tions; which, in their turn, have been puckered into earth-waves which *bear no relation to the old strikes* of the crust.

Faults, as might be expected, display a tendency to run parallel with earth-waves. When the crust is being forced into sharp curves, cracks will naturally occur at right angles to the lateral pressure. Hence the faults which traverse Cambrian and Postcambrian strata, being parallel to the newer flexures, will be *transverse to the underlying Precambrian strikes.*

It is now easy to see how a pair of parallel faults traversing at the surface rocks of (say) Silurian age, and cutting down through Cambrian and Precambrian strata, will account for the origin of Precambrian ridges with transverse strikes. The upheaval of the isolated wedge, and the denudation of the overlying Cambrian and Silurian beds, require no explanation. The continued prominence of the ancient ridge would be secured by the superior induration of its metamorphic or altered volcanic constituents.

To distinguish mountains of this type from anticlinal and synclinal ridges, the term *plagioclinal*[1] is suggested.

This peculiarity of structure may prove to be of practical aid in detecting Precambrian formations. A plagioclinal axis is not necessarily Precambrian, but its transverse strike should suggest inquiry.

The facts here announced militate against an extreme school of geologists, who deny that faults have had any perceptible share in shaping the landscape. They have certainly very largely contributed to determine the scenery of South Shropshire. That the original surface produced by great dislocations has been modified by subsequent denudation does not materially affect the question. It would be equally just to argue that, because the Romance words in the English language have been modified by time, the Norman Conquest has not affected our modern tongue.

NOTICES OF MEMOIRS.

I.—The Tufo and Tripoli of the Sulphur Zone of Sicily.[2]

TWO years ago Sig. E. Stöhr, when placing the sulphur deposits in the Messinian II. of C. Mayer, and the "tufo" in the Messinian I., remarked that perhaps this last should be removed lower down, and in the December number of the Bolletino R. Com. Geol. d'Italia he says, that the discovery of fossiliferous beds in a sulphur mine, near Grotte, in the Province of Girgenti, has confirmed this opinion.

Immediately below the sulphur beds is a bituminous schist, then the tuff and tripoli, and in this "tufo," which is described as an almost plastic clay, are a great number of Foraminifera, the subject of Sig. Stöhr's paper. Of the 115 species found, 23 are new, and are mostly described and figured by Dr. Schwager in an appendix.

[1] From πλάγιος, *oblique*, and κλίνω, *to incline.*

[2] Sulla posizione geologica del tufo e del tripoli nella zona solfifera, per E. Stöhr. Boll. R. Comit. Geol. d'Italia, vol. ix. No. 11–12, 1878.

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Of the remainder, the absence of *Milliolidea* (of *Spiroculina tenuis* one example was found), *Amphistegina*, *Heterostegina*, and *Polystomella* is noticeable, while the quantity of *Rhabdoidea* (38 species), *Cristellaroidea* (14), *Globigerinidea* (17), not only in the number of species, but also of individuals, is striking, and a deep sea is indicated, and is confirmed by the Radiolarian fauna, though the *Radiolaria* are only found scattered in the clay. Of the Foraminifera 63 are found at Baden, near Vienna; 38 are known living; and 52 are supposed to be extinct. The Molluscan fauna is also very similar to that of the Baden beds.

The tripoli beds, which are below the "tufo," were evidently deposited in a still deeper sea, as shown by the rich Radiolarian fauna of 109 species, studied by Mr. Stöhr. It most nearly resembles the tripoli of Caltanisetta, from which Ehrenberg described 31 species; but the Grotte beds furnish 68 new species, which will shortly be figured and described, and of the rest 29 are known living, about half of these in the Mediterranean. Some families and genera, hitherto unknown in the fossil state, are now described; for instance, the genus *Euchitonia*, which was previously only known as recent, furnishes several species, some identical with those found in the sea near Messina. The author says that this genus is sometimes so abundantly represented at Grotte that we might almost call this tripoli a mass of *Euchitonia*.

The conclusions arrived at are that both tripoli and "tufo" belong to the Tortonian (Miocene), and were deposited in deep water; afterwards there was elevation of the land, and lacustrine conditions supervened, when the deposits which now yield the sulphur were formed, during the Messinian I. II. and probably III. (of Mayer), after which sinking of the land and marine conditions followed.

A. W. W.

II.—On Some Points in Lithology. By Prof. J. D. Dana.

UNDER the above title Prof. Dana has recently published[1] a suggestive paper, which will be perused with much interest by those engaged in the study of rocks, and may possibly call forth a few remarks or further observations on some points discussed in the paper[2]; the object of the author being to consider the value of some of the distinctive characters which are generally accepted at the present time in defining certain kinds of rocks. As some of our readers interested in petrology may not have ready access to the original communication, we have reproduced the summary, by Prof. Dana, of the principal points with regard to rocks which have been brought out in this paper, together with his proposed classification of the crystalline rocks.

"1. The necessities of the science of Geology constitute the most prominent motive for distinguishing *kinds* of rocks; and they should determine to a large extent upon what characters distinctions should be based.

[1] Amer. Journ. of Science and Arts, vol. xvi. Nov.-Dec. 1878.

[2] See Article in the present Number, by Prof. Bonney, M.A., F.R.S., *ante*, p. 199.

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"2. In determining the rocks to be grouped as one in *kind* under a common name, near identity in the chemical and mineral composition of the chief constituents is the main point to be considered; not near identity in their crystalline forms, for isomorphism presupposes diversity of composition.

"3. Distinction of *kind* should be based on difference in chemical and mineral constitution as regards the chief constituents. When such difference exists, rocks are different in *kind*, and need, for the purposes of geology, distinct names. If it does not exist, the distinction is only that of *variety;* unless (as in the case of trachyte and felsyte), the very wide extension of the rock under persistent characters makes a distinction of name important to geology.

"4. It follows from the preceding, that differences in texture: as coarse, or fine, or aphanitic; porphyritic, or non-porphyritic; stoney throughout, or having unindividualized portions among the stoney grains; and differences in microscopic inclusions; are no basis for a distinction of *kind* among rocks, but only of *variety;* and that *porphyritic structure* is of hardly more consequence than coarse or fine granular.

"5. No marked change in the constituents of the earth's erupted material occurred after the close of the Cretaceous period, or just before the commencement of the Tertiary era; and, hence, no ground exists for the distinction of 'older' and 'younger' among eruptive rocks. The 'younger' eruptive rocks are essentially like the 'older' in chemical composition and their chief mineral constituents; and they differ when at all only in texture and some other points of as little importance—qualities that distinguish merely varieties, and which have proceeded from greater prevalence in these later times of subaerial eruptions.

"6. Since 'plagioclase' is not the name of a mineral species,—several minerals, of widely different compositions, being embraced under it—it is a confounding of differences and resemblances to speak of it as a constituent of a rock. And since it now includes, through the defining of the feldspar microcline, a large part of potash feldspar, which had been supposed to be orthoclase, it has become almost synonymous with the term feldspar. The 'simplicity' its adoption has been supposed to give to lithological system would be greater if 'feldspar' were substituted, and with its present range of constitution, the evil would be hardly less.

"7. Rocks differing mineralogically, and not chemically, like related hornblendic and augitic rocks (the minerals hornblende and augite being dimorphous), are rightly made distinct rocks, since the difference has depended, to a large extent, on wide-reaching geological operations or conditions, and is, therefore, of great geological significance.

"8. Since quartz is the most widely distributed and therefore the least distinctive of the minerals of rocks, it may rightly be regarded as of subordinate importance in the distinguishing of rocks, and hence not only such names as *dioryte* and *quartz-dioryte*, *trachyte* and *quartz-trachyte*, etc., are acceptable, but also *syenyte* and *quartz-syenyte*.

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"9. Biotite being closely like muscovite in composition, and not less common than it in granites, gneisses and mica schists, and being, moreover, unlike the mineral hornblende in chemical constitution and formula, the rocks in which biotite is a chief constituent cannot rightly be put in the same group with hornblende rocks; or those in which hornblende is a chief constituent in a group of mica-bearing rocks. Consequently the name 'mica-dioryte,' for a rock containing no hornblende, and the name 'hornblende-granite' for a rock containing no mica but hornblende instead, imply alike false relations.

"The discussion suggests the following additional remark:

"The incapabilities of the microscope and polariscope have favoured the use of the term 'plagioclase,' and have led some investigators to overlook or slight distinctions in chemical constitution. Lithology is to receive hereafter its greatest advances through chemical analyses; for chemistry alone can clear away the doubts the microscope leaves, and so give that completeness to the Science of Rocks which geology requires for right and comprehensive conclusions.

"Moreover the researches made in the laboratory to be of real geological value should be, if possible, supplemented by investigations in the field as to transitions among the rocks, and as to other kinds of relations. This field-work has often been well done, but not so by all lithological investigators.

"The principles presented lead to the following subdivisions in an arrangement of crystalline rocks, exclusive of the Calcareous and Quartzose kinds. Since leucite is a potash-alumina silicate, like orthoclase and microcline (it affording twenty per cent. or more of potash), it is here referred to the same group with the potash feldspars; and nephelite, sodalite, and the saussurites being eminently soda-bearing species, they are included with the soda-lime feldspars (anorthite to albite). This reference for lithological purposes of these minerals is sustained by their resemblance to the feldspars in constituents, and also in the quantivalent ratios between the alkalies, alumina and silica, this ratio being in leucite 1 : 3 : 8, as in andesite, and in sodalite and nephelite 1 : 3 : 4, as in anorthite. The term *potash feldspar*, as used in the headings below, is hence to be understood as covering orthoclase, microcline and leucite; and *soda-lime feldspar*, as including the triclinic feldspars from anorthite to albite, and also nephelite, sodalite and the saussurites.

"The arrangement is as follows. In the first series, the rocks graduate into kinds which are all feldspar, and into others that are all mica; and yet the amount of potash present is approximately the same.

I. The Mica and Potash Feldspar Series: including Granite, Granulyte, Gneiss, Protogine, Mica schist, etc., Felsyte, Trachyte, etc., and the Leucite rock of Wyoming.

II. The Mica and Soda-Lime Feldspar Series: including Kersantite, Kinzigite; and the nephelitic kinds Miascyte, Ditroyte, Phonolite, etc. (These nephelitic kinds belong almost as well in the preceding series.)

III. The Hornblende and Potash Feldspar Series: including Syenyte (with Quartz-syenyte), Syenyte-gneiss, Hornblende schist, Amphibolyte, Unakyte

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(this last containing epidote in place of hornblende); and the nephelitic species Zircon-Syenyte, Foyayte.

IV. The Hornblende and Soda-Lime Feldspar Series: including Dioryte (with Propylyte), Andesyte, Labradioryte (or Labrador-dioryte), etc., and the saussurite rock, Euphotide.

V. The Pyroxene and Potash Feldspar Series: including Amphigenyte.

VI. The Pyroxene and Soda-Lime Feldspar Series: including Augite-Andesyte, Noryte (Hypersthenyte and Gabbro in part), Hypersthenyte (containing true hypersthene), Doleryte (comprising Basalt and Diabase), Nephelinyte, etc.

VII. Pyroxene, Garnet, Epidote and Chrysolyte Rocks, containing little or no Feldspar: including Pyroxenyte, Lherzolyte, Garnetyte (Garnet rock), Eclogyte, Epidosyte, Chrysolyte or Dunyte (Chrysolite rock), etc.

VIII. Hydrous Magnesian and Aluminous Rocks, containing little or no Feldspar: including Chlorite schist, Talcose schist, Serpentine, Ophiolyte, Pyrophyllite schist, etc."

III.—A New Order of Extinct Reptiles.

PROF. O. C. MARSH has recently described[1] a genus of reptiles from the Jurassic formation of the Rocky Mountains, which he considers to represent a new extinct order—the *Sauranodonta*. The genus *Sauranodon* is closely related to *Ichthyosaurus*, and presents, in most of its skeleton, the characteristics of that genus, but is *without teeth*. The vertebræ, ribs, and other portions of the skeleton preserved cannot be distinguished from the corresponding parts of *Ichthyosaurus*, and many features of the skull show a strong resemblance. The great development of the premaxillaries, the reduced maxillaries, the huge orbit defended by a ring of bony plates, are all present, but the jaws appear entirely edentulous, and destitute even of a dentary groove. This genus *Sauranodon*, from the absence of teeth, bears a similar relation to the Ichthyosaurs that *Pteranodon* does to the true Pterodactyls, and it is interesting to find the two highly specialized forms preserved in the same region.

J. M.

REVIEWS.

I.—Der Obere Jura der Umgegend von Hannover eine Palæontologisch-geognostisch-statische Darstellung, von C. Struckmann. (Hans'sche Buchhandlung, Hannover, 1878.)

WHILST the English Oolitic rocks are remarkable for the number of their beds and the organic richness of their contents in the Lower and Upper Middle divisions of the series, the Oxford-clay, Kimmeridge-clay, and Portland beds have not yet afforded corresponding results to the palæontologist, and the student of Jurassic Geology has therefore to turn his investigations into other regions in order to obtain an insight into the condition of the shore life of Oxfordian, Kimmeridgian, and Portlandian strata.

We therefore welcome the appearance of Herr. Struckmann's beautiful Monograph on the Upper Jura of Hanover, and recommend its careful study to all students of Jurassic Geology. The formations described in this work are the Oxford; Coralline Oolite,

[1] American Journal of Science and Arts, vol. xvii. p. 85, January, 1879.

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