every other paragenesis of this mineral, partial peroxidation has supervened for the production of ferric oxide in atomic ratio with ferrous oxide. Saturation of ferrous oxide with ferric oxide for this evolution is indeed all that has arrested peroxidation of the lower oxide short of completeness wherever original silicates have been split up by oxidation of this unstable base under weathering influences. Hydro-chemical as well as thermo-dynamical agencies in eruptive paragenesis of magnetite have doubtless been far more active than in a metamorphic paragenesis. Physical differentiation or magmatic concentration of magnetite as such into concrete ore bodies from molten eruptives, as urged by Vogt, is scarcely conceivable without supervention of further physical or molecular concentration analogous to what takes place both in metamorphic and eruptive aggregates. No basic rocks even among the most modern can ever be assumed to retain their original condition or inter-molecular form.

There seems much however to support the theory that differentiation in molten eruptives may summarily take place in the order of specific gravity toward the borders of a magma basin, or, on the Soret principle, toward the marginal parts of dykes or other intrusions, with the effect of a determination, not necessarily in stochiometric proportions, of material richest in ferrous oxide to such a position relative to the mass. Hence of course the greater basicity of silicates and also the greater the subsequent evolution of magnetite in nether parts of intrusive masses, sometimes so as to afford the *locus* of ore bodies through slow hydro-chemical permutations. That concentration of magnetite has taken place in any given eruptive magma except as a product of secondary evolution seems to me extremely doubtful, as in the case of all other bodies of iron ore closely related to basic rocks—notably metamorphic rocks. The subject of physical differentiation of igneous magma antecedent to development of crystalline types of igneous rocks has been presented by Prof. Iddings in a manner which leaves little room at present for further citations of results of studies given to the same subject by Brögger, Vogt and others.*

*Iddings. Bull. Phil. Soc. Washington XII, 1892, pp. 89, 214; Vogt. Zeitsch. für. prak. Geol. I, 1893, pp. 4, 125, 257; III, 145, 367, 444, 465.

*Note.* Since the presentation of this paper an exact discussion of this hypothesis has been given by Becker. (Am. Jour. of Sc. III, 1897, 21.)



## DICERATHERIUM PROAVITUM.

(Plate XIX.)

By J. B. HATCHER, Princeton University.

In this journal for May, 1894, pp. 360-361, the writer described under the name of *Diceratherium proavitum*, a member of the *Rhinocerotidæ* new to the White River formation. In my original description of this species I was unable to see the proof sheets and hence some typographical errors appear in the text, and in at least two instances erroneous characters are assigned to the type. It is the purpose of this brief paper to correct those errors in my original description and to give further reasons in favor of placing this form in the genus *Diceratherium* rather than *Aceratherium*.

The type consists of a nearly complete skull (No. 10965) of a fully adult, in fact rather aged, individual, without the lower jaw. The principal specific characters are as follows: Skull rather short, low and broad especially in the region of the frontals; superior surface slightly concave antero-posteriorly; sagittal crest short, low and broad; strong postorbital processes on frontals; nasals very strong, partially coössified and bearing upon their upper and outer surfaces a pair of rugose prominences situated at about one-third the distance from their extremities to their junction with the frontals. These prominences resemble very much the rugosities supporting the nasal horns in many of the recent rhinoceroses, and doubtless served the same purpose in *D. proavitum*. Behind this pair of rugosities the nasals are constricted, but posteriorly they expand again to meet the broad anterior border of the frontals. The fronto-nasal suture is but little in front of the orbit. In front of the pair of rugose elevations the nasals contract rapidly and are directed downward and forward. The occipital crest is emarginate in the median line and overhangs the occipital condyles. The zygomata are rather slender but stronger than in *Aceratherium occidentale*. The post-tympanic and post-glenoid processes are in contact but not co-ossified. The anterior border of the posterior nares is situated just behind the posterior edge of the first molar. Of the teeth only the molars and premolars are preserved in the type and they are rather too much worn to determine accurately their characters. The first premolar is rather strong and well developed, the succeeding premolars increase in size from in front backward. The dorsum of the molars and premolars is very flat with no suggestion of a median costa. There is a basal ridge on the dorsum of the true molars but not on the premolars. The median sinus is shallow, especially in the premolars and the first molar; it is obstructed by only faint rudiments of the crochet and antecrochet. The anterior and posterior valla are shallow. There is a cingulum on the inner border of the premolars but none on the true molars. The principal measurements of the type are as follows:

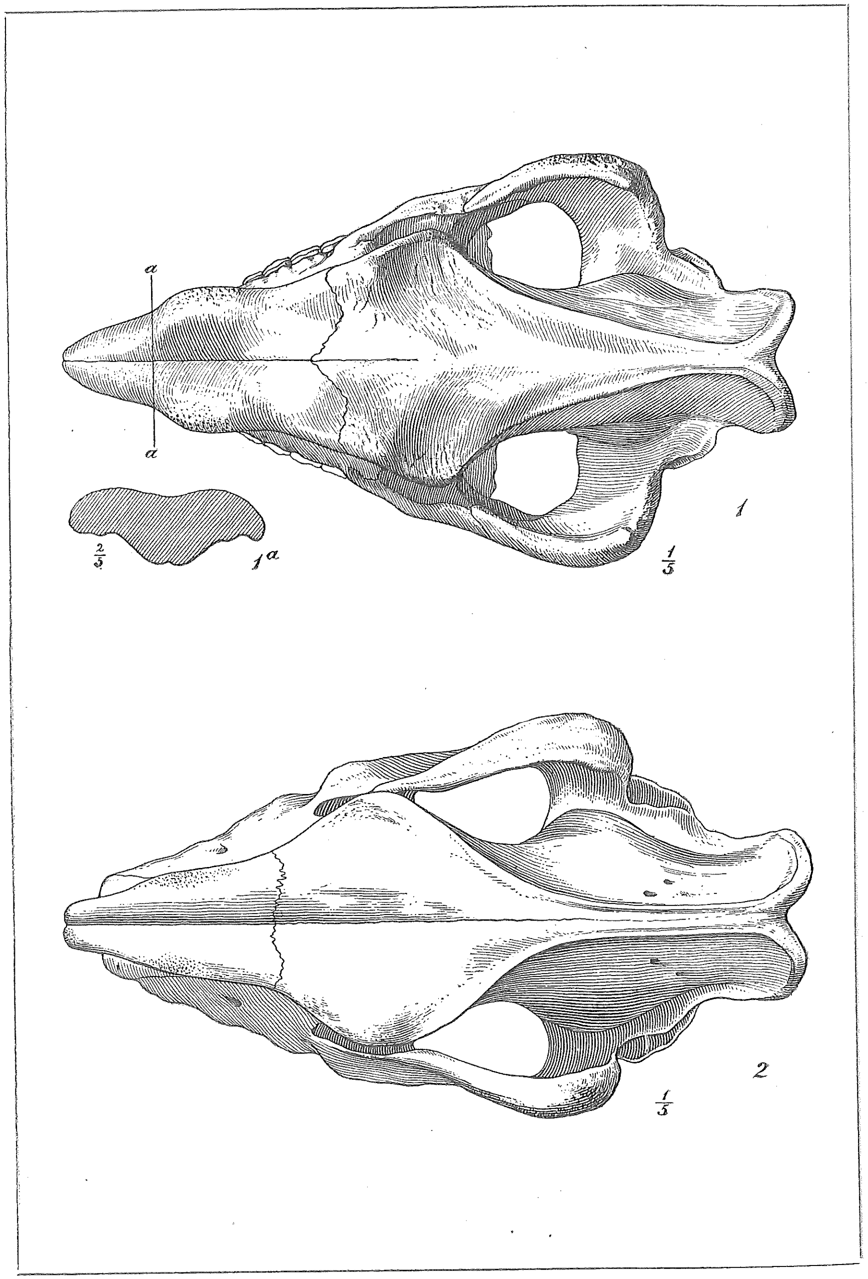
| | mm. |
|---|---|
| Length of skull from extremity of nasals to occipital crest ....... | 475 |
| Breadth across frontals at post-orbital processes ................ | 165 |
| Hight of occipital crest above foramen magnum ................ | 115 |
| Width of nasals at rugosities .................................... | 102 |
| Width of nasals just in front of rugosities at sec. shown in fig. 1a. | 63 |
| Thickness of nasals on median line in front of rugosities ......... | 24 |
| Length of premolar--molar series .............................. | 195 |
| Length of premolar series ........................................ | 97 |

Prof. Osborn* has considered *D. proavitum* as a synonym of his *Aceratherium tridactylum*. In his latest communication on this subject he says: "The large number of skulls in the collection belonging to *Aceratherium tridactylum* demonstrates that the species ran to two extremes, a high, long and narrow type, and a shorter, lower and broader type. The latter exhibit very prominent rugosities upon the nasals, which we might, with Hatcher, interpret as prophetic of *Diceratherium* were it not for the fact that equally rugose areas are found above the orbits and upon the zygomatic arches."

"These two varieties of *A. tridactylum* are not due to age, but may be partly sexual. The molar structure has no constant differences."

Prof. Osborn† in his original description of *A. tridactylum* says: "The occiput is high and rather narrow" and again in a more recent description he says:‡ "In the *type* the nasals are *perfectly* smooth, (italics mine), but in another skull (No. 541) the nasals exhibit a pair of rugosities which at once suggest the possession of a pair of horns, and Mr.

*See Bull. Am. Mus. Nat. Hist., vol. VII, 1895, p. 373.
†See Bull. Am. Mus. Nat. Hist. vol. V, 1893, p. 86.
‡See Bull. Am. Mus. Nat. Hist. vol. VI, 1894, p. 207.




DICERATHERIUM PROAVITUM *and* ACERATHERIUM TRIDACTYLUM.



Hatcher has recently shown that this species is followed by another, related to the John Day genus *Diceratherium* Marsh. The distinctive features of the skull are the high, narrow occiput and powerful sagittal crest, etc."

From the above it will be seen that the *type* of *A. tridactylum* belongs to the series, with skulls characterized by Prof. Osborn as high, long and narrow and in which the "nasals are perfectly smooth"; while the type of *D. proavitum* pertains to the other series with skulls characterized by Prof. Osborn as shorter, lower and broader and with prominent rugosities upon the nasals.

As shown by the above quotation Prof. Osborn has stated that these two varieties are not due to age, but that they may be partly sexual. In view of the fact that we do not find in the skulls of recent rhinoceroses or other perissodactyls similar sexual variations, I think it fair to conclude that these variations are not sexual, but of generic and specific importance. I therefore retain *Diceratherium proavitum* as distinct both generically and specifically from *Aceratherium tridactylum* Osborn; unless we abolish altogether the genus *Diceratherium* and with it *Aceratherium* and call them all *Rhinoceros* as has been done by Flower and Lydekker,* but which does not seem advisable.

Prof. Osborn's objection to considering the rugosities on the nasals of *D. proavitum* as indicative of horns because he finds similar rugosities on the zygomata and over the orbits can scarcely be considered tenable, since the latter rugosities are not in a position at all relative to that known to have been occupied by horns in later forms from the John Day beds, and very similar rugosities may be seen on the zygomata and over the orbits in the recent rhinoceroses which are known to bear horns on the nasals.

Aside from the rugosities, there are other evidences even more in favor of considering them as having borne horns; such as the great thickening of the nasals (shown in fig. 1a) in order to give them the necessary strength to support the horns, and the low, short and broad sagittal crest as shown in fig. 1. Furthermore, the geological horizon (*Protoceras beds*) in which the type was found is just that in which we

*See Mammals Living and Extinct, pp. 410-411.

should expect to find the ancestor of the John Day form. When the latter beds shall have been as carefully explored as have the White River beds there will doubtless be found a series of forms running gradually from *D. proavitum* in the *Protoceras beds* to *D. advenum* Marsh in the John Day. The rugosities in the former species are, it is true, not nearly so prominent as in the latter, but they are in the proper position, and that they supported incipient horns is shown by every collateral character which we should reasonably expect to find in the White River ancestor of the John Day form; it should therefore be considered as ancestral to that form.

I present here for comparison in figs. 1 and 2 the sup. view of the type of *D. proavitum* and a reproduction of Prof. Osborn's figure showing same view of *A. tridactylum*. The rugosities on the nasals in the latter as shown by Prof. Osborn's descriptions in the text and as stated by the draftsman are taken not from the *type*, but from another skull, referred to the same species. In fig. 1 the broad nasals, entirely concealing the premaxillaries, the position of the fronto-nasal suture and the low, short, broad sagittal crest are especially noteworthy as contrasting with the same characters in fig. 2.

Fig. 1. Sup. view of type of *D. proavitum* (No. 10965) 1-5 nat. size.

Fig. 1a. Cross-section of nasals immediately in front of horns, two-fifths nat. size. Drawn by R. Weber.

Fig. 2. Sup. view of *A. tridactylum*, 1-5 nat. size, after Osborn. Drawn by R. Weber.

The principal distinctive characters of *D. proavitum* and *A. tridactylum* may be tabulated as follows:

| *D. proavitum.* | *A. tridactylum.* |
|---|---|
| Skull rather short, low and broad. Nasals very thick, broad, and with prominent rugosities on sup. surface. Fronto-nasal suture only a little in front of orbits. Sagittal crest broad, short and low, almost disappearing. | Skull long, high and narrow. Nasals slender and perfectly smooth on sup. surface. Fronto-nasal suture situated well in front of orbits. Sagittal crest high, long and narrow. |

## THE FISHER METEORITE. CHEMICAL AND MINERAL COMPOSITION.

By N. H. Winchell, Minneapolis.

For the purpose of further determination of the mineral which resembles maskelynite, two micro-chemical tests were made. The particles are so small that no chemical examination is practicable; viz.:



1. Particles belonging to group 2, i. e. glass.
2. Particles of a translucent mineral which showed angular fracture, and but little or no cleavage, presumed to be the doubly refracting mineral which is like maskelynite, and possibly represented by groups 5 and 6.

With the first the test revealed lime and a little soda. With the second were developed, along with fluosilicates of lime, a liberal sprinkling of hexagonal rods of fluosilicate of soda.

There is not enough of this mineral present to warrant an attempt at quantitative analysis. It remains therefore undecided whether the meteorite contains maskelynite. The evidences in favor of its presence are:

1. A feebly polarizing mineral, low in double refraction, occurring in the midst of the chondri and elsewhere.
2. This mineral shows little or no cleavage.
3. It contains lime and soda.
4. The glass from which it seems to have crystallized also contains soda, and no soda has been detected in the other minerals.*

### Chemical Analysis of the Fisher Meteorite.

By C. P. Berkey, University of Minnesota.

An analysis was made of some small fragments of this meteorite. Preliminary qualitative tests showed the following elements: Silicon, aluminium, iron, nickel, calcium, magnesium, and sulphur. Silicon occurs as the oxide, forming the mineral *tridymite* and also occurs in the silicates *maskelynite*, *olivine*, and *enstatite*. Aluminium, calcium and magnesium and a part of the iron occur in the silicates. Nickel is present native or possibly forming an alloy with the iron. Iron is present in three forms, metallic iron, ferrous oxides in the silicates, and ferric oxide chiefly as an oxidation product from the native metal.

Sulphur is present in small quantity in the mineral *troilite*. No alkali metals were found.

The bulk analysis gave:

*Unavoidable obstacles have delayed the conclusion of this examination. The reader is referred to this journal for former accounts of this meteorite, viz, vol. XVII, pp. 173, 234, and to *Comptes Rendus des Séances de l'Académie des Sciences*, Paris, 16 Mar. 1896.