

ART. XXXV.—*The Upper Permian in Western Texas*;* by
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DURING the field season of 1901, as a member of a party under the direction of Mr. R. T. Hill, I examined a very interesting series of Carboniferous strata in western Texas. The route traversed was in part the same, though in an opposite direction, as that pursued by the expedition under Captain Pope in 1855, of which G. G. Shumard was a member. Our point of departure was El Paso, and we passed eastward, approximately along the thirty-second parallel, as far as the headwaters of Delaware Creek, in the Trans-Pecos region. There, finding that the old trail down Delaware was impracticable, we turned southward, meeting the railroad at Toya.

The region of special interest was the Guadalupe Mountains, where Shumard collected a number of species, subsequently described by his brother, B. F. Shumard, which indicated the existence at this point of a peculiar Carboniferous fauna, essentially different from anything known elsewhere in North America. Shumard gives the following section of the Guadalupe Mountains:†

1. Upper or white limestone	1,000 feet.
2. Dark-colored, thinly laminated and foliated limestone	50-100
3. Yellow quartzose sandstone	1,200-1,500
4. Black, thin-bedded limestone	500

The geologic series is finely exposed, and the order of superposition of the beds is obvious. The constituent formations are of rather unusual thickness and uniformity of composition. In fact, though we were able to make only barometric measurements, and though only the upper limestone was exposed in a continuous section, I believe that the thicknesses assigned by Shumard are too small. We measured 1,700 to 1,800 feet of the upper limestone, while the middle member, a yellow sandstone, must contain from 2,000 to 2,500 feet. Of the black limestone, which forms the lowest member of the section, probably not more than 500 feet are exposed, but the base was not seen.

Fossils were obtained from all these formations, but it is especially of those from the upper one that I desire to speak. The rock is a white limestone, sometimes stained yellowish or reddish in the lower portion, where it is also quite siliceous.

* Published by permission of the Director of the U. S. Geological Survey.

† Acad. Sci. St. Louis, Trans., vol. 1, 1860, p. 280.

Horizons which are dolomitic also occur, and one of these is a pisolite. The highest beds seen are exposed on the summit of El Capitan, and contain *Fusulina elongata* Shumard in great profusion. The main fossiliferous horizon, however, was found about 1,000 feet below. Near this level crystalline calcite occurs in great abundance and in cleavage blocks of considerable size. The locality was difficult of access, and could only be reached by hard climbing, so that the collections obtained were less complete than might be wished. The above remarks relate to the "white Permian," which is peculiarly massive and shows little evidence of bedding. The hundred feet or more of brownish or gray limestone immediately below it, however, which represent Shumard's "dark Permian," are obviously stratified. From the "white Permian," chiefly at the locality mentioned, were obtained upward of 75 species, some of the more interesting of which I will mention. The fauna is very varied, and includes representatives from nearly all the invertebrate groups, though the brachiopods and pelecypods are most numerous in species and individuals.

Of the Protozoa we have *Fusulina elongata* Shumard, a species unique so far as I am aware, which probably attains a length of nearly 2 inches.

Sponges are remarkably abundant, and belong chiefly to the *Calcspongiae*. The orders *Lycones* and *Pharetrones* are represented by a number of genera and species, most of which are probably new. In addition the genera *Mammillopora* and *Bothroconis* have been identified.

Though a species of *Lophophyllum* was found, coelenterates are rare, except for the group of *Hydrocorallinae* similar to those described by Waagen from India. Both in these forms and those representing the *Calcspongiae* the rock is crystalline and altered in such a way that the outlines of structures are partially obscured. The original difficulties attendant upon the study of these groups are therefore very much enhanced. Though of so widely different zoological affinities, such is the preservation in which they appear that in a number of cases I am not sure that some of the supposed *Hydrocorallinae* are not calcareous sponges, and I even entertain similar doubts with regard to certain of Waagen's representatives of that group.

Of the echinoderms nothing appears in the collection, nor of the helminths.

The Bryozoa, except for a single group, are mostly few and of a character alien to our known Carboniferous faunas. They consist of *Fenestella* sp., *Acanthocladia*? sp., a *Goniocladia* near *G. indica* Waagen, and a peculiar group of fistuliporoid Bryozoa much more like Mesozoic than Paleozoic types, which

are more abundant in the "dark Permian" than in the white limestone whose fauna I am attempting to summarize.

The brachiopod fauna is abundant, and while of an undoubted Carboniferous facies, presents one which is apparently later and certainly different from that of our usual Carboniferous rocks. The following species were found:

Streptorhynchus near pelargonatus Schl.
Derbya n. sp.
Derbya sp.
Derbya Bennetti?
Meekella n. sp.
Chonetes n. sp. near trapezoidalis Waagen
Productus semireticulatus var.
Productus pileolus Shum. ?
Productus cora d'Orb. ?
Productus near Wallacianus Derby (2 sp.)
Spirifer Mexicanus Shum.
Spirifer n. sp.
Squamularia? Guadalupensis Shum.
Martinia n. sp. near elongata Waagen
Ambocoelia planiconvexa ?
Spiriferina Billingsi Shum.
Spiriferina sp.
Spiriferina n. sp.
Seminula n. sp.
Hustedia? papillata Shum.
Pugnax n. sp.
Pugnax Swallowiana Shum.
Camarotoechia indentata Shum.
Camarotoechia sp.
Dielasma near truncatum Waagen (2 sp.)
Dielasma ?? sp.
Dielasma ? n. sp.
Hemiptychina near H. sparsiplicata Waagen
Spirigerella ? sp.
Lyttonia sp.
Richthofenia (several sp.?).

Besides the forms listed are several new genera and species of terebratuloid shells, which, even in the comparatively few specimens in our collections, present a really remarkable differentiation. Many of the genera cited above are new to North America. Among these may be mentioned *Lyttonia*, *Richthofenia*, *Spirigerella*, and *Hemiptychina*, though in one case, at least, the generic reference is questionable. Many of the genera common to our other North American faunas are represented in part or wholly by species of peculiar types not found in them. An orbicular *Spiriferina* with short hinge line is one of these.

Of the pelecypods the following species were collected:

Aviculopecten (*Pterinopecten* ?) sp.
Aviculopecten ? sp.
Streblopteria (3 sp.)
Entolium ? (3 sp.)
Lima n. sp.
Euchondria ? sp.
Camptonectes ? (2 sp.)
Avicula n. sp.
Myalina ? near *M. squamosa* Sow.
Myoconcha n. sp.
Modiola ? sp.
Edmondia ? sp.
Cypricardinia ? sp.
Macrodon ? sp.
Axinus securus Shum. ?

The aspect of this fauna also is quite varied. The shells are as a rule small and preserved as internal casts, so that it is difficult in most cases to ascertain the characters of really generic value. There is a general absence of the types which characterize the Upper Carboniferous or even the Permian of the Mississippi Valley. The development of the pectinoid and mytiloid groups is rather striking. The genus *Myoconcha*, of which I seem to have virtual representatives, has not before been recognized in North America, and *Camptonectes* is new among our Carboniferous faunas. The latter is abundantly represented by individuals, and has every external appearance of belonging in the Mesozoic genus.

Gastropods are rare and in size generally minute. So far only the following have been found:

Pleurotomaria ? group of *carbonaria* (2 sp.)
Pleurotomaria ? (n. gen. ?) sp.
Worthenia ? sp.
Euconispira ? sp.
Orthonema ? sp.
Holopella ? sp.

But little need be said of the gastropod fauna, in which there is nothing striking, except the absence of our familiar Carboniferous species.

Of the cephalopods, at a horizon where novel and interesting ammonoid types might be expected to occur, only an imperfect and undetermined species of *Temnocheilus* has been found.

No Crustacea have yet been noted, except *Phillipsia perannulata* Shumard, which occurs in abundance in the "dark

Permian" below, but which is in this instance doubtfully identified.

From the "dark Permian," some of it in place, but most from float pieces probably belonging to that horizon, were obtained the following species:

Fusulina elongata Shum.
Sponges (of several types)
Lophophyllum (2 sp.)
Striatopora? sp.
Acanthocladia sp.
Fistuliporoid Bryozoa of Mesozoic types
Crania? sp.
Streptorhynchus? sp.
Derbya sp.
Chonetes Permiana Shum.
Chonetes n. sp.
Productus Popei Shum.
Productus Popei var.
Productus semireticulatus var.
Productus, semireticulatus type (5 sp.)
Productus cf. Norwoodi Swal.
Spirifer sulcifer Shum.?
Squamularia? Guadalupensis Shum.?
Spiriferina Billingsi Shum.
Hustedia? papillata Shum.
Hustedia? (2 sp.)
Pugnax? bisulcata Shum.
Pugnax? n. sp.
Pugnax Swallowiana Shum.
Camarotoechia indentata Shum.
Camarotoechia sp.
Dielasma perinflatum Shum.?
Dielasma cf. truncatum Waagen
Aviculopecten sp.
Myalina? near squamosa Sow.
Euomphalus n. sp.
Bairdia sp.
Phillipsia perannulata Shum.

This fauna requires little comment. Its relation to that of the "white Permian," nearly a thousand feet above, is obvious, yet each has an individual facies. In this fauna *Phillipsia perannulata* is abundant, and also the curious small fistuliporoids to which attention has already been directed. The Producti are for the most part of the *semireticulatus* type, small, and characterized by strong curvature and a deep median sinus.

The fauna of the yellow sandstone I will only hastily refer to. It contains *Fusulina elongate* Shumard and some brachiopods, chiefly Producti of somewhat different types from those above. The major portion of the fauna consists of pelecypods, many of which are different from those of the limestone, and are new species.

The black limestone at the base of the section is sparingly fossiliferous. A number of species were obtained, however, about 18 in all. This fauna is related to those above, especially to that of the "white Permian," and it also includes a species of *Richthofenia*.

These faunas are clearly pre-Mesozoic, though containing certain obvious Mesozoic relations. They are also different from any American faunas yet known, and are more especially related to the late Paleozoic faunas of Asia. Among related faunas may be mentioned that of China, described by Richthofen,* that of India, described by Waagen,† that of the Carnic Alps, described by Schellwien,‡ and, somewhat more remotely, that of the Palermo province, described by Gemmellaro,§ and the Permian of England, described by King.||

Not only are these faunas very different from any known in America elsewhere, but they give evidence of being later in geologic time. For this reason I propose to give them a regional name which shall be employed in a force similar to Mississippian and Pennsylvanian. For this none more appropriate than one derived from the locality where they were first discovered can be found, and the term Guadalupian is suggested. The stratigraphic limits of the Guadalupian period will have to be determined on intrinsic evidence. At present it seems to include the whole section at the southern end of the Guadalupe Mountains, but the central fauna will be that of the "white" and "dark Permian" as described by Shumard.

I plan to resume field work in this region during the season of 1902, and hope to make important additions to the Guadalupian fauna, and to discover its relations with those which preceded and those which followed it. It is my purpose to more fully study and to describe this interesting fauna at an early opportunity.

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* China, Richthofen, vol. iv, Berlin, 1883.

† Geol. Surv. India, Paleontologia Indica, Salt Range Fossils, vol. i, 1887.

‡ Die Fauna der Trog-Kofelschichten, K. K. Geol. Reichsanstalt, Bd. 16, Heft, 1, 1900.

§ La Fauna dei Calcari con Fusulina, Molluscoidea, Palermo, 1898-99.

|| Mon. Perm. Foss. England, Paleontograph. Soc., 1850.