It is composed of three ankylosed vertebræ.

It is interesting to find Dinosaurs in these marine beds. The marine fossils are found mixed with the bones. While digging out the skeleton of *Claosaurus* nearly a dozen *Nautali* were found among the bones. As a rule, when bones are found a good part of the skeleton is there or there is evidence that it has been. Several skeletons had been found and the bones removed for curiosities before I had visited this region. The first skeleton I saw was shown to me by a young man, Mr. Albert Silberling, who lived on the ranch from which the others were dug. I think that very few fossil-hunters would have looked for Dinosaur bones here.

It seems that these deposits were made in a shallow inland sea or an estuary which, at least during a part of the time, was cut off from the ocean, for in places there is considerable gypsum. Perhaps we should hardly expect to find such large marine mollusca in such a place, but they evidently are not far from where they died. There is no evidence of strong tides, and if the shells had been washed up by these or the winds they would be broken, not complete as we find them.

As a rule land animals are not very perfectly preserved in marine deposits. In unearthing these animals, therefore, the question is always arising: "How did these bones get here?" Did these Dinosaurs that have been so modified, evidently fitting them for life on land, still retain their swimming habits, but occasionally suffer shipwreck and their carcasses sink to the bottom of the sea? By some invasion of the sea were they forced to stay and starve or 'swim for life' which proved in some cases to be for death? I have seen no indications that they were killed by violence or their carcasses destroyed by large carnivorous animals, though there has been a little disturbance of the bones. Did they die on some mud flat or did their carcasses float down some sluggish stream and get stranded in shallow water or get 'water-logged' and sink in deeper water? These are interesting questions, but more thorough and careful investigation is needed to decide the matter with any degree of certainty.

The University of Montana hopes before very long to publish a bulletin describing these beds and whatever is of interest in the collections obtained from them.

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Magmatic Differentiation of Rocks.

Since the time when the celebrated chemist Bunsen first elaborated his theory on the nature of rock magmas, the subject has been of great importance to the geologist. If one were asked to name three of the grander ideas which mark the progress of geology during the century just closed, this conception of magmatic differentiation of rocks would certainly be one of them. Of late years contributions to the subject have been numerous and important. Several of the most recent are especially noteworthy.

In the reconsideration, by H. S. Washington (*Bulletin Geological Society of America*, Volume XI.), of the 'Igneous Complex of Magnet Cove, Arkansas,' made exceptionally interesting through the elaborate efforts of J. Francis Williams, are recorded some observations on magmatic differentiation that are of unusual significance at this time. Contrary to previously expressed opinion, the several types of deep-seated rocks represented in the complex are regarded as integral parts of one great mass and as contemporaneous in origin, and therefore not due to successive intrusions. Furthermore, the structure of the whole mass is probably laccolithic in character.

A remarkable feature connected with the zonal distribution of the various rock-types is the complete reversal of the order almost invariably found among large masses of cooled magmas. Ordinarily the borders are basic and the central parts more acidic. But in the Magnet Cove mass the heavy constituents are in the center and the lighter silica, alumina and alkali components are on the edges. Notable instances of similar character are reported from Norway, Finland and Montana.

The exceptional character of the Magnet Cove mass appears to suggest unusual conditions. While the general subject of the causes of differentiation is not discussed at length, a possible explanation for the Arkansas complex

is offered. Briefly stated, the essential idea is that, just as in a highly cooled vessel of salt water the ice crystallizes at the sides, bottom and top, leaving a core of more concentrated liquid at the center, so here the solvent may have frozen out, collecting at the borders of the cavity in a more or less pure condition, as foyaite, and gradually becoming more basic (richer in the solute) as the freezing process crept towards the center.

Although the great work of the Russian petrographer, F. Loewinson-Lessing, on the Eruptive Rocks of the Central Caucausus, was issued more than two years ago, the views advanced are only beginning to get into form accessible to the majority of English students. The general interest lies in the discussions of the subjects of rock-classification and the differentiation of rock magmas.

The classification proposed for the igneous rocks is chemical. It is based primarily upon the degree of acidity of the silicate minerals. Four great groups are thus established: (1) The ultra-basic rocks, derived from a monosilicate magma, (2) basic rocks, which had a bisilicate magma, (3) neutral rocks, with a magma which was bisilicate or normal, and (4) acid rocks, in which the magma was polysilicate. These groups are subdivided in 14 sub-groups and 34 families.

In order to find the proper systematic position of an eruptive rock from the fundamental viewpoint of the proposed classification four factors are considered: (1) The relation of the oxygen in the silica and that in all the other oxides taken together, giving what is termed the coefficient of acidity; (2) the chemical composition, which gives for each type a distinctive formula; (3) the relations between the two groups of oxides according to their molecular proportions; and (4) the relations of the soda and potash in the alkaline rocks. This consideration of the principles of classification leads to the proof of the distinct phases of fundamental magmas.

Discussion of the differentiation of rock magmas has an unusual interest. The Russian author calls special attention to the principle of Soret, the action of super-saturated solutions, the effect of gravity, the principles of maximum work as proposed by Berthelot, and the reaction of mixed liquids, as operating in the separation of magmas.

Three distinct kinds of magmatic differentiation are recognized. They are: Static differentiation, taking place in the depths of the earth; differentiation by cooling during ascent to the surface; and crystalline differentiation. Specific gravity, pressure and temperature are the chief factors governing the course of the static kind; while chemical affinities come into play in large measure only in crystalline separation.

The rôle of inclusions of foreign rocks, which has so long been such an unsatisfactory subject to petrographers, is explained on the idea that it is only that portion of the magma yet undifferentiated which affects the introduced rocks. After thorough assimilation of limestone, for example, a separation of the modified magma takes place. One part contains very little lime and the other nearly all of it. Rock formed from the first mentioned might be a granite, while from the second would come perhaps a gabbro.

CHARLES R. KEYES.

ON THE REASON FOR THE RETENTION OF SALTS NEAR THE SURFACE OF SOILS.

VERY recently a light-colored saline incrustation was noticed by Professor Milton Whitney upon the surface of the soil in the grounds of the Department of Agriculture in Washington. This crust was collected and examined in the laboratory of the Bureau of the Soils under the direction of Dr. Frank K. Cameron. The crust contained about 1 per cent. of soluble matter, principally sulphates and nitrates of sodium and calcium. Samples were then collected at different depths and examined to determine the vertical distribution of the soluble salts. The results showed that although the soil was examined to a depth of three feet, practically all of the salt was in the surface inch, the larger part of it being in the top eighth-inch.

The crust was found at the end of a short, dry season, such as is common in the autumn months along the Atlantic coast region.

A number of similar occurrences of abnormal amounts of soluble matter on the sur-