

moderately deep, not shallow water, and generally below the actual mud-line of the coastal margin.

From geological evidence derived from other sources it is quite reasonable to assume that these glauconite grains in the clays, which by the way are worn and otherwise ill-defined, have been derived from local, disintegrated and re-sorted, moderately deep-water deposits, such as are seen in the Barton and Bracklesham Beds themselves. In the Plateau Gravels of the London Basin, by way of illustration, glauconite grains are frequent; but no one would venture to assert that these granules were actually formed in the deposit, since much of the material in places was derived from the Lower Greensand ridges to the south.

The difficulty of accounting for the presence of mollusca and sharks' teeth in the closely associated sediments may be met in this way. A slight lowering of the estuarine series would convert the area into sandy and clayey submerged marine coastal plains, on which such genera as *Corbula*, *Tellina*, *Leda*, *Arca*, *Glycimeris*, *Anomia*, *Cardium*, and *Cardita* could flourish; whilst slightly deeper conditions would permit of the existence of genera like *Panopæa*. At the same time the fact of many of the mollusca found in this series being in the state of casts, shows that the sea-bottom at this period was in a state of oscillation rather than of equilibrium.

NOTICES OF MEMOIRS.

TRIAS AND CARBONIFEROUS IN THE CAUCASUS.

WITTENBURG, P. W. Recent Researches on the Trias of the Caucasus. (In Russian.) Bull. Acad. Imp. Sci. St. Petersburg, 1912, p. 433.

ROBINSON, W. N. Recent Researches on the Geological Structure of the Northern Caucasus in the Basins of the Rivers Bielaya and Laba. (In Russian.) Bull. Acad. Imp. Sci. St. Petersburg, 1913, p. 33.

Translated and abridged from the Russian by FELIX OSWALD, D.Sc., F.G.S.

THE discovery in 1907 of Upper Trias in the Kuban district of the Caucasus, which was described in the GEOLOGICAL MAGAZINE (Dec. V, Vol. VI, No. 538, April, 1909, p. 171), has been considerably amplified and extended by the researches of P. W. Wittenburg, who explored the same district, viz. the upper courses of the Little Laba and Bielaya Rivers, and his results may be conveniently summarized in tabular form:—

1. *Rhætic Stage*.—(1) Typical *Avicula contorta* beds on Mt. Tkhach.
- (2) Lower Rhætic is represented by grey crinoidal limestone interbedded with red marly limestone containing many Brachiopods, particularly masses of *Spirigera* belonging to the typically Rhætic group of *S. oxycolpos*, Emmer., and *S. Manzavinii*, Bittn. (Kössen Beds). It is well exposed in the Kun Valley near Mt. Tkhach, and

contains *Waldheimia cubanica*, Tschern., *W. cf. austriaca*, Zugm., *W. Bukowski*, Bittn., *Terebratula pyriformis*, Suess, *T. turcica*, Bittn., *Rhynchonella obtusifrons*, Suess, *Spirigera cubanica*, Tschern., *Retzia superbescens*, Bittn., *Amphiclina squamula*, Bittn., *Aulacothyris cf. Ioharensis*, Bittn., *Mysidioptera Gremblichi*, Bittn., *Pecten subalterni-costatus*, Bittn.

2. *Noric Stage*.—The facies of the Dachstein Limestone with *Megalodus* sp. of the group *Megalodus* (*Neomegalodon*) *triqueter*, Wulfen, was found on Mt. Yatyrgvart (also in the Kuban district), but this seemed to be a somewhat isolated occurrence. The red, compact limestones usually contain a rich coral fauna (not specified) with masses of *Pseudomonotis ochotica*, var. *densistriata*, Teller, which the author considers to be synonymous with *Ps. (Monotis) salinaria*, Bronn. They dip 10° N.W. by N. and are transgressive over 3.

3. *Carnic Stage*.—Black, thinly-bedded, micaceous slates, interbedded with grey sandstones, altogether about 75 metres thick. They contain *Koninckina Telleri*, Bittn., and badly preserved *Tropites*. In the lower horizon of this series, on the eastern slopes of Mt. Tkhach, thick beds of oysters occur.

4. *Ladinian*.—(1) Red, quartzitic sandstones, interbedded with black slates and marls, dipping 20° N.N.W., containing the characteristic Wengen fossils *Daonella Lommeli*, Wissm., and *Posidonomya wengensis*, Wissm., with siliceous sponges and plant-remains in the upper part. The best sections occurred in the Sokhra Valley.

(2) Conglomerate.

(3) 'Upper contorted series,' consisting of grey calcareous flagstones, well developed to the south-east of Mt. Tkhach, and containing a Cephalopod fauna (described by Professor Karl Diener). Owing to their poor preservation the fossils could only be generically determined as follows: "*Ptychites* sp. ind. of the *Megalodiscus* group; gen. ind. sp. ind. of the Pinacoceratidæ family, recalling *Norites* or *Arthaberites*, but the condition of the suture-lines would permit of its being included in *Sageceras*; *Gymnites* sp. ind. aff. *incultus*, Beyr.; *Monophyllites* sp. ind. of the group *M. Suessi*, Mojs., closely resembling *M. Pitamaha*, Diener; *Monophyllites* n.sp.; gen. ind. sp. ind. of the Ceratitidæ family, recalling *Celtites* or *Monophyllites*; this specimen in all probability represents a new species near to *Nomismoceras spiratissimum*, Holzapfel; *Balatonites* sp. ind.; *Ceratitis* sp. ind. belonging to the group of *C. circumplicatus*; *Orthoceras* sp. ind."

(4) 'Lower contorted series.' Much crushed and dislocated, dark siliceous limestones, showing a prevalent dip to north-west. A bed of limestone immediately overlying this strongly contorted series contains characteristic Werfen fossils (Scythian stage), e.g., *Cælostylina werfensis*, Witt., *Terebratula* sp., *Gervillia exporrecta*, Leps., *Pseudomonotis venetiana*, Hauer, *P. aff. leptopleura*, Witt. This Scythian stage is widely distributed in the north-west Caucasus, e.g. in the valley of the Bielaya River near the confluence with its tributary the Dakh River, in many places in the Sokhra Valley (another tributary of the Bielaya), on Mt. Shavshin, and on the slopes of Mt. Tkhach.

The discovery by Messrs. Wittenburg and Robinson of these Werfen Beds in the Caucasus emphasizes the importance of the Caucasian Trias as a connecting-link between the Trias of the Alps and the Himalaya, for beds of this period have long been known to occur at Julfa in the Araxes Valley (which separates Russian Armenia from Persia), containing *Meekoceras* and species of *Pseudomonotis*, which Bonnet (Bull. Soc. Géol. France, sér. 4, xii, 312) has shown to be allied to those of the *Hedenstroemia* beds of the Himalaya. The upper, unfossiliferous part of the Julfa Series, consisting of 200 metres of marly limestones overlain by 1,000 metres of black limestones and dolomites, is probably equivalent to the Middle and Upper Trias of the Caucasus.

Still more recently W. N. Robinson (op. cit.) in 1912 was able to establish the fact that the Triassic beds of the Caucasus overlie Upper Carboniferous limestones, as at Julfa. The locality is also in the basin of the Bielaya River, at Mt. Gepho on the left bank of the River Kisha (Choga), a right tributary of the Bielaya. Mt. Gepho rises to a height of 1,200 feet above the Tegen stream, which flows into the Kisha, and the natural section discloses the following downward succession:—

1. *Trias (Ladinian)*.—(1) Grey, arenaceous flagstones with plant-remains and badly preserved fossils (not specified). Similar sandstones (dipping 70° N.E.) occur on the western spur of the Pshkish ridge. To the north-east the sandstones are dark red, very micaceous, and attain a considerable thickness.

(2) Conglomerate of small pebbles, mostly of quartz, but it varies considerably in thickness and materials; it extends nearly to the summit of Mt. Gepho and dips west. This conglomerate unconformably overlies the Carboniferous Limestone and is greatly developed along the northern slope of the Caucasus in the Kuban district. To the north-west it crops out in the Bielaya Valley, a little above Khamyshki (Alexievsk), and to the south-east as far as the Urups River and the upper course of the Zelenguk. Between the Bielaya and the Little Laba the conglomerate forms a large anticline and composes the ridges Pshkish and Bambak and the southern slope of the Mastakan ridge; it occurs also on the south-west side of the Dudugush ridge towards Mt. Oshten.

2. *Upper Carboniferous*.—(1) Grey limestones, forming rocky cliffs on both sides of the Tegen defile. They are so compact that the dip is scarcely visible, but in one place it seems to be southerly. They contain a rich Brachiopod fauna, e.g. *Entetes contractus*, Gemm., *E. carniolicus*, Schellw., *Ucinulus velifer*, Gemm., *Reticularia lineata*, Mart., *Chonetes uralica*, Möll., *Notothyris exilis*, Gemm., *Richtofonia laurenciana*, de Kon., *Aulosteges*, *Geyerella*, with Pelecypods, Gastropods, and sponges belonging to the families Sphærospongiæ (*Heterocælia*) and Sphærocæliæ (*Sollasia*, *Steinmannia*).

(2) Black, argillaceous slates, forming the bed of the Tegen River, with intercalated, thinly laminated, black sandstones, dipping rather steeply to the south. They are extensively developed to the south-west, south, and south-east of Mt. Gepho, towards the main axis of the Caucasus. No fossils occur in the slates; but the interbedded

sandstones (in the Kozi Valley) contain a few undetermined Gastropods and Pelecypods.

The southerly dip of the slates is maintained over a wide area, and it is only on the south-west slope of the granite ridge Juga (Cheleps) that an anticlinal fold occurs with a steep dip to north-east. The axis of the anticline reveals crystalline schists, which form the bed of the Kisha River near Dokhmat Sheklan. This fold does not, however, extend far either to north-west or south-east. W. N. Robinson attributes the formation of this small fold to the intrusion of the granite.

The second outcrop of Upper Carboniferous was observed 2 miles S.S.W. of the confluence of the Little Laba and Urushten Rivers. The limestone is greyer than on Mt. Gepho, and forms an anticline; in its axis mica-schists and other crystalline schists are visible. To the south this Upper Carboniferous Limestone is overlain by conglomerate (probably Triassic), and higher up the Urushten River red Triassic limestones form vertical cliffs on both banks. The Upper Carboniferous Limestone contains the following fossils: *Spirifer cameratus*, Morton, *Reticularia lineata*, Mart., *Urcinulus velifer*, Gemm., *Productus graciosus*, Waag., *P. pseudomedusa*, Tschern., Pelecypods (*Macrodon*, *Edmondia*, and *Lima*), and sponges (*Heterocelia*).

Probably a large portion of the Palæozoic schists of the main axis of the Caucasus will be found to belong to the Carboniferous, and it may be mentioned that a crushed *Calamites* was found by Inostranzeff some years ago in the Central Caucasus to the north of the main axis.

REVIEWS.

I.—THE NATURE AND ORIGIN OF FIORDS. By Professor J. W. GREGORY, D.Sc., F.R.S. 8vo; pp. xvi, 542, with 8 plates and 84 text-illustrations. London: John Murray, 1913. Price 16s. net.

THIS is a big book on a subject which, at first sight, seems hardly to justify such voluminous treatment; nevertheless, the author finds plenty to say. His travels have extended over wide areas of the globe, and he deals not only with the typical fiords of Norway, but with the fiords and other sea-inlets or drowned valleys, from Scotland, Greenland, and Alaska to Patagonia, Antarctica, and Australasia. Printed in bold type and well illustrated, the subject as expounded by Professor Gregory is of very great interest to geographer and geologist, and will doubtless be attractive to all travellers and students who seek to become acquainted with the origin of scenery. Apart from scenery, the author points out the influences of fiords since early times on navigation, the distribution of population, and the welfare generally of mankind.

We have been accustomed to look upon fiords, sea-lochs, and estuaries as for the most part drowned valleys excavated by rivers and in many cases also largely by glacial action, the resultant features being due to the effects of erosion on rocks of varying altitude, structure, and lithological character. Thus fiords occur among the