ON THE CUTICLE OF *DICROIDIUM (THINNFELDIA) SAHNII* (SEWARD) WITH SOME OBSERVATIONS ON THE GENERA *THINNFELDIA AND DICROIDIUM*

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ABSTRACT

The cuticular features of two specimens of *Thinnfeldia sahnii* are described as far as available. On the basis of this data it is suggested that *T. sahnii* may really belong to the genus *Dicroidium*. The early history of these two genera is briefly outlined and certain connected problems discussed.

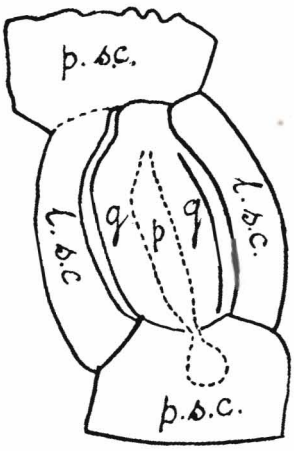
INTRODUCTION

THE genus *Thinnfeldia* was instituted by Ettingshausen in 1852. In India we have about 5 species referred to this genus — *T. indica*, *T. odontopteroides*, *T. chunakhalensis*, *Danaeopsis* (*Thinnfeldia*) *hughesi* and *T. sahnii*. But the epidermal features of all these are not known. Recently Lele (1961) has studied the cuticle of *T. odontopteroides* and *D. hughesi*. There are two specimens of *T. sahnii* Seward (1932) in the Botany department (PL. 1, FIGS. 1, 2) and a few more in the Birbal Sahni Institute of Palaeobotany. These were examined to find out if they could enlighten us on the cuticular features of this species. The fragmentary specimens in the Institute did not yield any cuticle. But the two specimens in the department were more encouraging. The impressions, just two in number, are preserved in ferruginous finegrained sandstone. The locality as indicated on the label is Chicharia (Triassic), South Rewah. The impressions are in part compressions and are fragile and the cuticle is not fully preserved but could be scratched out in bits with a sharp needle. A number of such cuticular bits were examined in xylol, canada balsam, in transmitted as well as reflected light. Although the preservation is far from satisfactory it was possible to make out the following details.

DESCRIPTION

The lower as well as upper epidermis are both stomatiferous. The frequency of stomatal distribution could not be made out as no piece sufficiently large could be recovered. The epidermal cells appear to be more angular in the upper epidermis than on the lower side. But in both epidermis the cell walls are slightly sinuous with some projections running into the cavity of the cell. Many of these cells from the lamina (PL. 1, FIG. 3) as well as rachis (PL. 1, FIG. 4; TEXT-FIG. 1) have a small round elevation in the centre which evidently is the base of a papilla. The cells are penta to hexagonal on the lamina (TEXT-FIG. 2) and rhomboid on the rachis. Both on the lamina and on the rachis variations from the above general observations occur also. Further, on the rachis and lateral veins the cells are arranged lengthwise. On the lamina however, the cells are not in any definite order.

The stomata occur on both sides and do not show any structural difference in view of their position. The preservation of the cuticle and its mineral composition make it difficult to observe clearly all the details of a stoma. The stomata on any of the surfaces are without any arrangement so far as observed. The stoma in Pl. 1, Fig. 5 and Text-fig. 3 represents all the details that could possibly be made out. The two guard cells are flanked on the sides by the subsidiary cells (*s.c.*). Both are longish. At the poles there are two more cells one on each side, so that the actual stoma is surrounded by two lateral and two polar subsidiary cells. The pore of the stoma is elongated. The guard cells' thickenings are not clearly visible but at places one can see what looks like cutin thickenings on the dorsal side of the guard cell. The stomata are sunk below the general leaf surface and at the surface only the stomatal pit enclosed by the 4 subsidiary cells is seen (PL. 1, FIG. 3). The guard cells are not



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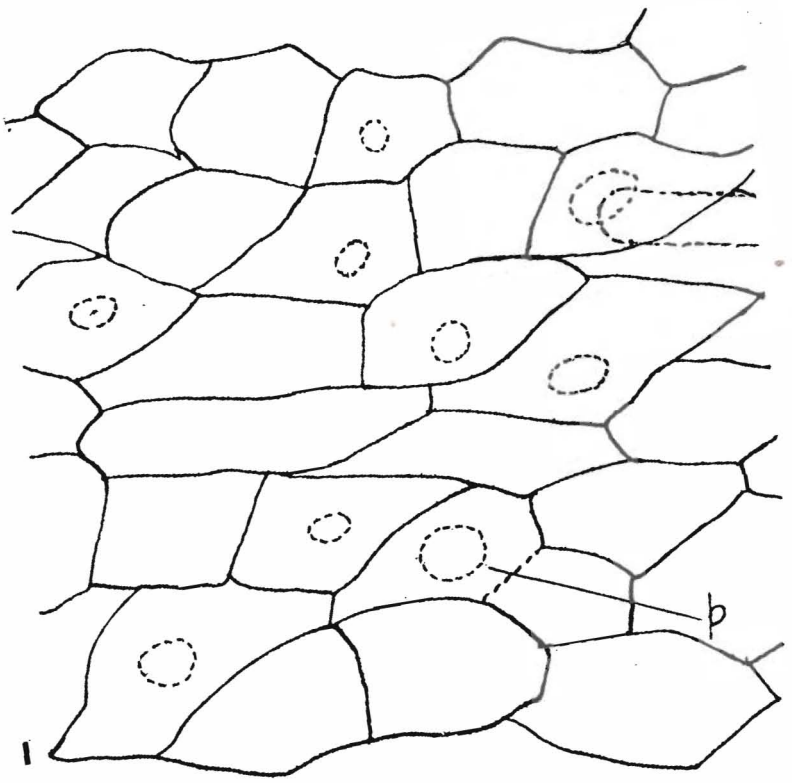

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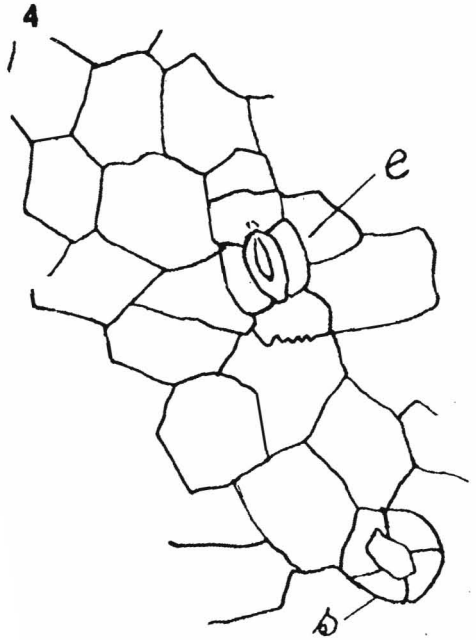

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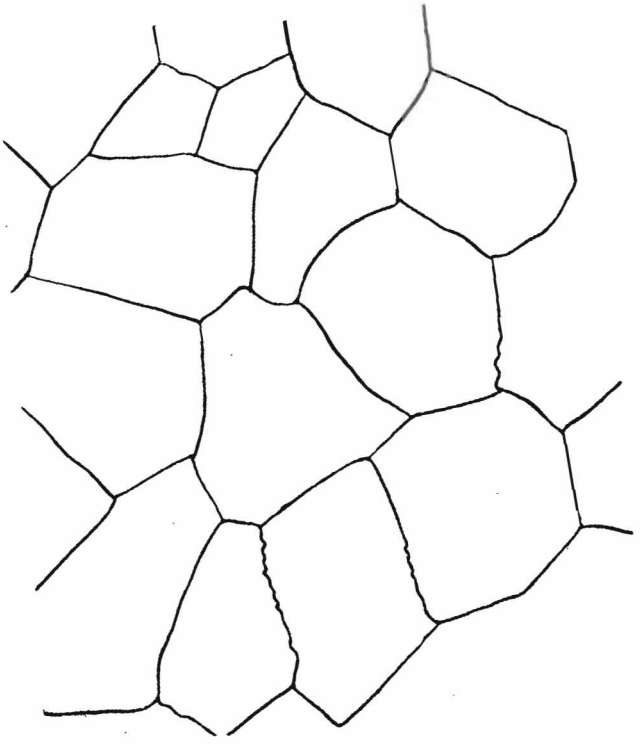

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TEXT-FIGS. 1-4

seen. A curious feature is that while some stomata appear to be sunk, others appear to be not sunk, but occur almost at the level of the epidermis itself. The result is that on even a small stretch of the epidermis stomata can be seen in both the above views (TEXT-FIG. 4) It may be pointed out here that exactly similar conditions are reported in *Dicroidium odontopteroides* by Townrow under the terms 'exposed and sunken stoma'.

These specimens have been referred to the genus *Thinnfeldia*. They should be referred to the genus *Dicroidium* on the basis of their cuticular features which resemble those of *Dicroidium* and *D. odontopteroides* in particular, and also in view of the differences from the cuticle of *Thinnfeldia*. The genus *Dicroidium* was separated from *Thinnfeldia* mostly on the basis of the forked rachis. A specimen like ours, where the exact nature of the rachis cannot be made out, can be referred to either of these genera. The cuticular features have been clarified by Townrow (1957) (FIGS. 5, 6; TABLE 1). Our observation of the epidermis of *T. sahnii* suggests a closer resemblance with the genus *Dicroidium* and the species perhaps deserves to be referred definitely to this genus.

The agreement in cuticular features between those of *D. odontopteroides* and *Thinnfeldia sahnii* raises a doubt as to whether they are not specifically also identical. It is unfortunate that the cuticular features of the type specimen are not known. In fact even the present diagnostic features of *T. sahnii* need to be confirmed by more and better preserved specimens. It is also rather significant that they agree morphologically also with *T. odontopteroides* as pointed out by Seward (1932), the creator of this species. He has pointed out the close resemblance between *T. sahnii* and other Indian, Australian and African species and has admitted that he has created a new species with the greatest hesitation.

TABLE 1 — DISTINCTION BETWEEN *DICROIDIUM* AND *THINNFELDIA* (ACCORDING TO TOWNROW)

Dicroidium	*Thinnfeldia*
Rachis almost always forked	Never forked
Leaf amphistomatic, stomata scattered, subsidiary cells do not form a ring but are four in number, common wall of the guard cell and lateral subsidiary cell strongly cutinized	Hypostomatic, stomata mostly in interveinal bands, stomatal pit rounded, surrounded by a ring of numerous subsidiary cells; common wall between the guard cell and lateral subsidiary cells weakly cutinized
Cell outlines sinuous or with processes. Cells papillate	Cell outlines straight, cuticle surface smooth
Essentially characteristic of the Southern Hemisphere	Essentially characteristic of the Northern Hemisphere
Characteristic of Triassic formations	Characteristic of Rhaetic and mostly Liassic formations and hence stratigraphically younger than *Dicroidium*

DISCUSSION

The genus *Thinnfeldia* was instituted by Ettingshausen in 1852 for some pinnate and bipinnate leaves from the Liassic of Stieerdorf. These leaves were supposed to be ferns. Now of course they are regarded as possibly Pteridospermous. In 1912, Gothan split the old comprehensive genus of *Thinnfeldia* into *Thinnfeldia* proper and a new genus *Dicroidium*. Under the latter he included those Thinnfeldias which once had a forked rachis. He also studied the epidermal features of these *Dicroidium* specimens and established the fact that the cuticular features of the two genera differed. Antevs in 1914 further studied the Thinnfeldias. He also separated the genus *Dicroidium* from *Thinnfeldia*, but not on the basis of the cuticular features. In fact, he criticized Gothan's criteria and was inclined to consider cuticular differences as of not such great significance. Walkom in 1917 reviewed the earlier work and expressed the opinion that the evidence available did not warrant the separation of *Dicroidium* from *Thinnfeldia*. He even revised the diagnosis of the genus *Thinnfeldia*

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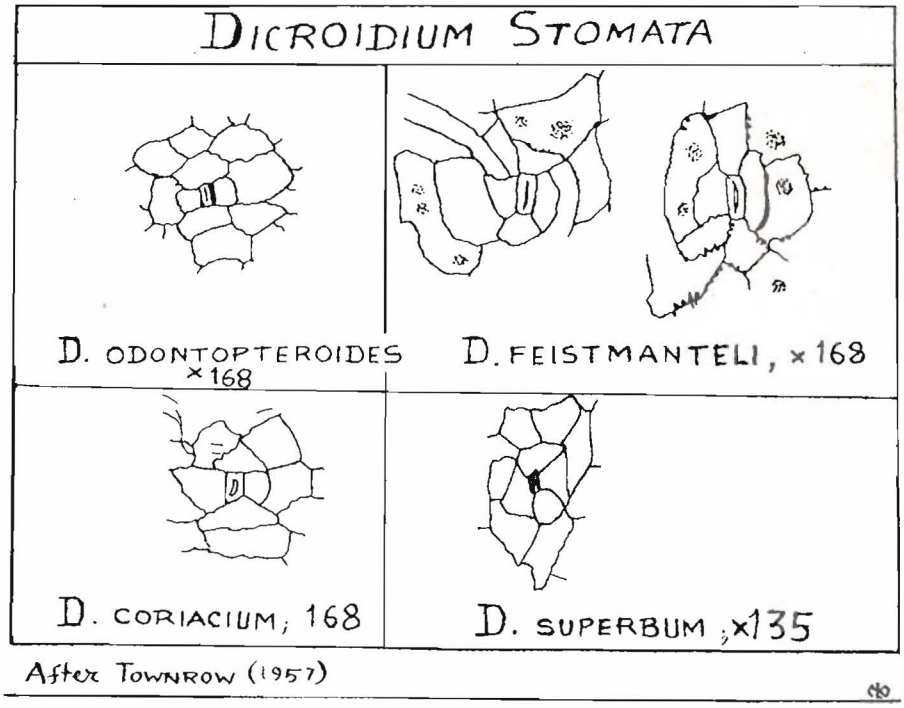
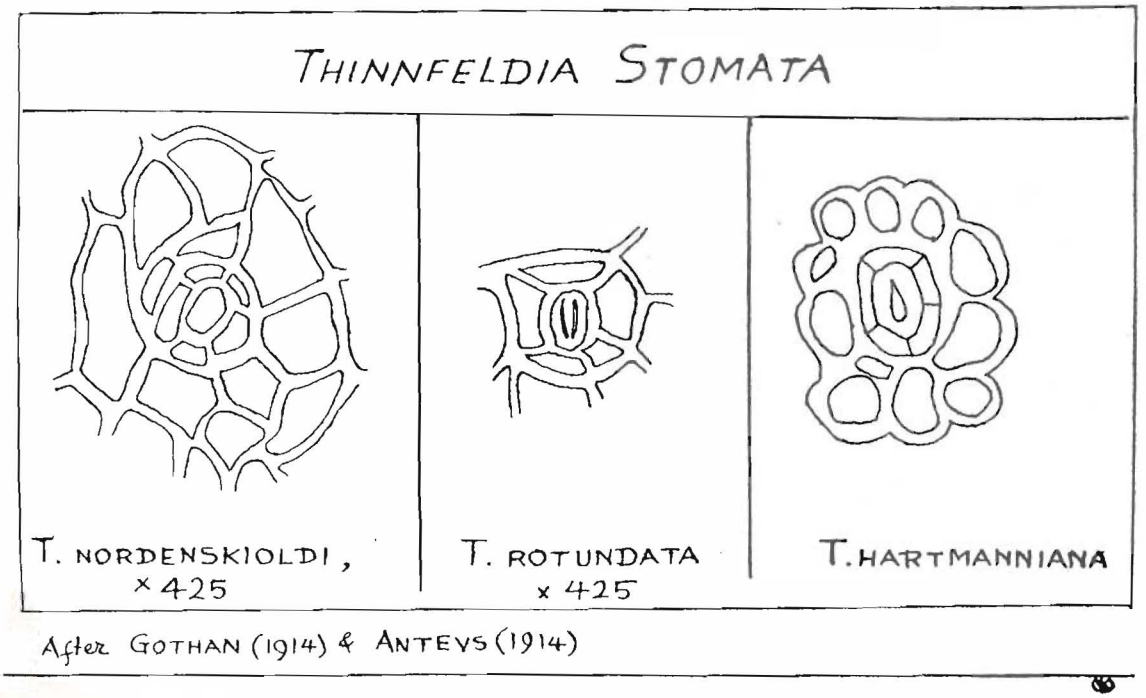
TEXT-FIGS. 1-4 — 1 Epidermal cells of the rachis showing a papilla (*p*) in the centre of some cells. × 400. 2, Epidermal cells of lamina. × 300. 3, A single stoma showing two polar subsidiary cells (*p.s.c.*), two lateral subsidiary cells (*l.s.c.*), guard cells (*g*) and pore (*p*). × 665. 4, A small part of the lamina showing the exposed (*e*) as well as sunken (*s*) stomata. × 235.



TEXT-FIG. 5

to include fronds with ' frequently dichotomous rachis ' and pinnules with Alethopteroid or Odontopteroid venation. We will not discuss his specific determinations here as it is not relevant. It might, however, be pointed out that Townrow (1957) has shown abnormal specimens of *Dicroidium* with epidermal characters of that genus but without the characteristic forking of the rachis. Seward (1903, 1932) and Arber also maintained the comprehensive nature of the genus *Thinnfeldia* and preferred to overlook the cuticular differences. Perhaps they felt that it was premature to split the genus until reproductive structures were known. Meanwhile detached pinnae or pinnules from the mesozoic beds having Odontopteroid venation were unhesitatingly put into the genus *Thinnfeldia*. Frenguelli (1943), studying a large collection from South America, maintained the distinction between *Thinnfeldia* and *Dicroidium* on the basis of the forked rachis. He too rejected the cuticular differences as of no importance. Jacob & Jacob, in 1950, studying Australian specimens of *Thinnfeldia*, found that they could also be classed on cuticular grounds under *Dicroidium*. They further strongly emphasized that the genus *Dicroidium* was essentially a southern genus, and that *Thinnfeldia* was a northern genus. In fact, the geographical distribution constitutes the main ground for their generic separation of *Dicroidium* from *Thinnfeldia*. The next important critical contribution on the subject is by Townrow (1957). He subscribes to the views of Gothan with some modifications. He maintains that cuticular differentiation is a valid criterion, and that geographical distribution and stratigraphical differentiation are other criteria (TABLE 1). We are inclined to agree with Townrow.

The first aspect of the problem is whether we should recognize a single comprehensive genus *Thinnfeldia* with such very widely varying morphological and epidermal characters or agree to split the genus into two genera *Thinnfeldia* and *Dicroidium* as was done by Gothan. In the latter case the salient points in favour of the genus *Dicroidium* would be the dichotomy of its rachis, frequently Sphenopteroid, less



TEXT-FIG. 6

frequently Odontopteroid or Alethopteroid type of venation of the pinnules, its essentially southern nativity, and peculiar epidermal features (TABLE 1). We feel that the epidermal features which have played such a prominent part in the resolution of other groups of genera should not be rejected here.

A second aspect of the problem is to see how far it would be advisable to use these generic names for the various fragmentary remains that turn up every now and then. It is here suggested that any suspected *Thinnfeldia* or *Dicroidium* need not necessarily be referred to that genus straightaway. It should be subjected to a critical cuticular study and then only referred to its proper genus. At the same time unforked leaves and all pinnules or pinnae of suspected *Thinnfeldia* appearance should only be *compared* with and not *referred* to that genus until its cuticular features are known. These should on no account be considered for purposes of stratigraphical geology.

It might be pointed out here that the work of Townrow (1957) and others suggests that many of the so-called Thinnfeldias are really Dicroidiums. But this is a problem that can be solved by a very critical examination of all specimens of *Thinnfeldia* from different countries. Until this is done, it is perhaps unwise to make any categorical statements on the subject.

The work of Du Toit (1927) in Africa has brought out the important fact that the *Glossopteris* flora was succeeded by the *Dicroidium* flora although this was known as *Thinnfeldia* flora. Similar results are indicated in Australia and South America by Jacob & Jacob and Frenguelli respectively.

Turning to India we find that, as far as is known at present, the *Dicroidium* flora was poorly represented in India. But the fact that the few earliest representatives of this group are more like Dicroidiums is significant (LELE 1961). This suggests though not categorically that even in India the *Dicroidium* flora succeeded the *Glossopteris* flora. This should not at all surprise us, if

India — a Gondwana neighbour to Australia, South America and South Africa — registered a similar succession of floras but in a less emphatic way. Incidentally this also confirms the essentially southern nativity of the genus *Dicroidium* — a point on which some workers have laid a good deal of emphasis for separating the genera *Thinnfeldia* and *Dicroidium*.

The Parsora stage in particular claims our attention. Long ago Feistmantel (1882) with his remarkable vision conceived the idea of the Middle Gondwanas. After him it was only Sahni (1922) who pointed out the floral admixture in these beds. Subsequently Saksena (1952) and Lele (1955) pursued the problem further. Both of them confirmed the floral admixture in Parsora itself and indicated roughly the Parsora stage as a possible part of the Middle Gondwanas. It is desirable that this should be tested further with the help of palaeobotanical criteria, and attempts made to find out how far the Middle Gondwanas based on geological grounds coincide with the floral break or the mixed flora in Parsora.

According to Saksena and Lele the Parsora beds have yielded *Vertebraria indica*, *Glossopteris* sp. and *Dicroidium*. If our identification is correct, we could perhaps add *Dicroidium sahnii* (Sew.) also to this list. As already suggested by Saksena and Lele we are probably looking at a mixed flora in the Parsora beds, a flora which includes the decadent members of the *Glossopteris* flora and the pioneers of the *Dicroidium* flora. The data at hand does not permit us to be emphatic on this point, but yet we can postulate on the possibility of the Parsora beds registering a transitional flora. The Parsora beds have not been investigated fully. It would not be surprising if this transitional flora shows an overlapping of the genera *Dicroidium* as well as *Thinnfeldia*.

Lele (1953, 1955, 1961a) has further pointed out that the characteristic Mesozoic genera *Pterophyllum*, *Marattiopsis*, *Pseudoctenis*, *Baiera*, *Cladophlebis* and *Araucarites* are represented in the Parsora stage. Indeed, the Parsora flora was probably a truly mixed flora and putting it in a popular way was the meeting place of the Palaeozoic and Mesozoic floras in India.

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EXPLANATION OF PLATE 1

(All photographs are from untouched negatives. The specimens and slides are preserved in the department of Botany, University of Lucknow.)

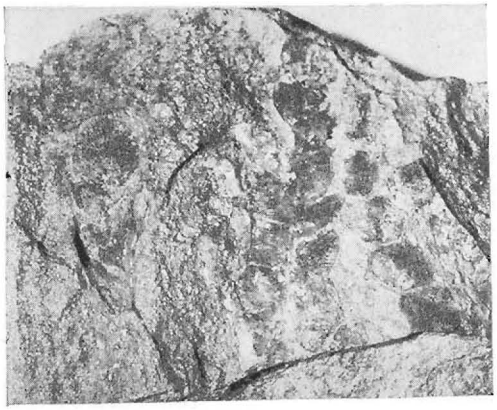
1. *Dicroidium* (*Thinnfeldia*) *sahnii*, frond with a rachis bearing few pinnae. × Natural size.

2. *D. sahnii*, another specimen showing three detached pinnae. In the terminal pinnule on the extreme left the venation can be seen. × About natural size.

3. Epidermal cells of the lamina. At the bottom a sunken stoma showing the 4 subsidiary cells is seen. In the middle of the photo an exposed stoma is seen. × 300.

4. Epidermis of the rachis showing cells in many of which the round base of a small papilla (*p*) is seen. × 200.

5. A stoma enlarged. × 200.



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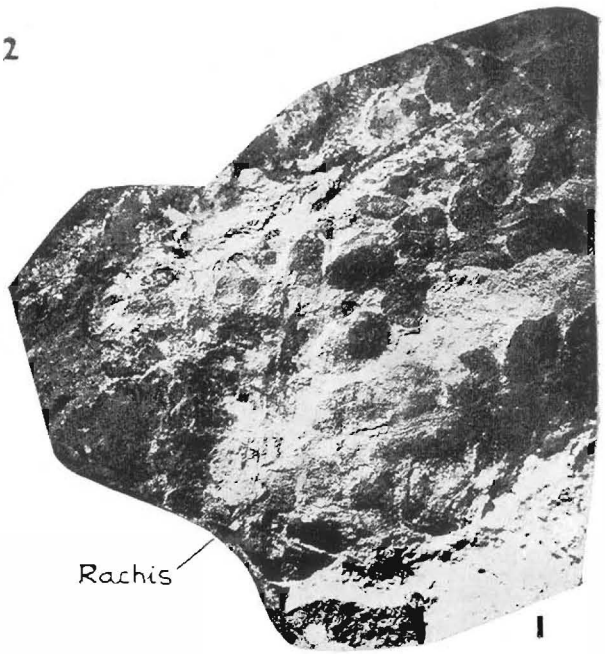

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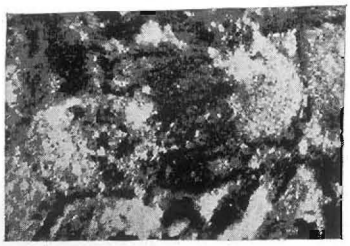

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