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Oregon Counties
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March 23, 1962

We feel that you guys need some worthwhile
literature for your files; hence this copy of an impending
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picture some yourselves.

Day + Howard

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Marine Jurassic outliers in the Juniper Mountain
area of eastern Oregon^{1/}

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^{1/}Publication authorized by the directors of the United States Geological Survey and the State of Oregon Department of Geology and Mineral Industries. Manuscript received _____, 1962.

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ABSTRACT

Middle Jurassic fossils have been found at a number of localities within a thick sedimentary sequence in northern Malheur County, eastern Oregon. The fossils, mostly ammonites, furnish correlations with the Weberg, Warm Springs, and Snowshoe formations of east central Oregon and with the early and middle parts of the Bajocian stage of Europe. That pre-Bajocian Mesozoic strata are present, also, is indicated by other fossil evidence. In addition, many parts of the sequence have yielded no fossils and hence strata younger than Bajocian may be present.

Knowledge concerning the Jurassic paleogeography of Oregon has recently been advanced significantly by discoveries of several areas of fossiliferous marine Jurassic sedimentary rocks near the eastern border of the state. Prior to these discoveries Jurassic rocks had been found in Oregon only in its southwestern corner in the Klamath Mountains and in its east central part within a triangular area (Izee-Suplee) whose corners are marked by the towns of John Day, Burns and Paulina. The recently discovered Jurassic occurrences in eastern Oregon are located; (1) about eleven miles southwest of Ironside, Malheur County (Lowry, unpublished manuscript), (2) about ten miles south of Ironside, Malheur County, (3) in the area of Juniper Mountain west and southwest of Brogan, Malheur County, and (4) in the Snake River Canyon, Wallowa County, near the northeast corner of the state (Morrison, 1961, p. 105-110). In addition Jurassic beds may be present between Brogan and Huntington, but the fossil evidence consists only of one fragmentary ammonite found about 4 miles north of Brogan (Ernest Wolff, unpublished thesis). Figure 1 shows the relative position in Oregon of all the above mentioned Jurassic areas.

This paper deals primarily with the Juniper Mountain area and particularly with the Jurassic fossil collections made therein. The first collections were made by Wagner and Brooks during the summer of 1960 while making a reconnaissance map of the area. Additional collections were made during the summer of 1961 with the help of Imlay and other visiting geologists. Figure 2 shows the pre-Tertiary rock exposures in the area mapped by Wagner and Brooks, and the approximate positions of the localities from which Mesozoic fossils were obtained. All fossil identifications were made by Imlay.

The Juniper Mountain area contains windows of pre-Tertiary rocks that are old topographic highs representing the most southeasterly of the pre-Tertiary exposures of the Blue Mountains uplift in northeastern Oregon. These rocks are surrounded widely by volcanic, lacustrine, and fluviatile formations of Miocene to Pleistocene age, including at least two basalt units, a rhyolitic tuff, and a basaltic tuff-agglomerate. Over most of the area the younger units of the blanketing Cenozoic are horizontal to gently dipping. Steep dips are present locally, however, owing mainly to faulting or to tipping of fault blocks. Physiographically the area is part of a deeply incised volcanic plateau that is locally modified by faulting.

Stratigraphy and Structure of Pre-Tertiary beds

The pre-Tertiary rocks of the Juniper Mountain area from oldest to youngest include (1) a sequence of acidic to intermediate meta-volcanics that contain some intercalated shale, sandstone and conglomerate; (2) a massive limestone; and (3) a very thick sequence of more or less metamorphosed shale, sandstone, graywacke and conglomerate. The massive limestone appears to be separated from the adjoining rocks units by slight unconformities and perhaps, also, by faulting along its lower contact.

At present the meta-volcanics and associated sedimentary rocks are considered to be of Late Triassic age on the basis of structural position and a scant amount of poorly preserved fossils (personal communication, David Bostwick, Oregon State University, 1960). The overlying limestone is considered as probably Late Triassic or possibly Early Jurassic, but it has furnished no fossils. The highest sequence locally has furnished fossils of Middle Jurassic age, which are discussed herein.

The strata containing the Jurassic fossils consist of a repetitious sequence of black, grey and tan shales, greywackes, and conglomerates. In nearly all exposures the beds strike northeast to east and dip steeply north. Field observations made during the course of mapping failed to disclose the usual stratigraphic or structural criteria indicative of repetition by folding or faulting. Therefore, prior to the identification of the fossils, the repetitious lithology was considered to be the result of normal cyclic sedimentation and the sequence was thought to be thousands of feet thick, becoming progressively younger to the north. Doubt was cast on the validity of these observations, however, by the folding indicated in the area of the fossil localities when the fossils found at localities 1 and 2 proved to be slightly older than those at localities 3, 4, and 5.

Because of the difficulty in proving the existence of isoclinal folding in many of the pre-Tertiary rock sequences of northeastern Oregon further study of this area with its potential fossil control might prove very worthwhile.

MESOZOIC FOSSIL LOCALITIES IN MALHEUR COUNTY, OREGON

The geographic locations of the fossil localities in the Juniper Mountain area of Malheur County are shown in figure 2. The fossils found at these localities are listed below.

Localities	Fossils
1. Near top of ridge about 100 feet north of fence in SW $\frac{1}{4}$ sec. 5, T. 16 S., R. 41 E.	Tmetoceras sp. Pleydellia? sp. Posidonia ornati Quenstedt
2. About 100 feet north of locality 1.	Tmetoceras sp. Pleydellia? sp. Lytoceras? sp. Posidonia ornati Quenstedt Astarte sp.
3. Near center NE $\frac{1}{4}$ sec. 7, T. 16 S., R. 41 E.	Witchellia of. W. albidus Buckman Docidoceras? sp Posidonia ornati Quenstedt
4. S. E. corner NW $\frac{1}{4}$ sec. 7, T. 16 S., R. 41 E.	Witchellia sp.

5. Center of south line of
SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 5, T. 16 S.,
41 E

Stephanoceras (Skirroceras?) sp.
Plicatula? sp.
Isognomon? sp.

A. Just above massive
limestone, SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 9,
T. 16., R. 41 E.

Astarte? sp., Oxytoma sp., Oxy-
toma sp., Entolium? sp., Pleuro-
mya? sp., Isognomon? sp.,
Gervillia sp., Linguloid and
rhynchonellid brachiopods.

B. About 75 to 100 feet north
of massive limestone in N. E.
 $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 9, T. 16 S., R.
41 E.

Oxytoma sp., Lima? sp. Chlamys?
sp., Entolium? sp., Cercomya? sp.,
Isognomon? sp., Myoconcha? sp.,
Crucilobicerias? sp.

Some occurrences of Jurassic fossils west and northeast of the Juniper Mountain area in Malheur County are of interest because they show that Jurassic rocks are fairly widespread in eastern Oregon. The fossils found at these localities are listed below.

Localities	Fossils
On Duncan Ranch, about 8 miles south of Ironside, in NE corner sec. 9, T. 16 S., R. 39 E.	Witchellia cf. <i>W. albidus</i> Buckman Docidoceras? sp. juv. Posidonia ornati Quenstedt
Near Rail Canyon, about 8 miles southwest of Ironside in S. W. corner sec. 11, T. 16 S., R. 38 E.	Stephanoceras sp. Witchellia sp. Parabigotites? sp. Posidonia sp.
Near Becker Creek, about 13 miles W. S.W. of Huntington, in sec. 36, R. 42 E., T. 14 S.	Tmetoceras? sp.

In the Juniper Mountain area the basal Middle Jurassic is represented definitely at localities 1 and 2 by the ammonite Tmetoceras, which occurs world wide in the lower part of the Bajocian. This genus in the Izee-Suplee area of east central Oregon occurs in the basal beds of the Weberg formation (Lupher, 1941, p. 253) on the west side of the Mowich Anticline, and about 100 feet above the base of the Snowshoe formation on the east side of the Mowich anticline, as based on field observations by Imlay.

Slightly younger beds of early middle Bajocian age are represented by fossils from localities 3 and 4. This age is based on the presence of the ammonite Witchellia which in Europe ranges through the zones of Sonninia sowerbyi and Otoites sauzei into the lower part of the zone of Stephanoceras humphriesianum. In the Izee-Suplee area Witchellia occurs in the middle and upper parts of the Weberg formation and in the overlying Warm Springs formation. It occurs, also, in the lower and middle parts of the Snowshoe formation above the basal 100 to 200 feet, according to field observations by Imlay.

The middle Bajocian is represented, also, by fossils at locality 5 as shown by the occurrence of the ammonite Stephanoceras. This genus in Europe ranges from the upper part of the zone of Sonninia sowerbyi into the zone of Strenoceras subfurcatum (basal upper Bajocian). The specimens found at Juniper Mountain locality 5 are

all fragmentary, but bear large tubercles near the middle of the flanks as in the subgenus Skirroceras which is common in the middle part of the Snowshoe formation in central Oregon. In Europe Skirroceras occurs in the upper part of the range of Witchellia in the Otoites sauzei zone, but ranges higher to the top of the middle Bajocian. Likewise in Oregon it ranges higher than Witchellia.

The age of the strata represented by localities A and B is uncertain because most of the fossils collected are either wretchedly preserved or belong to long-ranging genera. However, the presence of the pelecypod Oxytoma favors a Jurassic or a late Triassic age. Likewise, one ammonite fragment matches fairly well with the genus Crucilobicerias from the Lower Jurassic of the Izee-Suplee area.

The fossil occurrences west of Juniper Mountain on the Duncan Ranch and near Rail Canyon are of middle Bajocian age, also, because the same ammonites are present as at localities 3 to 5 on Juniper Mountain. The ammonite found near Becker Creek southwest of Huntington is too poorly preserved for a positive generic identification but its characteristics favor assignment to Jurassic rather than to Triassic genera.

All these occurrences in Malheur County are good evidence that Jurassic beds were once continuous eastward from the Izee-Suplee area of central Oregon at least as far as Brogan. Furthermore, the great thickness of probable Jurassic rocks near Brogan suggests that the Jurassic extended somewhat further east. In this regard it is only 25 to 30 miles from Brogan to Mineral, Idaho, where both Lower Jurassic (McKee (and others), 1956, p. 2) and Upper Jurassic (Callovian) (Livingston, 1932, p. 33, 34; Luper, 1941, p. 265) fossils have been found. Evidently Jurassic seas covered most of eastern Oregon and at least part of western Idaho.

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