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Boardman Gravels (Au) Morrow County

River gravels along the south shore of the Columbia River two miles west of Boardman were examined and sampled to determine their gold content. Although samples taken were of necessity too small for accurate quantitative determination of gold present (bulk placering or large scale drilling is usually considered necessary for the determination of values in placer ground) they were of sufficient size to indicate the values, which varied from one mill to about 15 cents per yard. Such values could not be considered commercial except under large-scale operation such as bucket-line dredging.

Location: Near center of west edge of section 12, and in the northeast quarter of section 11, T. 4 N., R. 24 E.W.M., between the railroad and the Columbia River, about two miles west of the town of Boardman.

Area and Ownership: No information as to area and ownership was obtained during the short visit undertaken at the request of the highway department. Samples were taken for a distance of over half a mile along the river, one sample in section 12, and two in section 11.

Description: The south bank of the Columbia River two miles west of Boardman rises rather steeply, within a distance of about thirty feet, to an elevation of about 15 feet above water level, and then levels off so that the area between the river and the railroad is almost level. This terrace is composed of poorly sorted gravels ranging in size from a fraction of an inch to over a foot in diameter. Perhaps 30 percent of the gravel is over 2 inches in diameter and 70 percent below 2 inches, but the size range is irregular and spotty in different exposures. There appears to be little change with depth, and bedding is either very obscure or absent. No bedrock was seen in the expo-

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sures, which went below river level in two places.

Samples were taken as follows:

#1. From the bottom of a 15-foot pit, lying about 300 feet east of the section line in section 12, halfway between the railroad and the river. Sample was taken with the dragline bucket from the bottom of the pit (near water level) and weighed about 16½ pounds.

#2. Sample was taken from a 5-foot face in the west end of a small cut just west of the drainage ditch, about 1000 feet west of #1, 30 feet from the rivers edge. One third of the original sample was large boulders, discarded. Final weight of sample after reduction in size was 11½ pounds.

#3. Sample was taken from three vertical faces about 2½ feet high in a cut 30 feet long, 20 feet south of the rivers edge, located about 3000 feet to the west of #2. About a third of this sample was of large boulders and was discarded. The weight of the final sample was 9½ pounds.

Samples were treated as follows:

Procedure:

The samples were screened and washed through a 10-mesh screen. The screened and washed oversize (plus 10-mesh) was screened through a ¼-inch screen. The oversize was examined for coarse nuggets. The minus ¼-inch, plus 10-mesh was panned and examined for nuggets. None were found. Minus 10-mesh was then panned and the pannings examined. Three pieces of fine gold were observed in sample #3. The concentrates from the minus 10-mesh samples were dried and the total dried concentrate assayed for gold. The gold expressed in milligrams below represents the total gold in each sample.

Results of the assay were as follows:

Sample	Total gold in sample (Weight in milligrams)
1.	0.06
2.	0.24
3.	0.52

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Although the samples are too small to be representative, for comparative purposes it was deemed advisable to make calculations as to the value per yard of the gravel sampled. These values were arrived at as follows:

Given: (1) 1 mg. gold has a value of 0.1125 cents.
(2) 1 cubic yard of gravel weighs 3000 pounds.

Sample #1. 16.5 lbs. gravel containing .06 mg. gold.

$$\frac{3000 \times .06 \times .1125}{16.5} : 1/10 \text{ cent per yard.}$$

Sample #2. 11.5 lbs. less 1/3 boulders removed :
15.3 lbs., containing .24 mg. gold.

$$\frac{3000 \times .24 \times .1125}{15.3} : 5\ 1/3 \text{ cents per yard.}$$

Sample #3. 9.25 lbs. less 1/3 boulders removed:
12.35 lbs. containing .52 mg. gold.

$$\frac{3000 \times .52 \times .1125}{12.35} : 14\tfrac{1}{2} \text{ cents per yard.}$$

It is to be noted that, according to samples, the values upstream are very minute, whereas the samples grow progressively richer downstream, away from the area where the gravel is now being removed.

Report by: John Eliot Allen, March 9, 1943

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THE POTENTIAL FOR MINERAL OCCURRENCES OF ECONOMIC WORTH ON THE BOMBING AND GUNNERY RANGE AT BOARDMAN, MORROW COUNTY, OREGON.

Foreword:

This report consists primarily of an analysis of the geologic conditions prevailing on, and under, the land surface in the vicinity of the bombing range in terms of the probable mineral potential of the area. It was prepared at the request of the State Planning Commission for their guidance in evaluating the worth of the land from a mineral resource standpoint. A first-hand examination of the area was made on the 14th and 15th of November, 1961 but a backlog of data collected previously by the writer in connection with other examinations in the area was also used extensively in the preparation of this report. Common sand and gravel, and occurrences of rock suitable for aggregate and ballast use, have been disregarded because the widespread abundance of these materials throughout the region as a whole effectively lessens the intrinsic value of individual occurrences at any one particular place.

Location:

The Boardman Bombing and Gunnery Range is located near the northwestern corner of Morrow County, Oregon, a short distance south of the town of Boardman. It embraces an area of 148 sections including the four northern tiers of sections in Township 2 North, Ranges 24 and 25 East, all sections in Township 3 North, Ranges 24 and 25 East., and the southern two tiers of sections in Township 4 North, Ranges 24 and 25 East., plus Sections 15, 20, 21 and 22 in Township 4 North, Range 24 East. (1) Otherwise the range can be described as situated in the Geomorphic Division of Oregon known as the Deschutes-Umatilla Plateau. These locations are pictured graphically in Figures 1 and 2.

Bedrock geology:

A concise description of the Deschutes-Umatilla Plateau area as a whole, taken from the Ore.-Bin, Volume 21, Number 10, is as follows: "--A north-sloping lava plateau or monocline bounded on north by Columbia River. Elevation 600 to 3,000 feet above sea level. Surface deeply dissected by youthful streams separated by broad, gently rolling inter-stream areas. Scabland channels eroded by glacial flood waters occur in northern part. Region underlain by thousands of feet of Miocene basalt flows (Columbia River basalt); in places gently warped into large open folds. Surface blanketed in part by Pliocene lake beds and river gravels (Dalles and Shutler formations), Pleistocene ice-rafted boulders and torrential flood-deposited alluvium, and loess."

The surface formations within the range boundaries consist almost exclusively of the sedimentary phase of the rock types just described. These vary in character from poorly consolidated, fossil-bearing strata, deposited originally in mid-Pliocene (2) fresh-water lakes, to aeolian dunes and loesses which even today are still subject to drift and migration. Included also are fluviatile gravels introduced at different times during the Plio-Pleistocene evolution of the Columbia River drainage system.

Two firm exposures of basalt, or basaltic andesite, represent the only other rock formation observed first-hand in the range area proper. In both instances these exposures are very restricted in their aerial extent. However, conditions suggesting near exposures exist in the area surrounding these outcrops. An extended search could therefore result in the discovery of a few more outcrops. In any event, well logs and the circumstances of natural exposure combine to show that the two recorded occurrences are fairly thin flows interbedded in the sedimentary section.

Because of inadequate exposures in depth within the boundaries of the bombing range, investigation of the area was extended to include study of the adjacent terrain on the east, south and west. Well logs were utilized also for the purpose of clarifying the subsurface picture. Willow Creek Canyon provided almost continuous exposure of several hundreds of feet of the geologic section prevailing along the western and southern sides of the range from the Columbia River to Lexington. The well logs were of particular value in revealing both the character and depth of the sediments in the area east of the range where relief conditions afforded little in the way of natural exposures suitable for examination purposes.

The aggregate results of this study, that is, both within the range boundaries and outside thereof, indicate that the area as a whole is underlain at depth by massive basalts of the Columbia River formation; that the thickness of the overlying sedimentary mantle is quite variable but almost universally substantial; and that the sedimentary section contains, in places, and principally west of the range, one, and sometimes two, interbedded basalt members.

Natural exposures of the massive Columbia River flows occur throughout almost the entire length of the Willow Creek Canyon. These are for all practical intents essentially horizontal excepting in the section between Ione and a point a few miles north of Morgan where an anticlinal structure is exposed. The indicated trend of the axis of this anticline projects north-northeastward into the bombing range area.

Few well logs are available for the highland area between Lexington and the southern margin of the range. However, natural exposures in the small gullies tributary to Willow Creek combine with random exposure on the highland surface itself to indicate that the Columbia River basalt surface is topographically high in this area. In other words, the sedimentary covering can be postulated as comparatively thin here.

In contrast to the foregoing situation the average depth of the overlying sediments in the area east of the range is 130 feet as computed from thirty-seven well logs. If a cluster of nine comparatively shallow indications is disregarded as a local phenomenon, the average depth increases to approximately 160 feet. The greatest recorded depth is 288 feet. In this area the underlying basalts have been logged as belonging to the Columbia River formation.(3) Seven of the logged wells show a penetration into this basalt in excess of 500 feet, the deepest penetration being 738 feet. Pertinent statistics concerning these check wells, and others to be described hereafter, are plotted on Figure 1.

The area between the central portion of the bombing range and westward to, and beyond, Willow Creek is the one in which the sediments contain the interbedded basalt horizons. An exposure of one of these basalts occurs on the bombing range in the same general vicinity as Shotwell's mid-Pliocene fossil locality. The precise relationship between these sediments and the basalt is not currently known, however, at least insofar as can be determined by the writer from available references. Therefore, because of the attendant uncertainty concerning the age of the basalt interbeds, the depth of the Columbia River basalt surface is less easy to establish here. This is illustrated by the log of the well drilled by the Boeing Company in Section 33, Township 24 East, Range 3 North, approximately six miles south of the mid-Pliocene fossil locality but at an elevation approximately 200 feet higher. A penetration of 27 feet of basalt is recorded in this well between minus 30 and 57 feet. Another 85 foot section of basalt is logged between minus 103 and 178 feet. Finally, basalt is again reported as extending from the minus 273 foot level to the bottom of the hole at minus 564½ feet. Sediments are logged in all intervening sections of the hole.

Interpretations with widely different conclusions can be made from this log regarding the lithologic nature of the underlying Columbia River formation and the depth at which the Columbia River surface occurs. One interpretation involves presumption that both of the basalt interbeds are affiliated with the Columbia River formation in age. The other hinges on the presumption that the host sediments in the instance of one, or both, of the interbeds are mid-Pliocene or younger in age. Explanation of each of these possibilities follows.

Acceptance of the first interpretation means that the mid-Pliocene sediments must overlie the shallowest basalt and hence the thickness of the entire section of surficial sediments from the mid-Pliocene up is limited to 30 feet at the well site. If this is indeed the situation, the deposition of all sediments below the shallowest basalt must be related in time with the tapering off phase of the Columbia River emplacement. In this connection there is geologic precedent in other portions of the Columbia Basin, particularly in Washington, for occasional straggler interbeds of basalt in an overlying section of sediments closely related to the

Columbia River basalts in time of deposition. For that matter Waters describes some very late flows of the Yakima member of the Columbia River formation as interbedded with sediments equivalent to the Ellensburg formation in the general vicinity of Klickitat, at the Dalles, and even as close to the bombing range as Arlington.(4)

The second interpretation hinges on the fact that Waters also describes the very "Late Yakima" flows as having some mineralogic resemblance to the Pliocene-Quaternary basalts unconformably overlying the Yakima beds over wide areas in the Cascade Mountains and central Oregon plateaus. This leaves the door open for possible error in correlation in areas such as Boardman where geologic mapping has not been carried out on a detailed level heretofore. Applied to the present problem this means that if one or both of the basalt interbeds encountered in the Boeing well actually occur within the post Columbia River section instead of with the Columbia River formation as postulated above, the bottom of the section of mid-Pliocene and younger sediments then stands at either minus 103 or minus 273 feet respectively instead of the minus 30 foot level cited previously.

There are several other wells besides the Boeing well in which two basalt interbeds have been encountered. For this reason the logs of all other wells have been reproduced on Figure 3 by way of illustrating the problem graphically. The figure shows the great variation which exists in the thickness of the basalt interbeds, the differences that also exist in the thickness of the intervening sections of sediments and the wide differences in elevation at which these formations are reported to occur. The locations of the wells from which these logs were obtained is indicated on Figure 1 by well numbers corresponding to those indicated on the logs.

Additional study in the form of chemical and petrographic examination of the interbeds, plus careful mapping, should serve to establish the proper correlation of the interbeds without too much difficulty. In terms of the present problem, however, the question of immediate pertinency has to do with the occurrence of mineral resources of possible commercial value in the general vicinity of the bombing range. On this count it is immaterial whether the sediments overlying the massive Columbia River basalts are exclusively mid-Pliocene to recent in their make-up, or in places older as well. Either way their potential for containing mineral occurrences of a commercial nature is quite limited. This much is well established by studies and mapping done in other parts of the Deschutes-Umatilla Basin area and in related portions of the Columbia River Basin area in Washington. The remainder of this report will be devoted to a review of the mineral resource subject per se.

Mineral Resource Picture, Tertiary:

As indicated previously, only a small variety of mineral resources have been found to occur in commercial quantities in association with Tertiary lakebeds and later fluviatile sediments in eastern Oregon. Nevertheless, those that do occur constitute a

precedent which must be considered in any overall evaluation of the mineral resource potential of the Boardman area. The list of such minerals includes diatomite, lignitic coal and clays in direct association with the lakebeds, cinnabar under special circumstances, and gold in placer form in connection with the coarse fluviatile gravels. A brief resume of the geologic nature and mining history of each of these resources, together with comments bearing on the likelihood of their occurrence in the Boardman area, is as follows:

Diatomite: This rates as a resource having great commercial potential because of its range of vital industrial applications. It occurs in significant quantities in only five or so states of which Oregon is one. The Oregon occurrences are located almost exclusively east of the Cascades. One of these occurrences has a record as a contributor of a very substantial percent of the nation's past requirements in the important filter-grade field. This occurrence was mined on a large scale continuously from in the early 20's until July of 1961 at which time the operation was terminated due to exhaustion of reserves. This operation was located in central Oregon, near Terrebonne.

Of particular pertinence to this report is the fact that whereas most of the eastern Oregon diatomite occurrences are associated with lakebeds of earlier Tertiary age, the Terrebonne deposit was associated with lakebeds reported by Moore (5) and Hodge (6) as late Tertiary to early Pliestocene in age. Analogy to the general geologic environment possible at depth in the Boardman area is further emphasized by the fact that the Terrebonne sediments overlie Pliocene lavas and are in turn overlain by even younger lavas. In other words the Terrebonne environment is entirely similar to what could conceivably exist in connection with the older sediments at Boardman if the Pliocene section continues to depths below one or both of the basalt interbeds. For this reason special care was taken to screen all evidence which might indicate the presence of diatomite beds in the sedimentary section at Boardman. It can be reported, however, that despite the possible parallelism of geologic environments no diatomite interbeds of significant proportions are exposed in the geologic section revealed in the Willow Creek canyon. Neither do any of the logs listed on Figure 1 contain any references that can be construed to indicate that minable beds of diatomite were penetrated during the drilling of any of the wells. Under the circumstances there is little reason to anticipate minable sized beds of diatomite as underlying the bombing range area at any shallow, minable depth.

Coal: The situation with regard to the possibility of sub-surface occurrences of coal in the bombing range area is also negative insofar as direct evidence is concerned. In addition, the record of attempted development of eastern Oregon coal occurrences is devoid of anything resembling commercial success primarily because said development disclosed the coal to be of lignitic quality with poor slaking characteristics and high ash content. Then too, the best formed occurrences of eastern Oregon coal occur in association with sediments of early Tertiary age rather than with those of late Tertiary time. Because of this combination of reasons, the prospects of commercial occurrences of coal can be appraised as remote to the point of being essentially nil in the Tertiary sediments of the Boardman area. Their complete absence in the later fluviatile sediments is a foregone conclusion.

Clay: Several of the Boardman area well logs contain references to clay but in no instance is there any data to indicate that any of said clays have any special-use properties or that they differ in any way from the run-of-the-mill clays normally present wherever lakebed sediments are found. This wholly negative approach to a conclusion can be supplemented with the observation that clays with bentonitic characteristics represent the only known occurrence in eastern Oregon of Tertiary clays with special-purpose properties over and above those required for the production of common burned brick. These bentonitic clays are found in several places in eastern and central Oregon but because of limited demand for bentonite the occurrences are relatively unexplored. A small production of bentonite has been made during recent years in Crook county for use as a ditch sealant and as a binder for feed pellets. (7) As this is the only instance of commercial utilization despite the abundance of known prospects elsewhere in eastern Oregon, it follows that bentonite occurrences on the bombing range would have but questionable value even if present.

Cinnabar: The production of quicksilver in Oregon is noteworthy because Oregon is one of the very few states in the nation in which minable cinnabar ores have been found. (8) By far most of the cinnabar prospects occur in rocks of Tertiary age and of these the most are very intimately associated with rocks of volcanic origin—chiefly those of acidic to intermediate composition. In some few instances, however, thermal waters rising along shear zones have resulted in local replacement of lakebed sediments and tuffs by silica and cinnabar. This is the reason cinnabar prospects are included

in the list of minerals that can be envisioned as worthy of consideration in the Boardman area. In this connection it can be stated that no bodies of opalite or kindred evidence of thermal replacement were observed in the field in any of the oldest sediments examined. Neither were any cinnabar prospects reported to exist in the area by any of the various native informants questioned on the subject, nor was there any evidence of the occurrence of any local rhyolite plugs or other of the related volcanic rocks normally present in areas where cinnabar prospects are found. These negative findings are sustained by the lack of published record of any cinnabar prospects in the area. They are also in harmony with the prevailing concept of geologic conditions in the area as it has come to be understood on the basis of regional studies.

Gold: Gold has been eroded from ore-bodies in certain Oregon rock formations of pre-Tertiary age and deposited with fluviatile gravels throughout Tertiary to recent times. The richest of the deposits thus formed occur close to the sources of the parent lodes located for the most part in the Blue Mountains of Baker and Grant counties. However, the Snake River sands are noted for their content of very fine gold originating from sources in Idaho as well as from Oregon. By and large this gold is not economic to recover because of its exceptional fine state of particle size. It is, nevertheless, a matter of historic record that some placer mining was done by hand means by Chinese workers on gravel bars and islands in the Columbia River in the vicinity of The Dalles during the last century. (9) The circumstances under which this mining was done are not presently known but it is to be doubted that the effort was financially rewarding. In any event the fact that some placer mining was done forces consideration of the question of gold values in the fluviatile gravels in the Boardman area.

On this count it can be stated that some flour gold is undoubtedly present in such portions of the presently high gravel channels as were originally deposited by the Columbia River. For the most part, however, the abundant gravels in the Pleistocene fluviatile blanket were derived from the highlands immediately south of the Boardman area and hence are composed almost exclusively of basalt and related volcanic detritus. Under the circumstances there is no geologic reason to expect them to contain any placer gold content whatsoever. Conversely there is much geologic precedent for believing the placer gold content of the Columbia River gravels is at best exceedingly low. It follows, therefore, that the placer gold

potentialities of the Boardman area fluviatiles must be classed as nil to negligible on the basis of available data and general geologic reasoning.

In summation, the obvious conclusion to the foregoing paragraphs is that, although the geology of the Boardman area has never been mapped in detail, the basic picture of the geologic conditions in the Deschutes-Umatilla Plateau area at large, as developed over the years by observation on a reconnaisance level, rates as wholly applicable-----namely, Columbia River basalts overlain by an assemblage of mineralogically uninteresting sediments with occasional basalt interbeds. Evidence to the contrary, in terms of mineral potentialities of the sort found in association with comparable geologic environments elsewhere in eastern Oregon, is insignificant.

Mineral Resource Picture, pre-Tertiary:

The Tertiary section is known to be exceptionally thick in the Deschutes-Umatilla Basin area and the counterpart portion of Washington. This is amply demonstrated by the logs of many deep water wells and borings drilled in connection with oil and gas tests. The very identity of the pre-Tertiary formations underlying the basin as a whole is therefore a matter of conjecture and its possible content of commercial type minerals is totally unknown.

By way of illustrating the thickness of the Tertiary to recent section it can be stated that Newcomb gives the Columbia River basalt formation a thickness in excess of 5,000 feet in the central part of the Columbia Plateau region.(10) Another graphic illustration is provided by the log of an oil test drilled near Condon by the Standard Oil Company in 1957.(11) This is the only recorded instance in the Deschutes-Umatilla Basin area of a well drilled clear through the Tertiary section and into confirmed marine strata of pre-Tertiary age. The log can be interpreted as indicating a Tertiary section substantially in excess of 6500 feet.

On the basis of the examples just cited it should be manifest that the great thickness of the overlying Tertiary section represents a barrier of virtually prohibitive proportions when it comes to prospecting the pre-Tertiary for occurrences of the non-mobile minerals in all portions of the Deschutes-Umatilla Basin area bordering the Columbia River, the Boardman Bombing Range area inclusive.

The one exception to the foregoing conclusion occurs in connection with oil and gas potentialities. The reason for this is that oil and gas are mobile mineral substances which by their very nature are prone to migrate through permeable subsurface strata and collect in concentrated quantities in places where subsurface conditions favor impoundment.

In the instance of these mobile minerals very sizeable expenditures have been made during the past fifteen years on studies of pre-Tertiary stratigraphy throughout the whole of eastern Oregon. These investigations have been carried out by several of the nation's

leading oil and gas companies. All of their studies of the pre-Tertiary were of necessity made on exposures located for the most part in the Blue Mountains. However, supplementary work of far-reaching proportions has also been done in the Tertiary-covered basin and plateau areas. This has included various geophysical surveys and several exploratory wells. The pre-Tertiary investigations have had to do primarily with evaluation of the source bed potential of the marine pre-Tertiary strata in general. The other studies have had to do with development of indications pointing towards a possible combination of favorable source and storage conditions at depth in the Tertiary-covered areas surrounding the mountain exposures as it is from the strata underlying these Tertiary-blanketed areas that any eastern Oregon occurrences of oil and gas must originate.

To date no commercially important discoveries of oil or gas have been encountered in any of the eastern Oregon tests, either in the several carefully controlled deep tests drilled during recent years by the highly experienced companies or in any of the many "wildcat" wells drilled earlier by groups of enthusiastic speculators. (12) These negative results may seem disappointing, and indeed are. It remains to be remembered, nevertheless, that the study of pre-Tertiary stratigraphy has been sufficiently encouraging to justify the recent test drilling to hitherto unprecedented depths. Also to be noted is the fact that the truly deep tests are few in number in proportion to the many hundreds of square miles of Tertiary-covered terrain suitable for exploration. Accordingly, a great many more deep probes remain to be drilled before the oil and gas potential of eastern Oregon can be written off as wholly negative.

The prospects for the discovery of oil and gas in the Boardman area cannot be described as being either more, or less, encouraging than the potential for eastern Oregon as a whole. It is to be noted, however, that a flammable natural gas is discharged along with the water at Wells Springs on the southern border of the bombing range and that the bombing range was part of an acreage that figured in a promotional oil and gas development as far back as 1930. It is to be noted also that the Rattlesnake gas field of Benton county, Washington is located only 45 miles north of the bombing range. in a direct line with the indicated strike of the anticline exposed in the Willow Creek canyon immediately south of the bombing range. Even more significant, perhaps, is the fact that the Standard Oil Company saw fit to start their 8726 feet exploration test in the Columbia River basalt at a location in the Deschutes-Umatilla geomorphic area as close to the bombing range as Condon. These observations combine to suggest that it may be unwise to discount the oil and gas potential in the bombing range area until such time as additional data is available for evaluating said potential more authoritatively.

Conclusions:

All of the data reviewed heretofore in this report point to the probability that no sub-surface mineral occurrences of commercial worth can be anticipated to occur in the geologic section underlying the bombing range. This conclusion applies to all non-mobile minerals with a status over and above common sand, gravel and crushed rock, and especially to those minerals noted for their occurrence elsewhere in eastern Oregon in a geologic environment comparable to that at Boardman. In view of these findings it is the writer's opinion that the Planning Commission is justified in consummating lease or sale negotiations for the Boardman Bombing and Gunnery Range with no undue concern one way or another over the question of mineral rights in the instance of the "in place" mineral potential.

The conclusion with respect to the oil and gas potentialities of the region is fundamentally similar to that just cited for the "in place" minerals for the reason that there is no specific evidence presently available which can be interpreted as favoring eventual discovery. In other words, the Commission would appear to be justified in regarding the oil and gas potential in the same manner as suggested for the non-mobile minerals should their negotiations for land acquisition and subsequent lease or sale offer no room for latitude in their dealings. Otherwise, and because of the mobile nature of oil and gas, and because the case for a negative appraisal is less clearly founded, it might be to the Commission's best interest from a defensive standpoint to reserve for the State either the oil and gas rights, or a stipulated royalty therefor, should the possibility for making such a reservation be open to them.

N. S. Wagner

Report by: N. S. Wagner, Geologist
January 3rd., 1962

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Figure 1. Township-Range grid of Boardman area as taken from U. S. Corps of Engineers regional topographic maps, scale 1:250,000.

LEGEND		
	Red overprint:	Bombing and Gunnery Range boundaries.
	Orange overprint:	Approximate location of observed basalt exposures.
	. 529	Well location and total logged depth.
	. 141-710	As above except that the first number represents the depth of reported sediment-basalt contact; the second number represents total logged depth.
	#3 . 609	Wells specially numbered are those illustrated on Figure 3.
	.	Wells shown on maps in the Bombing Range headquarters for which no data is available.
	GAS	Well locations at which flammable natural gas is reported to have been encountered.