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On the Occurrence of Chipped (?) Flints *in the* Upper Miocene of Burma.

By Dr. Fritz Noetling, F.G.S., *Palæontologist, Geological Survey of India.* (With a Plate.)

While engaged in mapping out a part of the Yenangyoung oil-field my attention was particularly directed to the collecting of vertebrate remains, which are rather common in certain strata around Yenangyoung. One of the most conspicuous beds, palæontologically as well as petrographically, is a ferruginous conglomerate, upwards of ten feet in thickness. This bed may be distinguished a long distance off as a dull-red band, running in a continuous line, across ravines and hills. Besides numerous other vertebrate remains, such as *Rhinoceros perimense,* etc., one of the commonest species is *Hippotherium antelopinum* Caut. and Falc. of which numerous isolated teeth can be found.

While stooping to pick up the fine lower molar which is figured in the accompanying plate, my attention was drawn to some curiously shaped flints partly imbedded in the ferruginous conglomerate. Next to the molar just mentioned, I found the fine specimen figure 2, —; and on looking further about I found about a dozen or so of other flints, some of which are figured on the same plate.

Before discussing the geological position in which these flints were discovered, it will be useful to describe shortly their appearance. As regards their general shape, we may distinguish three types, *viz.*:—

(*a*) Irregularly shaped flat flakes.
(*b*) More or less triangularly shaped flakes.
(*c*) A rectangular flake.

(*a*) *Irregularly shaped flakes.*—These are generally flat, more or less square flakes, up to about 40 mm. in length, which are thicker in the centre than near the edges; edges sharp and cutting. Flakes of this kind are frequently found.

(*b*) *Triangular flakes.*—These show a roughly triangular shape; one side being generally flat, the opposite one being more or less rounded, so that a cross section has an irregular triangular or wedge-shaped outline. The lateral edges are straight, sharp and cutting; figures 3, 4 and 5 show good samples of this kind; particularly figures 3 and 4. Figure 5 is particularly remarkable, it shows that the upper face must have been produced by the repeated chipping off of thin flakes.

(*c*) *A rectangular flake.*—I found only one specimen of this kind, in fact it was through this specimen that my attention was directed to these flints. It is of a somewhat irregular rectangular shape and slightly curved; the length being 45 mm., the breadth 20 mm., both faces are roof like, so that a rhomboidal section is produced. The two long edges run nearly parallel and are sharp and cutting. This flake affords particular interest in as much as the two faces must have been produced by an action, which is difficult to explain by natural causes. Let us consider the convex face first; it will be seen that one side is smooth, apparently produced by the chipping off of a single flake, while the other side shows that at least four smaller flakes have been chipped off at a right angle to the first one. The concave face which is however much damaged at one side must have been produced by the chipping off of two longitudinal flakes.

The shape of this specimen reminds me very much of the chipped flint described in Volume I of the Records, Geological Survey of India, and discovered in the Pleistocene of the Nerbudda river, the artificial origin of which nobody seems to have ever doubted.

As regards the geological position in which these flakes were found, I mentioned above that they were imbedded in a ferruginous conglomerate. It remains now to be explained what position this bed holds in the sequence of the tertiaries near Yenangyoung. According to my researches, which will be published in detail at a later period, three distinct groups can be distinguished in the Yenangyoung tertiaries, namely, in descending order :—

3. GROUP C.—Consisting chiefly of light coloured, yellow sandstones or soft yellow sand-rocks with hard siliceous concretions, alternating with beds of light brown clay. Silicified wood very common, besides fragments of terrestrial and fresh-water animals. Measured thickness not less than 4,620 feet.

2. GROUP B.—Consisting of brown and red sandstones and light brown clays, containing numerous crystals of selenite, and locally countless numbers of *Batissa crawfurdi*, Noetl., terminating in a bed of ferruginous conglomerate with numerous remains of terrestrial animals, among which *Hippotherium antelopinum*, Caut. and Falc., and *Rhinoceros perimense* preponderate; chipped flints locally not rare. Measured thickness of the whole group 1,105 feet.

1. GROUP A.—Consisting of a series of blue clays alternating with beds of grey sandstone, which contain locally large quantities of petroleum. Fossils are scarce, but such as have been found consist chiefly of true salt water fossils with some rolled fragments of bones and some teeth of terrestrial animals. Thickness not less than 1,000 feet.

It is apparently quite clear that this succession of strata exhibits the gradual change from true marine strata, deposited somewhere near a coast, through estuarine deposits as represented by the strata containing *Batissa crawfurdi*, Noetl. to fresh water deposits containing the remains of terrestrial and fresh water animals as represented by Group C. A superficial examination of the vertebrate remains shows that the fauna is nearly identical with that of the Siwaliks, or in other words, that Group C (probably inclusive of Group B) must be of upper miocene if not pliocene age. We must therefore claim either pliocene or at the latest upper miocene age for the ferruginous conglomerate in which the chipped flints have been found. But whatsoever their particular age be, it is certain that a considerable amount of time must have lapsed since the deposit of a series of strata of more than 4,620 feet thickness, containing numerous genera of animals which are now-a-days either entirely extinct, or at least no longer living in India, which rests upon it.

Having now described the geological position of the strata in which the chipped flints were found, there still remains the question to be discussed whether they were really found *in situ*, or not. To this I can only answer that to the best of my knowledge they were really found *in situ*, and that I most probably would not have discovered them, if I had not stooped to pick up the molar of *Hippotherium antelopinum*, figure 6. The exact spot where the flints were found is marked on my geological map of the Yenangyoung oil-field with No. 49 and is situated on the steep eastern slope of a ravine, high above its bottom, but below the edge in such a position that it is inconceivable how the flints should have been

brought there by any foreign agency. There is no room for any dwelling place in this narrow gorge, nor was there ever any; it is further impossible from the way in which the flints were found that they could have been brought to that place by a flood. If I weigh all the evidence, quite apart from the fact that I actually dug them out of the bed, it is my strong belief that they were *in situ* when found.

As to their nature whether artificial or not, I do not want to express an opinion; all I can say is, that if flints of this shape can be produced by natural causes, a good many chipped flints hitherto considered as undoubtedly artificial products are open to grave doubt as to their origin.

EXPLANATION OF PLATE.

Fig. 1. Rectangular flint flake, top view.
Fig. 1*a*. „ „ „ lower view.
Fig. 1*b*. „ „ „ side view.
Fig. 2. Triangular flint flake, top view.
Fig. 2*a*. „ „ „ lower view.
Fig. 2*b*. „ „ „ side view.
Fig. 3. Triangular flint flake, top view.
Fig. 3*a*. „ „ „ lower view.
Fig. 3*b*. „ „ „ side view.
Fig. 4. Triangular flint flake, top view.
Fig. 4*a*. „ „ „ lower view.
Fig. 4*b*. „ „ „ side view.
Fig. 5. Triangular flint flake, top view.
Fig. 5*a*. „ „ „ ower view.
Fig. 5*b*. „ „ „ side view.
Fig. 6. Left upper molar of *Hippotherium antelopinum*, Caut. and Falc. Twice the natural size.

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fig. 1.

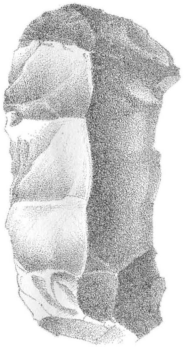

fig. 6.

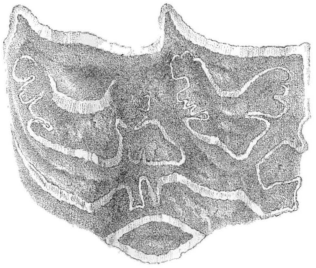

fig. 1.a.

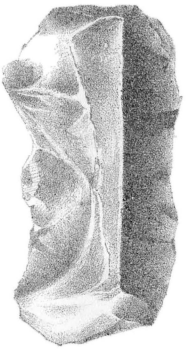

fig. 1.b.

fig. 2.

fig. 3.

fig. 4.

fig. 5.

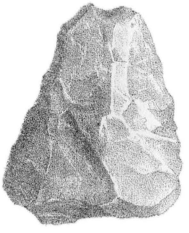

fig. 2.a.

fig. 3.a.

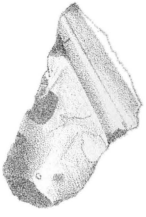

fig. 4.a.

fig. 5.a.

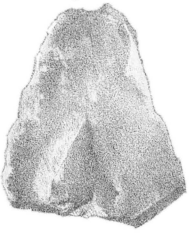

fig. 2.b.

fig. 3.b.

fig. 4.b.

fig. 5.b.