THE HOH FORMATION OF WASHINGTON

R. H. PALMER
Seattle, Washington

ABSTRACT

Three members of the Hoh formation have been delimited: lower, a thick series of soft gray organic Oligocene or Lower Miocene shales of unknown thickness; middle, a soft gray sandstone 150 feet thick, and upper, 2,000 feet of blue-gray sandstone with conglomerate lenses equivalent to the Lower Miocene Temblor of California.

The Hoh formation covers more than half the area of the Olympic Peninsula of the state of Washington. Its rocks have been known for twenty years and the general area has been frequently visited by geologists, yet so uncertain has been its position in the geological column that either the entire formation or members of it have been tentatively placed in the Cretaceous, pre-Cretaceous, Jura, Trias, and even the Carboniferous. The same uncertainty characterizes the information relating to the sequence of its various members.

The unsatisfactory geological information from this region finds explanation, first, in the complicated folding and faulting that characterize the Hoh exposures in the cliffs along the Pacific Coast from Mukkaw Bay to the Raft River, 50 miles to the south; second, in the extreme meagerness of available data inland from the coast, due to the thick mantle of glacial till and the all but impassable forest and underbrush growth; and third, in the complete lack of paleontological data.

During the field season of 1926 a locality was found on the coast, 1 mile north of the Hoh River, where the stratigraphic relationships of at least three of the Hoh members are well exposed. The lowest is a gray shale with a few sandy and conglomerate lenses. The upper 1,000 feet only of these shales are exposed. The thickness is therefore unknown. This member contains much organic matter in the form of vegetable material, Foraminifera, and a few molluscan remains. There is evidence to the effect that this is the oldest Hoh

member exposed anywhere along the coast of the Olympic Peninsula. In this member no fossils were found that are definite age-markers. A *Thyasira bisecta* and a *Phacoides acutilineatus*, however, are evidence that these shales are no lower in the column than Oligocene. A *Crenella*, *Modiolus*, *Diplodonta*, *Solemya*, *Dentalium*, and several other unidentifiable molluscan forms were also found in these shales. In this member oil and gas seeps occur.

The gray shale grades upward into a soft, thinly bedded, light-gray sandstone that has a thickness of 150–200 feet. The bedding is very regular, and many of the individual beds show cross-bedding and also contain much bituminous matter but no fossils.

Lying apparently unconformably upon the gray sandstone are nearly 2,000 feet of massive and bedded sandstone, technically an arkosic graywacke. Within this, and apparently confined to the coast and a few miles inland, are many conglomerate lenses. The sandstone and included conglomerate are very hard and resistant and for the most part form the steep headlands and offshore islands so characteristic of the Washington coast. The sandstone varies from blue gray to blue black and weathers to various shades of tan, buff, and brown near the coast. High in the Olympic Mountains the sandstone is almost black in color owing to the presence of femic minerals and of black organic material. So dense and dark is the rock that isolated unaltered hand specimens have been mistaken for basalt. The weathered surfaces in the higher altitudes are very light or whitish gray. This phenomenon is due to the fact that in the higher altitudes weathering attacks the dark femic minerals much more energetically than the light-colored feldspars and quartz, with the result that the latter minerals persist as bosses on the rock surfaces, while the former retreat into deep pits. In lower altitudes, where organic soil acids are an important factor in weathering, the order of mineral disappearance is reversed.

This sandstone and the gray shale compose the terrain from the coast eastward to the Olympic Mountains, though the shale becomes more sandy toward the east. Near the coast the sandstone is locally quite fossiliferous. Fifty-nine species of molluscs were found. Of these, ten have been described, seven others are very close to described forms, and a few others are evidently identical with forms

from other localities, but as yet undescribed. On the basis of this fossil content, the blue-gray sandstone member of the Hoh formation is correlated with the Clallam formation which occurs along the Strait of Juan de Fuca, with the Empire and Astoria beds of Oregon in part, and with the Kern River Temblor of California, and is therefore Lower Miocene in age.

The underlying members, the gray sandstone and gray shale, may therefore be either pre-Temblor Miocene or Oligocene.

In several localities along the coast a sandy shale is known to occur, though its stratigraphic position is uncertain. This is regularly bedded, greenish gray in color, and quite different from the gray shale member. Its geographic occurrence with the hard sandstone and conglomerate suggest stratigraphic proximity to that member. If such is the case, its position is probably still higher in the column.