the main axis and vertical rows of fruits x 2, 2 B. Cross-section of hexaspermum Sahni showing main axis surrounded by 9 rows of fruits x 3.5

To understand the structure of the individual fruit, while preparing the longitudinal section of the fructification the section was studied and photographed at various levels of grinding. Thus a series of photographs were obtained showing the fruits cut in cross section from top to bottom (Plate II, 5, 10; Figs 3 A-E). Thus a cross-section passing through almost top of the fruit shows six free perianth-like lobes arranged in more or less circular fashion. Each lobe is wing shaped about 1 mm in width and 2 mm in thickness.

In the next section passing through a somewhat lower level, the lobes are increased in dimensions and have come a little closer to each other. They also show a little curving of their lateral tips towards the centre. This process continues in the successive stages and ultimately these lobes join with each other to form the six partition walls of the hexacarpellary fruit. Thus the structures which are described as "processes" by SAHNI or 'spines' by CHITALEY are in fact distinct perianthlike lobes which are fused with the ovary wall in the lower half and form a distinct cup-like structure over it. Another important point to note is the presence of a pinhead-like protruberance on the inner surface of each lobe as seen in cross-section. This structure is present at every stage before the hexalocular condition is reached. This indicates the presence of a vertically running upraised ridge on the inner surface of each lobe. It was probably this structure which was interpreted by CHITALEY (1954) as the inner set of spines. Probably this ridge also continues to run on the top surface of each carpel as has been described in Shuklanthus superbum by VERMA (1958). The 'spines' are usually described as hairy. A study of all the cross-sections of the fruit at various levels clearly indicates that the complete cup-like structure formed by the periant-like lobes above the ovary is filled with hair coming out from the inner surface of the lobes (Plate II, 5-9; Fig. 3 A-E).

LASTLY, CHITALEY (1954) has mentioned the presence of a depression in the centre of each fruit surrounded by twelve such depressions in two rings, each of six. A study of these fruits, wherever they are exposed in the vertical section, shows that contrary to depression the central axis of the fruit around which the six locules are arranged is rather raised above the level of the locules in the form of small dome like structure (Plate I, 1, 4; Fig. 4 B). The other depressions mentioned by Chitaley (1954) are not seen in any of the specimens studied.

Thus, in the light of these observations the individual fruit of Viracarpon hexaspermum can be described as ebracteate, sessile, hex-angular with 6 equal locules surrounding a central core, each locule containing a single seed, the central core protruding slightly above the locules; outer wall of the ovary extending upwards in the form of six perianth-like lobes, free at the top forming a cup-like structure and joining below to give rise to the six partitions of the ovary; a vertical ridge running in the centre of each lobe on its inner surface from top to its base; the inner surface of the perianth-like lobes covered with hair (Plate II, 5-10; Fig. 4 B).

With the help of these details a new reconstruction of the entire fructification as well as individual fruit has been attempted (Fig. 5). For the sake of its comparison with the earlier reconstruction of a complete furctification as suggested by NAMBUDIRI and TIDWELL (1978), an individual fruit of Viracarpon Sahni, CHITALEY (1954) and that of Shuklanthus superbum. VERMA (1958) have also been reproduced (Figs 1 A B C D).

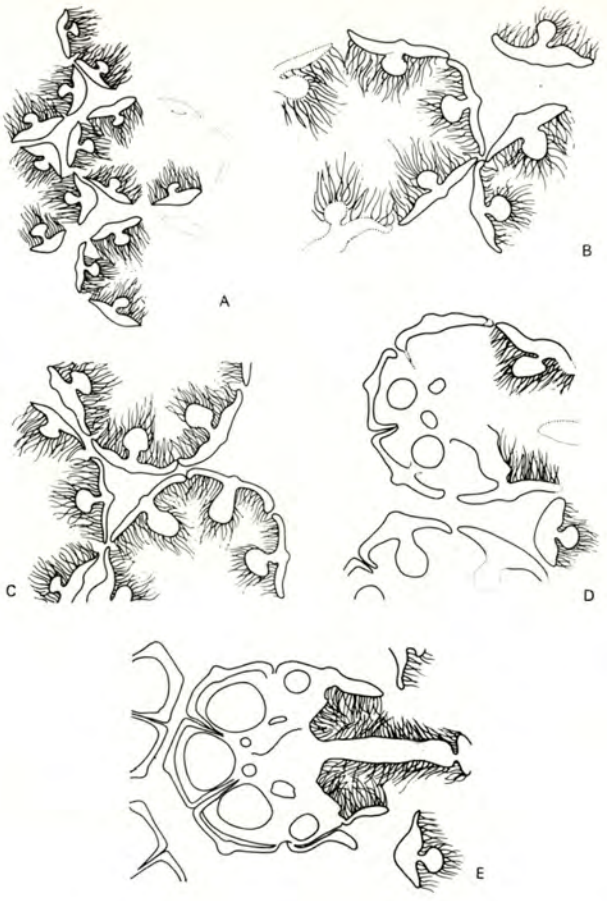



Fig. 3 A-E. Camera lucida drawings of individual fruits of Viracarpon hexaspermum Sahni showing gradual formation of 6 partition walls by fusion of 6 perianth-like lobes free at the top. Also showing the vertical ridge on the inner surface of lobes with hair (Fig. A x10, Fig. B-E. x 7).

Affinities - As is the case with the structure, the affinities of Viracarpon Sahni have also been suggested with different taxa by different workers. HISLOP (1853) mentioned these type of fossils as mulberry-like fruits, SAHNI (1944) suggested the affinities of Viracarpon with the South American family Cyclanthaceae. VERMA (1958) while describing the 'fructification' of Shuklanthus superbum which was later merged with Viracarpon elongatum, suggested its affinities with the genus Triglochin of Scheuchzeriaceae (Juncaginaceae). However, CHITALEY (1954) pointed out that although Cyclanthaceae have a compact fructification, it is very different from Viracarpon in its alternate zones of male and female flowers. The fruit in this family is embedded in a fleshy disc, which is not the case in Viracarpon. Moreover, the unilocular ovary in Cyclanthaceae has many seeds. Similary, in Scheuchzeriaceae, as pointed out by CHITALEY the fructification is not compact and each flower has a well developed perianth or bract. Besides the above two families, CHITALEY (1954)

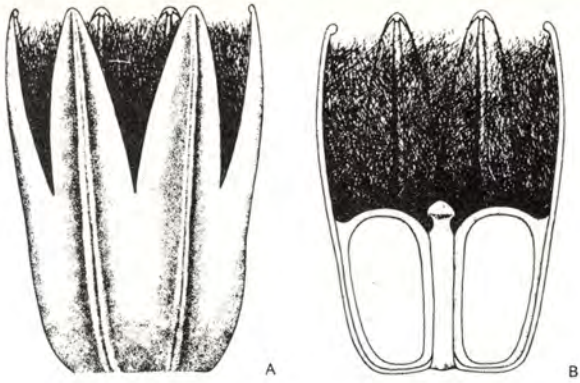



Fig. 4 A. Reconstruction of an individual fruit of V. hexaspermum Sahni as suggested by present authors (Semidiagramatic). Fig. 4 B. Longitudinal section of the same showing two locules with one seed each, central axis, perianth-like lobes with vertical ridge and hair (semidiagramatic)

compared Viracarpon with members of three more families, viz., Hydrocaritaceae, Araceae and Pandanaceae, the common character being the presence of ovaries with more than three carpels which are united for their whole length. Hydrocharitaceae was rejected as there are no such compact fructifications in this family, and the ovary differs greatly in being unilocular with parietal placentation and having many more ovules in the carpels. Of the remaining two families, in Araceae, although there is apparant similarity with the fructification of Viracarpon, it has been pointed out that the majority of the genera in this family have less than six carpels, of if six, then this is merely one possible number among the adjacent ovaries with fewer. In Viracarpon this number is always six. Besides, most of the genera show more than one ovule per loculus in this family (CHITALEY 1954). Thus, we are left with only Pandanaceae and although CHITALEY (1954) did point out that the agreement with this family is also imperfect, the closest affinity was suggested with the genus Pandanus of this family.

NAMBUDIRI and TIDWELL (1978) have also traced the affinities of Viracarpon with both Pandanaceae and Araceae but more with Pandanaceae. The main similarity with Pandanaceae being the presence of a compact solitary, terminal infructescence (termed as Cephalium) with 6-8 vertical rows of hexacarpellary, completely or partially fused phalanges made of 6 fused drupes with a single seed per locule. Although NAMBUDIRI and TIDWELL (1978) have pointed out some differences between Viracarpon and various genera of Pandanaceae, a look at the reconstruction of Viracarpon hexaspermum suggested by them makes it clear that it has been done while keeping the fructifications of Pandanus as model. Further, these authors have opined that Viracarpon can reasonably be included in Pandanaceae as an extinct genus. Regarding its resemblance with the Araceae they are of the view that Viracarpon fruits might have belonged to an ancestral stock from which living pandanaceaous and araceaous plants have evolved.

However, the present reinterpretation of the structure of Viracarpon hexaspermum given in the earlier pages clearly points out that the affinities of this fruit with Pandanaceae are more apparent than real. A study of a large number of fructifications of various species of Pandanus which are described in detail by JOHN (1960) and STONE (1974), is sufficient to support this view. The difference which can easily be noticed is that in none of the species of Pandanus studied are the fructifications as small as in Viracarpon hexaspermum. The second and the most important difference is the presence of six perianth-like lobes which are free at the top and united below, and which form a cup-like structure full of hair on the top of the each hexalocular fruit in Viracarpon hexaspermum. This type of structure has not bee observed in any species of Pandanus or



Fig. 5. Reconstruction of a complete infructescence Viracarpon hexaspermum Sahni as proposed by the present authors (semidiagramatic)

for that matter, in any genus of the families of monoctyledons with which the comparisons have been made. This single charter is important enough to restrict the assignment of Viracarpon hexaspermum to any of the families referred above. At the same time it must be admitted that the present authors also do not have any solution to offer for this problem. Thus, as is the case with some other fossils from the Deccan Intertrappean flora like Enigmocarpon, Tricoccites, etc. the affinities of Viracarpon hexaspermum still remain unknown. CHITALEY (1954) is of the opinion that Viracarpon hexaspermum belongs to an extinct genus of an either known or extinct family. The present authors do not agree with this view. In case of most of the fossil woods, which form a major portion of the Deccan Intertrappean flora, it is possible to identify them at generic level. This is possible because our knowledge regarding the wood anatomy of modern taxa is reasonably sufficient. On the other hand forms like Viracarpon, Tricoccites or Enigmocarpon still elude our attempts to know their affinities because the information regarding the fruits, seeds etc. of modern taxa is neither complete nor easily available. However, it is hoped thet the reinterpretation of the structure of Viracarpon hexaspermum will help future workers to trace out the botanical affinities of this interesting fossil.

## EMENDED GENERIC DIAGNOSIS

Viracarpon Sahni

Pedunculate, spiny, aggregate fructification, consisting of a central unbranched axis continous with peduncle and bearing crowded fruits in longitudinal rows. Fruits sessile, ebracteate. Individual fruit hexangular with 6 equal loculi around a central core, each locule containing a single seed; the central core protruding slightly above the loculi; outer wall of ovary extending upwards in the form of six perianth-like lobes forming a cup-like structure free at the top and joining below to give rise to the six partitions of the ovary; a vertical ridge running in the centre of each lobe on its inner surface from top to its base; inner surface of the perianth-like lobes covered with hair. Peduncle with monocotyledonous bundles.

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TABLE SHOWING IMPORTANT CHARACTERS OF VARIOUS SPECIES OF VIRACARPAN SAHNI

| Characters | V. hexaspermum Sahni | V. sahnii Chitaley, Shallom Mehta | V. elongatum Sahni | V. chitaleyi Patil |
|---|---|---|---|---|
| 1. Fructification | Racemose, 30 x 19 mm in length and diameter | 25 x 16 mm in t.s. | 50-68 x 4.5-5 mm | 25 x 4.3 mm |
| 2. Fructification axis | 25 x 5.9 mm | 14 x 5 mm in t.s. incomplete in L.S. 15 mm long with scattered, monocotyledonous vascular bundles | 1.8-2 mm thick, 6 large V.B. forming imperfect ring in the centre | 1.6 mm thick V.B. monocotylednous scattered, with 5 central larger bund les in a ring |
| 3. Stalk of fructification | 17 x 2.5 mm outer zone with V.B., inner parenchymatous zone with air spaces. Vascular zone made up of 9 large V.B. surrounded by small scattered V.B., V.B. monocotyledonous | - | | |
| 4. Arrangement of fruits on the axis | 8 or more (8-12) alternate, vertical rows | 8-10 alternate vertical rows | 6 alternate vertical rows | Spirally arranged in 5 rows with 6th standing above the 1st completing two rows |
| 5. No. of fruits in one row | 6-7 | - | - | - |
| 6. Fruit | Ebrocteate, Sessile, hexalocular, syncarpus; style, stigma absent | Hexalocular, syncarpus sessile, ebrateate, 5.5 mm in length 6 mm in breadth | 1.3-1.5 x 2-2.2 mm sessile, ebracteate | 1.5 mm x 2 mm board sessile hexalocular |
| 7. Size and attachment of the seed | One in each locule | One in each locule anatropus, endospermic | | One in each locule 6 x 0.51 mm attachment not distinct |
| 8. Perianth | ? Present | - | Present in two whorls, Inner perianth members 1 against each locule fused to it at base, free above | Present in two whorls. Each of 6 inner members fused with each locule at base free above |
| 9. Ribs | - | - | Present 6 radial | - |
| 10. Spines | Present, hairy, in two whorles (in pairs) | Present, short hairs absent | - | - |
| 11. Affinities | Cyclanthaceae (Sahni) Araceae, Pandanaceae (Chitaley) | - | - | - |

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## EXPLANATION OF PLATES

### Plate I.

Viracarpon hexapermum Sahni

1. Longitudinal section passing through main axis showing fruits in vertical rows x 3 (B.S.I.P. slide no. 9349)
2. Cross-section showing main axis with monocotyledonous vascular bundles and surrounded by 9 rows of fruits x 3. (B.S.I.P. slide no. 9350)
3. Longitudinal section passing through just above the main axis showing hexacarpellary fruits arranged in alternate fashion. x 3. (B.S.I.P. slide no. 9351)
4. Longitudinal section showing peduncle, main axis and fruits. x 3. (B.S.I.P. slide no. 9352)

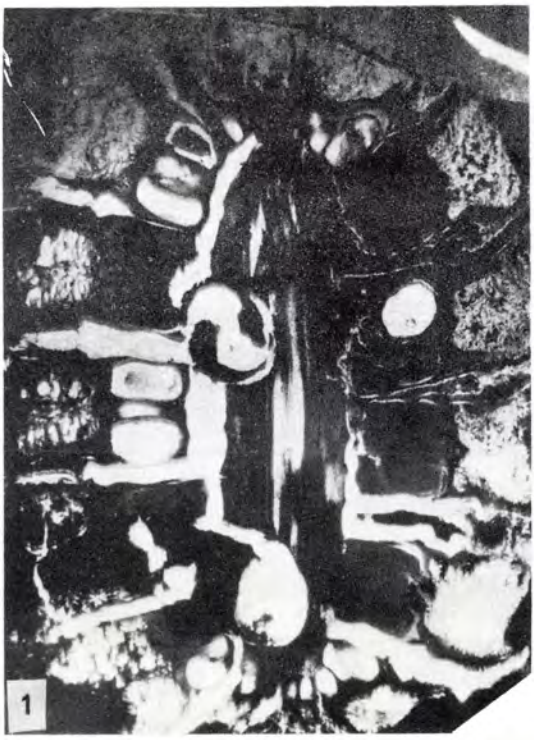
### Plate II.

Viracarpon hexaspermum Sahni

5-10. Serial photographs under reflected light of individual fruits cut in cross-sections and showing gradual formation of 6 partition walls by fusion of 6 perianthlike lobes free at the top. Note the vertical ridge on the inner surface of the lobes with hair. Figs 5-6 x 6.5 and 7-10 x 10

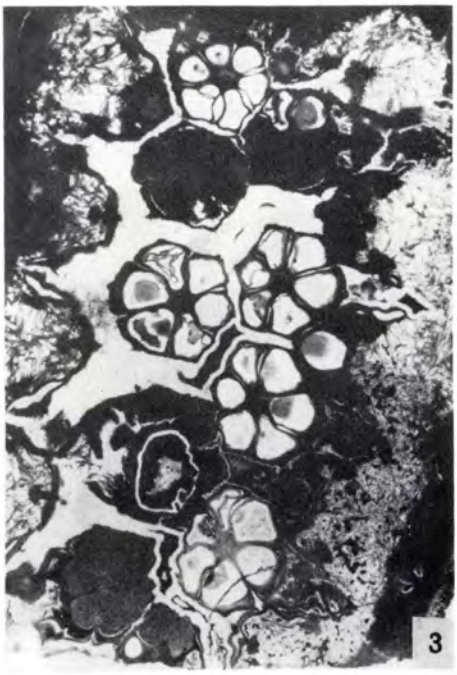

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# Plate I.












# Plate II.

