

## ON THE AGE OF THE DECCAN TRAPS NEAR RAJAHMUNDRY.

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### *Introduction.*

FROM very early times in the study of Indian geology the problem of the age of the Deccan traps has been the subject of some difference of opinion, and the different views expressed from time to time on this interesting question may be classified as follows :—

- (a) the entire Deccan traps are early tertiary in age (eocene);
- (b) they wholly belong to the upper cretaceous; and
- (c) they were poured out in the epoch which covers the close of the mesozoic and the early beginnings of the tertiary era.

Our interest in the study of this problem has been revived by a recent paper on "The Deccan Traps: Are they Cretaceous or Tertiary?" by Dr. Sahni.<sup>1</sup> In this very valuable communication Dr. Sahni has drawn pointed attention to the considerable body of direct palæo-botanical evidence he has recently gathered from the inter-trappean beds of the Nagpur-Chhindwara region in support of assigning an eocene age to the Deccan traps as a whole—thus going back to an opinion which, as Dr. Sahni has pointed out, was the earliest to be put forward by such pioneer geologists as Malcolmson, Hislop and Hunter, and T. Oldham.

In the course of a reply to Dr. Sahni's paper, Dr. C. S. Fox<sup>2</sup> has discussed the whole problem and placed before us the other point of view, as it were, of this question. One important fact which emerges from Dr. Fox's communication is that though the official opinion of the Geological Survey of India that the Deccan traps are wholly upper cretaceous in age has not been publicly revised for want of sufficient evidence, there is no doubt that the view "that the Deccan trap series is entirely of cretaceous age is largely out of date and is not the view of those officers (of the G. S. I.) who

<sup>1</sup> *Curr. Sci.*, Oct. 1934, 3, No. 4, 134-136.

<sup>2</sup> *Curr. Sci.*, March 1935, 3, No. 9, 428-430.

are most familiar with these lavas." In the light of more recent studies, Dr. Fox and his colleagues with whom he has discussed this problem are now prepared to accept Dr. W. T. Blanford's view that this volcanic period (the Deccan traps) possibly straddles the close of the cretaceous and the beginning of the tertiary era.

To any one interested in this problem of the age of the Deccan traps, these two papers mentioned above are of very great value, since they review the whole position up to date and enable us to appreciate further discussion. In the course of their remarks both Dr. Sahni and Dr. Fox have referred to the Deccan traps and their associated sediments found near Rajahmundry, and it has generally been recognised that studies in this area are likely to be very useful in determining the age of these lava flows. As Dr. W.T. Blanford wrote so far back as 1879,<sup>3</sup> "the most important clue to the correlation of the volcanic rocks with the known series of fossiliferous deposits might be expected to be obtained from the marine beds associated with the volcanic formations at Rajahmundry."

We have recently examined the fossiliferous sediments associated with the Deccan traps near Rajahmundry and the main object of the present paper is to briefly review the geology of this area, with special reference to certain new palæontological observations made by us and discuss their bearing on the age of these lava flows.

#### Rajahmundry area.

*The infra-trappean beds.*—It is well known that near Pungadi, Gowripatam and Dudukur there occurs below the lowest trap flows a gray sandy fossiliferous limestone of marine origin; and between this infra-trappean limestone and the overlying trap there is an unconformity. This limestone and the included fossils have been described by King<sup>4</sup> and he comes to the conclusion that "the majority of fossils are such as are usually considered as of tertiary age"; and according to W.T. Blanford<sup>5</sup> "Although the whole facies is tertiary, there is a remarkable absence of characteristic genera, and the chief distinction from the cretaceous fauna of the upper beds in South India is simply the want of any marked cretaceous form. The fauna is distinctly marine. . . . .The balance of evidence is rather in favour of referring the latter (the Pungadi infra-trappeans) to cretaceous times rather than to tertiary. They may be of intermediate age."—an opinion very

<sup>3</sup> *A Manual of the Geology of India*, 1879, Part I, 329.

<sup>4</sup> *Mem. Geo. Sur. Ind.*, 1880, 16, Article 3, 42.

<sup>5</sup> *A Manual of the Geology of India*, Part I, 316.

similar to that expressed by H. F. Blanford<sup>6</sup> in describing the age of the Niniyur beds in the Trichinopoly District when he says: "There is much resemblance between some of the species (of the Niniyur fossils) and those of the Rajahmundry beds, the fossils of which have been described by the Rev. S. Hislop, and one species of *Turritella* appears to be identical with *T. prolonga* of that formation. . . . It will be seen from the above that the tertiary aspect of the fossils of the Niniyur bed is more due to the absence of characteristic cretaceous forms than to the presence of those which we have been accustomed to think as peculiar to tertiary deposits; but the latter are not entirely wanting."

In this connection we may point out that sometime back the late Prof. H. C. Das-Gupta<sup>7</sup> collected from this very infra-trappean bed near Dudukur *Venericardia (Cardita) Beaumonti*, d'Arch.—a fossil of great stratigraphical value in Indian geology. On this and other paleontological evidences Prof. Das-Gupta also concludes that "the Dudukur fossiliferous band should be placed under the upper part of the upper cretaceous age" and thus must occupy a very high position in the upper cretaceous system. It is also well known that in the Niniyur beds of the Trichinopoly area we get *C. Jaquinoli*, which is believed to be identical with *C. Beaumonti*, and we know, on other evidences, that the Niniyur stage marks almost the passage from the uppermost cretaceous to the lower tertiary. Thus it is obvious from all considerations that this infra-trappean limestone in the Rajahmundry area is at least uppermost cretaceous in age; and it is on this bed that the lowest trap flows of this area unconformably overlies. Now the question is, what exactly is the age of these traps? To understand this we must now focus our attention on the inter-trappean beds.

*The inter-trappean beds.*—These have been elaborately described by King from exposures noticed near Kateru, Rajahmundry, Gowripatam and Dudukur, together with the more common fossils found in them. After examining the evidence afforded by these fossils King<sup>8</sup> writes as follows regarding the age of these beds: "The inter-trappean beds are clearly of the trappean period and they are in some respects rangeable with Hislop's inter-trappeans of Central India; but the latter are essentially of lacustrine or fresh-water origin, while the Pungadi and Kateru fauna is estuarine. However, there are three shells common to the two, viz., *Paludina normalis*, *Physa prinsepi*, and *Lymnea subulata*, and as it appeared when Hislop wrote there

<sup>6</sup> *Mem. Geol. Surv. Ind.*, 1865, 4, Article I, 141.

<sup>7</sup> *Quart. Jour. Geol. Min. Met. Soc. Ind.*, June 1933, 5, No. 2, 59-66.

<sup>8</sup> *Loc. cit. supra*, page 53.

seemed very good reason for his conclusion that the rocks of the one locality are a fair estuarine representative of the lacustrine rocks of the other, and that they are of lower eocene age. I am unable myself to enlarge on or narrow Hislop's generalisation further than to instance the fact that *the traps do not appear to be dissociated from the infra-trappean beds to such an extent of unconformity as the supposedly upper eocene age of the inter-trappean beds would require.*" On the question of the age of these inter-traps in the Rajahmundry area, Dr. W. T. Blanford<sup>9</sup> says: "The most marked feature of this fauna is its distinctly estuarine character. .... The inter-trappean beds of Rajahmundry were deposited in brackish water which was supplied with fresh-water by streams, but which was also in communication with the sea. .... On the whole it may be safely asserted *that no tertiary alliances of any value have been detected amongst the inter-trappean Rajahmundry fossils, and that their relations are rather with the upper cretaceous rocks of Southern India, although the connection is not strong.*" (Italics in these two quotations are ours.)

From the above it will be obvious that while both King and Blanford have not straightaway accepted Hislop's view of the lower eocene age of these inter-traps, they are not prepared to oppose this idea as improbable, nor have they said definitely that these beds are only upper cretaceous. Their attitude in this matter is very clear. King's hesitation to readily accept Hislop's view is merely due to his doubting whether the unconformity between the infra- and inter-traps in this area is of sufficient magnitude. To W. T. Blanford the view that the inter-trappeans are of upper cretaceous age is more acceptable, not because there is any strong connection with the upper cretaceous rocks of Southern India but because 'no tertiary alliances of any value have been detected among the inter-trappean Rajahmundry fossils.' In this connection we should like to refer to some interesting palæontological finds made by us in the course of a recent detailed examination of some of the inter-trappean beds of this area.

#### *Kateru inter-traps.*

One of the best exposures of the inter-traps near Kateru is seen in a small quarry about 500 yards to the north of the sanatorium rise and about 200 yards to the west of the Koraikonda road. Forming part of the inter-trappean bed here we have a thin band of a dirty green marl which on washing has yielded the remains of numerous *Chara* fruits. A detailed account of these will be separately published and we might only mention here that the following species of *Chara* are well represented: *C. Wrightii* Salter, *C. helicteres*

<sup>9</sup> *Loc. cit. supra*, pages 318-319.

Brong., *C. cœlata* Reid and Groves, *C. turbinata* Reid and Groves, *C. vasiiformis* Reid and Groves, and *C. strobilocarpa*, Reid and Groves.

The value of Charophytic remains in the correlation of estuarine and fresh-water deposits lying in isolated basins is well known. As Reid and Groves<sup>10</sup> observe: "In the correlation of far distant deposits we need a group of fossils easily dispersed and therefore widely spread, having many generic and specific forms of limited range in time, with specimens occurring in profusion in a determinable state; in short, for zonal work in fresh-water strata we require a group somewhat equivalent to the Graptolites in wide distribution and characteristic forms. One group (the Charophyta) seems to possess all these characteristics, if we can obtain sufficient material." A reference to the stratigraphical distribution of these *Chara* species mentioned above from the inter-traps of Kateru shows that they are all distinctive early tertiary types—especially the three most common forms *C. Wrightii*, *C. helicteres*, and *C. cœlata*—and thus serve to indicate the age of this inter-trappean bed.

In this connection it would be interesting to recall that some fossil *Chara* have been recognised long ago from the lower inter-trappean beds near Nagpur and one species has been described under the name *C. Malcolmsoni*. We have so far not noticed this form in the Rajahmundry material.

*Pungadi-Dudukur inter-traps.*

Thin sections of the limestones forming the lowest beds of the inter-trappean series near Pungadi and Dudukur have revealed among other fossils remains of algæ belonging to the family Dasycladaceæ. These algæ are being studied in collaboration with Dr. Julius Pia (of the Natural History Museum, Vienna) but even a preliminary examination of this material has revealed the occurrence of the important form, *Acicularia* which is generally recognised as a distinctive early tertiary type. Here then we have another evidence on the age of these inter-trappean beds pointing in the same direction as the *Chara* of the Kateru inter-traps. Thus it would appear that the position in the Rajahmundry area is merely this; we have the infra-traps of at least upper cretaceous age, and overlying this unconformably we have the trap flows whose age as determined by the fossils in the inter-trappean beds is at least lower eocene.

Before proceeding further we should like to say a few words regarding the exact mode of origin of these inter-trappean beds near Rajahmundry. While they are generally recognised as estuarine in character, W.T. Blanford<sup>11</sup> says: "The inter-trappean beds of Rajahmundry were deposited in brackish

<sup>10</sup> *Quar. Jour. Geo. Soc. London*, 1921, 77, Part 3, 176.

<sup>11</sup> *Loc. cit. supra*, page 319.

water which was supplied with fresh-water by streams, but which was also in communication with the sea." The idea that the sea has played an important part in the deposition of some of these inter-trappean beds is supported by the fact that we have recently discovered the remains of numerous Foraminifers in these beds near Pungadi and Dudukur. A detailed study of these is in progress but enough work has been done to indicate the general character of this Foraminiferal fauna. The following families are commonly represented: Miliolidae, Lagenidae, Nonionidae, Rotalidae and Anomalinidae; and in some cases these forms are so crowded that the rock may almost be called a Foraminiferal limestone. Since many of these families of Foraminifers have a fairly wide range in time, they are not of much value in determining the exact age of the beds containing them; but there is no doubt that a further study of these and other fossils in these marine intercalations in the Rajahmundry area will be of great value in comparing them with the sediments of the Trichinopoly area in the south and the Assam area in the north since all these areas must have formed part of the same marine province which came into existence as a result of the transgression of the southern sea, as will be obvious from a reference to the map showing the geography of Gondwanaland during the cretaceous period drawn by Dr. Fox and found accompanying his memoir<sup>12</sup> on "The Gondwana system and related formations".

#### The relation of the Rajahmundry area to the main mass of the Deccan traps.

We shall now proceed to briefly compare the position in Rajahmundry with what obtains in the main area of the Deccan traps in Central Provinces. In this latter area the lowest trap flows are frequently seen to overlies unconformably the Lameta beds or sometimes the Bagh beds; as a matter of fact, in a large part of this area the infra-trappean beds are the Lametas, which are believed to be the fresh-water equivalents of the marine Bagh beds (or slightly younger) and are of Cenomanian age. The Lametas have been so commonly noticed as the infra-trappean beds throughout this area that one working here develops a tendency to consider the two terms—Lametas and infra-traps—as synonymous and interchangeable. This is rather misleading at times, especially when one leaves the Central Provinces and goes to an altogether different area of the traps like that of Rajahmundry; for in this area immediately he sees the beds below the traps—the infra-traps—he starts with the assumption that these must be equivalent in all respects to the Lametas he has noticed as the infra-traps in Central Provinces<sup>13</sup> while,

<sup>12</sup> *Mem. Geo. Sur. Ind.*, 1931, 58.

<sup>13</sup> For example, in his paper 'On the age of the fossiliferous beds at Dudukur' (*Quar. Jour. Geo. Min. Met. Soc. Ind.*, Vol. 5, No. 2, June 1933, the late Prof. H. C. Das-Gupta says:

as a matter of fact, these beds of the Rajahmundry area may have nothing to do (and actually these have nothing to do) with the true Lametas, except that they are both infra-trappean in position.

In this connection we may point out that W. T. Blanford has carefully guarded himself against this tendency for he says<sup>14</sup> after describing the infra-trappean bed near Dudukur: "It is difficult to say whether this bed should be referred to the Lameta group or not. The mineral character is similar, but all known Lameta outcrops are so distant that the identification is somewhat doubtful. The distinctions between the fossils of the Bagh beds and those of the infra-trappeans of Dudukur and Pungadi appear to be too great to be attributed solely to the existence of a land barrier between the two areas; it is difficult to suppose that the two formations can be of the same geological age; and the difficulty consequently arises that if the Lameta beds represent the Bagh group, they are probably more ancient than the Pungadi infra-trappeans." We think it is very necessary to keep this distinction in mind, especially when we are comparing the infra-trappean beds of widely separated areas.

Now to come back to the position in Central Provinces. As mentioned above, in many parts of this area the lowest trap flows overlie the Lameta beds and are therefore younger. The question is, what exactly is the age of these traps? Here again we have luckily a few inter-trappean beds with important fossils; and it is from these beds found in the Nagpur-Chhindwara region that Dr. Sahni and his collaborators have described a rich silicified flora<sup>15</sup> and have shown that there is a considerable body of direct palæobotanical evidence distinctly in favour of a tertiary age for these inter-trappean beds; and in view of the fact that all these plant fossils come from the lowest part of the inter-trappean series, Dr. Sahni<sup>16</sup> naturally goes on to conclude that "the tertiary era had already dawned when the first lavas of the Deccan were poured out" and that "the whole period represented by the traps from Nagpur as far as the west coast was comprised within the lower tertiary and probably within the eocene."

In this connection we may also refer to the occurrence of certain fossil fishes discovered long ago in the supposed Lameta beds near Dhamni and

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"King placed the Dudukur fossiliferous band as infra-trappean. \*\* The beds known as infra-trappean with respect to the Deccan trap are, in terms of Indian Geology, designated as belonging to the Lameta stage. \*\* The infra-trappean and the Lameta beds are synonymous," pages 65-66.

<sup>14</sup> *Loc. cit. supra*, page 317.

<sup>15</sup> *Proc. Ind. Sci. Congress*, Botany section, Bombay, Read January 1934, published March 1934.

<sup>16</sup> *Curr. Sci.*, March 1935, 3, No. 9, 430.

Dongargaon, in Central Provinces. These fishes have been studied by Sir Arthur Smith Woodward<sup>17</sup> who after discussing their affinities fixed the age of this fish fauna as between the Danian cretaceous and the upper eocene, and thought they were probably of lower eocene age, a conclusion difficult to reconcile with the otherwise accepted Cenomanian age of the Lameta beds. But from a recent study of these fish-bearing beds near Dongargaon, Dr. C.A. Matley<sup>18</sup> has adduced reasons to believe that these "beds are not Lametas but are of inter-trappean age," . . . . .laid down in a separate basin of deposition. This important conclusion clarifies the whole situation; and the fish fauna of the Dongargaon beds may now be considered as further supporting the case for the lower eocene age of the inter-traps in this area based on the plant fossils recently described by Dr. Sahni.

It has been generally admitted that these lava flows of the Nagpur-Chhindwara area, as also those of Rajahmundry, belong to the base of the Deccan trap formation as a whole; and in both these areas the fossil evidences from the lowest inter-trappean beds indicate that "the tertiary era had already dawned when the first lavas of the Deccan were poured out."

#### Conclusion.

It must be remembered, however, that practically all this palæontological evidence in support of an eocene age for the Deccan trap comes from plant fossils; and the question naturally arises as to what dependence is to be placed upon fossil plants as a guide to geological age—how far they could be considered "absolute indicators of a geological horizon". Whenever there has been a possible difference of opinion on the age of a bed as determined by the evidence of terrestrial fossil plants as against fossil marine animals, it is true that the geologist will always prefer the evidence of the latter and fix the age accordingly. But in a case like the age of the inter-traps where the decisive evidence of fossil marine animals is not available, it seems only reasonable to accept an age based on the verdict of the plant fossils, unless such a conclusion can be shown to be definitely unacceptable from the geological side.

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<sup>17</sup> *Pal. Ind. N. S.*, 1908, 3, 1-6.

<sup>18</sup> *Rec. Geo. Sur. Ind.*, 1921, 53, Part 2, 159.