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STRATIGRAPHIC IMPLICATIONS OF SOME CENOZOIC FORAMINIFERA FROM WESTERN OREGON*

By
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EOCENE*

Upper and/or Middle Eocene

Yamhill formation and Sacchi Beach beds (upper and/or middle Eocene): The Yamhill formation of the Mill Creek area in Polk County (22g)*** and the beds exposed at Sacchi Beach in Coos County are essentially equivalent insofar as their foraminiferal content is concerned. They are similarly equivalent to the lower part of the McIntosh formation of Washington. The Yamhill-Sacchi Beach-lower McIntosh fauna is distinguished by the common and restricted occurrence of Amphimorphina californica Cushman and McMasters, which is Laiming's marker for his upper Domengine B-1A zone in California.

The Yamhill-Sacchi Beach Amphimorphina californica fauna contains in excess of 150 species of foraminifera. It appears to mark the upper range limits of a few middle Eocene species, including Nodosaria latejugata Gümbel and probably Amphistegina californica Cushman and M. A. Hanna, A. Simiensis (Cushman and McMasters), and Pseudophragmina psila (Woodring). It appears also to mark the lower range limits of a number of upper Eocene species, including Gyroidina cf. G. soldanii d'Orbigny (9, pl. 50, figs. 13 a-c) (10, pt. 4, pl. 10, figs. 6 a-c), Robulus welchi Church, and Valvulineria chirana Cushman and Stone.

Gyroidina cf. G. soldanii occurs commonly in the Yamhill-Sacchi Beach fauna and in considerable abundance in the fauna of the lower member and the lower 375± feet of the middle member of the Coaledo formation. Bulimina corrugata Cushman and Siegfus is common in the Yamhill-Sacchi Beach strata, very rare in the Umpqua formation, and common in the lower 375± feet of the middle member of the Coaledo formation. A very few poorly preserved specimens closely resembling this species have been observed in an assemblage from the uppermost part of the middle member of the Coaledo formation. Gaudryina cf. G. atlantica (Bailey) var. asperita Cushman and Barbat has common to abundant occurrence in the Yamhill-Sacchi Beach fauna and in that of the lower member of the Coaledo formation.

A chart compiled by the writer in 1953 and published in 1955 (22g) recorded 86 forms from the Amphimorphina californica fauna. Forty-four were given generic names only. Specific identifications given for the other 42 were tentative and needed revision. Subsequent study

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* Concluded from The Ore.-Bin, vol. 18, no. 7, July 1956.

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*** See note concerning bibliography on page 15.

indicates, for instance, that Gyroidina simiensis does not occur in the Yamhill-Sacchi Beach fauna, but that G. cf. G. soldanii (9, pl. 50, figs. 13 a-c) (10, pt. 4, pl. 10, figs. 6 a-c) appears to conform with the description of G. simiensis in all respects except in the development of thickened knobs at the umbilical ends of the chambers. G. cf. G. soldanii has no umbilical knobs.

Bandy (7) has recorded the following foraminiferal assemblage from gray shale at Cape Blanco, giving its indicated age as middle Eocene: *Amphistegina simiensis (Cushman and McMasters), Anomalina packardi Bandy, Astacolas subtumidus Bandy, *Bulimina ampla Cushman and Parker, *B. pupoides d'Orbigny, Cibicides celebrus Bandy, *C. howelli Toulmin, *C. lobatus (d'Orbigny), C. mexicanus Nuttall, C. perlucidus Nuttall, *Glandulina elliptica Reuss, Globigerina eocaenica Terquem, G. quadripartita Koch, *G. trilocularis d'Orbigny, *Globorotalia lotus (Schwager), Guttulina oregonensis Bandy, *Lagena williamsoni (Alcock), Lamarckina rugatina Bandy, Marginulinopsis cingulosa Bandy, M. prolata Bandy, Nodosaria consobrina (d'Orbigny), Nonion planatum Cushman and Thomas, *Quinqueloculina laevigata d'Orbigny, Robulus americanus (Cushman), R. degolyeri (Plummer), R. texanus (Cushman and Applin), *Rotorbinella colliculus Bandy, *Saracenaria blancoensis Bandy, Spiroplectammina adamsi Lalicker, *Triloculina laevigata d'Orbigny, Valvulineria cooperensis (Cushman), V. lottensis (Garrett), V. patelliformis Bandy.

This assemblage appears to be more closely related to the Yamhill-Sacchi Beach fauna than to those of the Tyee and Umpqua formations. Forms which closely resemble Bandy's figures for the species indicated by asterisks in the preceding list occur in the Yamhill-Sacchi Beach fauna.

Middle and Lower Eocene

The Tyee and Umpqua formations are here considered to be middle and lower Eocene in age and essentially equivalent to Laiming's Domengine and Capay zones B-1 through C. It may be that Laiming's Meganos D zone fauna is also represented, but this has not been conclusively demonstrated by material examined by the writer. Neither does it appear certain that all of Laiming's B zones are separately distinguishable in the Oregon section. The B-1 zone assemblage with Cibicides coalingensis (Cushman and G. D. Hanna), for instance, has not been observed by the writer.

Presently available material indicates clearly, however, that zoning of the Tyee-Umpqua section will be possible when suitable control section material becomes available for detailed study. This will probably depend upon drilling in fossiliferous sections of the middle and lower Eocene. In the meantime a fair degree of bio-stratigraphic control is possible, based upon study of stratigraphic series of samples collected along roads and rivers and scattered samples from other suitable surface exposures.

It does not yet appear certain that consistently dependable separation of Tyee foraminiferal assemblages from those of some strata which have rather generally been considered upper Umpqua in age can be made on the basis of material presently at hand, although in all probability data for distinguishing the Tyee formation from the Umpqua formation will eventually be developed.

Tyee formation (upper middle Eocene): Foraminifera from sediments believed to be of Tyee age are listed from the following four localities. None of the lists is complete for the assemblage represented, but each is nearly complete except the one for the Glide section Tyee? Identifications are based primarily upon comparison with published figures.

1. Glide section Tyee?. Along North Umpqua River approximately 17 miles northeast of Roseburg in sec. 17, T. 26 S., R. 3 W., between the west section line and Lone Rock Bridge. Low Tyee? (4b, p. 11, fig. 3, table 3). Ammodiscus cf. A. incertus (d'Orbigny), Anomalina cf. A. coalingensis Cushman and G. D. Hanna (compressed form), Bulimina cf. B. schencki Beck, Ceratobulimina sp., Cibicides cf. C. sp. D of Cushman and McMasters, Cornuspira sp., Cyclammina cf. C. cancellata Brady var. obesa Cushman and Laiming, Dentalina cf. D. approximata Reuss, D. cf. D. consobrina d'Orbigny, Eponides cf. E. ellisorae Garrett, E. minimus Cushman, Globulina sp., Gyroidina cf. G. soldanii d'Orbigny, G. soldanii d'Orbigny var. octocamerata Cushman and M. A. Hanna, Lenticulina cf. L. convergens (Bornemann), Marginulina mexicana Cushman var. (Resembles Hemicristellaria vacavillensis [G. D. Hanna] of Israelsky [5a, pl. 3, figs. 4, 5] in its somewhat inflated final chamber.), M. cf. M. truncana (Gümbel), Nodosaria cf. N. adolphina (d'Orbigny), N. cf. N. arundinea Schwager, N. latejugata Gümbel, Pseudoglandulina laevigata (d'Orbigny) var. ovata (Cushman and Applin), Quinqueloculina cf. Q. yeguaensis Weinzierl and Applin, Rhabdammina eocenica Cushman and G. D. Hanna, Robulus cf. R. midwayensis (Plummer) (8-9 instead of 10-12 chambers in adult form), Sigmoilina sp., Textularia cf. T. distortio Cushman and Applin, Triloculina (?) cf. T. inornata d'Orbigny.

2. Basket Point type Tyee. At Basket Point on north bank of Umpqua River near section line between secs. 29 and 30, T. 24 S., R. 7 W. High Tyee. (4b, pp. 16-20, 38. Doubtless due to typographical error, the range was given as 4 W. in Turner's paper.) Bathysiphon (?) sp., Cibicides cf. C. jeffersonensis Garrett, C. cf. C. sp. D of Cushman and McMasters, Cyclammina cf. C. clarki G. D. Hanna, Dentalina communis d'Orbigny, Eponides cf. E. ellisorae Garrett (10, pt. 4, pl. 10, figs. 7 a-c) (Some partially crushed specimens may be E. guayabalensis Cole var. yeguaensis Weinzierl and Applin), E. cf. E. minimus Cushman, Gaudryina (?) sp., Gyroidina soldanii d'Orbigny var. octocamerata Cushman and G. D. Hanna, Marginulina mexicana Cushman var. A of Laiming, Nodosaria latejugata Gümbel, Nonionella cf. N. frankei Cushman, Robulus inornatus (d'Orbigny).

3. Elkton Tyee. Roadcut on south side of Umpqua River about $1\frac{1}{4}$ or $1\frac{1}{2}$ miles west of Elkton in sec. 24, T. 22 S., R. 8 W. High Tyee. Anomalina cf. A. coalingensis Cushman and G. D. Hanna (compressed form), Cibicides cf. C. sp. D of Cushman and McMasters, Dentalina cf. D. approximata Reuss, D. communis d'Orbigny, D. consobrina d'Orbigny, Eponides ellisorae Garrett (10, pt. 4, pl. 10, figs. 7 a-c), Gyroidina soldanii d'Orbigny var. octocamerata Cushman and G. D. Hanna, Marginulina mexicana (Cushman) var. A of Laiming (5b, p. 198, figs. 4 a-b), M. mexicana (Cushman) var. B of Laiming (5b, p. 198, figs. 5 a-b), M. mexicana (Cushman) var. (Resembles 5a, pl. 3, figs. 4, 5 in the somewhat inflated final chamber), Nodosaria latejugata Gümbel, Quinqueloculina cf. Q. yeguaensis Weinzierl and Applin, Robulus inornatus (d'Orbigny), R. cf. R. midwayensis (Plummer) (8-9 instead of 10-12 chambers in adult form), R. pseudovortex Cole, Textularia labiata Reuss.

4. Comstock overpass Tyee. Roadcut at east end of (former) highway overpass $\frac{1}{2}$ mile south of Comstock on Pacific Highway, sec. 20, T. 21 S., R. 4 W. High Tyee. (4b, pp. 21, 38). Bathysiphon eocenica Cushman and G. D. Hanna, Cibicides cf. C. sandiegensis Cushman and M. A. Hanna, C. cf. C. sp. C of Cushman and McMasters, C. sp. D of Cushman and McMasters, Eponides cf. E. guayabalensis Cole var. yeguaensis Weinzierl and Applin, Gaudryina cf. G. convexa Cushman var. sandiegensis Cushman and M. A. Hanna, Globigerina cf. G. bulloides d'Orbigny, Haplophragmoides coalingensis Cushman and G. D. Hanna, Marginulina mexicana Cushman var. A of Laiming, M. cf. M. mexicana Cushman var. A

of Laiming (thinner than Laiming's figure), M. mexicana Cushman var B of Laiming, Nonionella (?) cf. N. frankei Cushman, Robulus inornatus (d'Orbigny), Textularia cf. T. labiata Reuss var. of Cushman and M. A. Hanna.

Umpqua formation (middle and lower Eocene): Next older than the upper middle Eocene Tyee formation is the Umpqua formation of middle and lower Eocene age. In the Glide section (4b, pp. 10-15) it contains a large foraminiferal fauna which includes the following species: Allomorphina trigona Reuss, *Anomalina dorri Cole var. aragonensis Nuttall, Bathysiphon eocenica Cushman and G. D. Hanna, *Bolivina (Loxostoma) applini Plummer, Bulimina cf. B. corrugata Cushman and Siegfus, B. cf. B. inflata Seguenza, Cassidulina globosa Hantken, *Clavulina cf. C. parisiensis d'Orbigny, Cyclammina sp., Dentalina communis d'Orbigny, D. consobrina d'Orbigny, Discocyclina sp., *Eponides umbonatus (Reuss), *Gaudryina indentata Cushman and Jarvis, G. cf. G. jacksonensis Cushman var. coalingensis Cushman and G. D. Hanna, *Globorotalia cf. G. crassata (Cushman), G. crassata (Cushman) var. densa (Cushman), *Gümbelitria cf. G. columbiana Howe, *Gyroidina cf. G. florealis White, Marginulina mexicana (Cushman) var. C of Laiming, M. cf. M. mexicana (Cushman) var. D of Laiming, M. saundersi (Hanna and Hanna), M. subbullata Hantken, Nodosaria latejugata Gümbel, N. cf. N. parexilis Cushman and K. C. Stewart var. sentifera Cushman and Parker, N. cf. N. vertebralis (Batsch), Nonion cf. N. danvillense Howe and Wallace, *Pleurostomella alternans Schwager, Pseudoglandulina conica (Neugeboren), Rhabdammina eocenica Cushman and G. D. Hanna, Robulus cf. R. inornatus (d'Orbigny), R. cf. R. midwayensis (Plummer) (8-9 instead of 10-12 chambers in adult form), *Silicosigmoilina cf. S. californica Cushman and Church, Siphonina claibornensis Cushman, Textularia cf. T. mississippiensis Cushman.

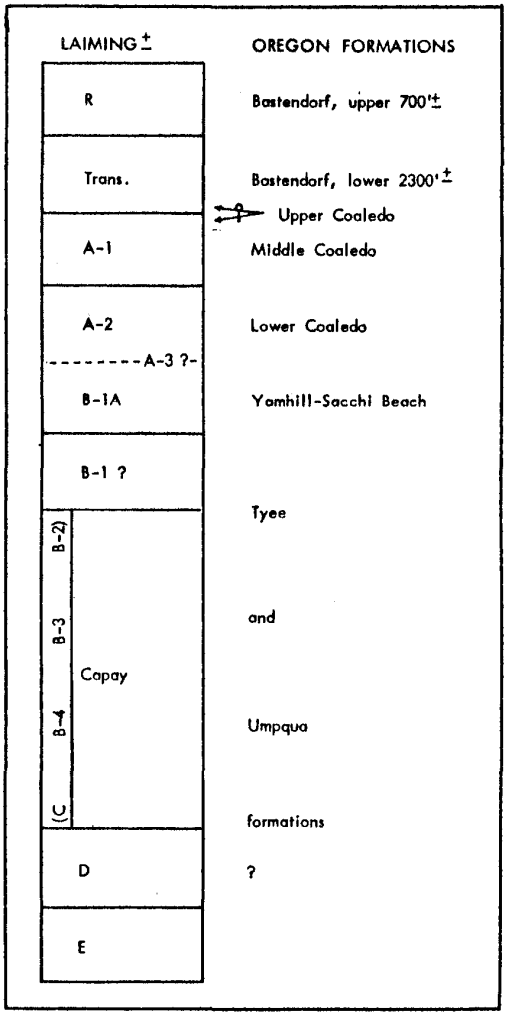

Figure 2. Chart showing apparent correlation between Laiming's California Eocene zones and some Oregon formations.

The species marked with asterisks in the preceding list indicate close affinity between the fauna of the lower sediments of the Glide section and that of Laiming's lower Capay C zone of California.

Concluding Statement

Figure 2 shows apparent foraminiferal relationships between the Oregon Eocene formations discussed in this paper and the California Eocene zones of Laiming.

The lower 2300± feet of the Bastendorf formation appears to be uppermost Eocene in age and faunally transitional between the lower Oligocene upper Bastendorf beds and the middle member of the upper Eocene Coaledo formation.

In the coastal section, which is discussed in this paper, shale predominates in the lithology of both the Bastendorf formation and the middle member of the Coaledo formation. The intervening upper member of the Coaledo formation, however, is composed almost entirely of thick-bedded sandstone with very minor amounts of shale and coal. There is some question, therefore, as to whether an upper Coaledo shale facies which was doubtless deposited farther off-shore during upper Coaledo time is more closely related faunally to the Bastendorf formation or to the middle member of the Coaledo formation.

Existence of some doubt as to the upper or middle Eocene relationships of the Yamhill-Sacchi Beach fauna has been pointed out in this paper (The Ore.-Bin, vol. 18, no. 7, July 1956, p. 57, fig. 1, and vol. 19, no. 2, February 1957, p. 11).

Reference has also been made to the present tentative status of foraminiferal zoning in the Tyee-Umpqua portion of the Oregon Eocene section.

Present ideas regarding the Tertiary of Oregon are wide open for all manner of revision, and changes involving many parts of the section are to be expected. Weaver (8, pp. 1399, 1401, 1403) has given an admirable outline of this situation in the following statement:

> "The entire area of the Coast Range between the Olympic Mountains on the north and the Klamath Mountains on the south together with most of the Puget Sound-Willamette trough is composed exclusively of Tertiary volcanic and sedimentary rocks. These materials have a total maximum thickness of 30,000 feet although a complete stratigraphic section of all the formations is not present in any one locality. These rocks accumulated in continuously changing embayments and under different physical environments. Accordingly, a single formation may vary in thickness, lithologic character, and geologic age from one locality to another. The base of a formation at one place may correspond with the middle of the same formation at another locality where its deposition began somewhat later. For similar reasons the top beds of the same formation may not everywhere be contemporaneous. The basins in which a single formation accumulated may have been intricately connected with one another or entirely separate, thus permitting contemporaneous but entirely different conditions of accumulation of sediments. The contained faunas were responsive to these varying physical environments. Consequently, the exact correlation of the different sections of the Tertiary formations in western Oregon and Washington is always open to revision."

This is the last of three parts of a paper entitled "Stratigraphic Implications of Some Cenozoic Foraminifera from Western Oregon" published in The Ore.-Bin (vol. 18, no. 1, January 1956, pp. 1-6; vol. 18, no. 7, July 1956, pp. 57-63; vol. 19, no. 2, February 1957, pp. 11-15). The paper is to be revised and, under the same title, reissued as State of Oregon Department of Geology and Mineral Industries Bulletin 36, Part 9.

Anyone interested in obtaining a copy of the bibliography prior to final publication may do so by addressing a request to the Department.

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EASTERN OREGON CHROME PRODUCTION
August 3, 1951, through December 31, 1956

The General Services Administration's chrome-purchasing depot at Grants Pass, Oregon, opened for business August 3, 1951, for the purpose of purchasing domestic-mined chromite ores in accordance with the government's defense materials procurement program. Depot operation was predicted on a support price designed to make possible the operation of domestic chrome occurrences.

Although the first ore purchased at the depot originated from the nearby Oregon Chrome mine, Josephine County, subsequent depot purchases have included a considerable tonnage of ores and concentrates from many distantly located properties in California and eastern Oregon. This shows that the opening of the depot stimulated the development and operation of domestic chrome properties in the intended manner. However, due to the fact that the ore-purchasing schedule contains no provisions for equalizing mine-to-depot transportation costs, except to the extent of provisions made August 10, 1956, for purchases of carload lots (see The Ore.-Bin, December 1956), the operators of properties located far from the depot have been faced with high mine-to-depot delivery costs. As a consequence, prospect development in the outlying chrome areas has lagged.

The operators in the John Day chrome area of east-central Oregon represent a group which has had to absorb mine-to-depot delivery costs ranging from $16 to $18 a ton, on top of their base operational costs. This has constituted a serious deterrent to the development of the John Day area for the reason that most investors have been prone to spend their speculative capital on prospects located closer to the depot in order to gain the advantage of the more favorable delivery costs.

The first eastern Oregon shipment was made in mid-summer of 1952, practically a year after the Grants Pass depot had opened. Once started, eastern Oregon deliveries continued steadily. Approximately 4,616 dry long tons were delivered to the depot by December 31, 1956, representing approximately one-eighth of the recorded Oregon production. Value received by eastern Oregon chrome producers for the recorded 4,616 tons shipped was $481,064. The average value of eastern Oregon's chrome was $104.20 per ton, as compared with a reported average of $81.60 per ton for all chrome purchased from the State as a whole since the depot opened. The difference undoubtedly reflects the purchase of greater amounts of crude lump ore from western Oregon shippers. Eastern Oregon shipments have been largely concentrates, due to the prevalence of concentrating-type ores in eastern Oregon, and to the greater delivery costs faced by the eastern Oregon operator.

Most of the eastern Oregon chrome shipments originated from the Haggard and New and Dry Camp mines, both of which have a previous production record. The old Ward mine, which has a World War I production record of between 2000 and 2500 tons, and which has been idle ever since, is the third largest producer. It was reactivated during the summer of 1956. In all, the production originated from thirteen different deposits and was made by fifteen different operators. Several of the smaller properties represent deposits having no previous record of operation. Five concentrating mills were erected in the John Day area during this period, the first being a small pilot plant constructed by Burt Hayes in the summer of 1952. Three of the five mills were intact at the close of 1956; all were in operation at various times duing the 1956 season. These are (1) the Tri-County mill operated on a custom basis, (2) the Al Dunn mill, operated part time on ore from the Dunn lease and part time on a custom basis, and (3) the Haggard and New mill operated exclusively on ore from the Haggard and New mine.

In addition to the shipments cited in the previous paragraphs, there was on hand in the John Day area at the end of 1956 an estimated 260 tons of ore ready to be milled and 50 tons of concentrates ready to be shipped as soon as weather conditions moderated. There were also nine operators who announced plans for continued and expanded operation in 1957.

Such is the picture of eastern Oregon chrome mining at the close of 1956. Whether the 1956 production record of 1533 dry short tons and $167,390 settlement value will be maintained during 1957, remains to be seen, but the year is in any event starting out strong, and the new carlot shipment plan should be a help to those operators who can afford to hold back their concentrates long enough to amass a carload.

N. S. W.

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BLACK SAND POTENTIAL INVESTIGATED

Black sand deposits in Idaho, Montana, Oregon, and Washington are appraised in a recent report by the U.S. Bureau of Mines entitled "Potential of heavy-mineral-bearing alluvial deposits in the Pacific Northwest." Technology and uses of the heavy minerals are reviewed also.

Heavy minerals present in recoverable quantities in black sands are chromite, ilmenite, magnetite, zircon, monazite, columbite-tantalite, and radioactive blacks. The term "radioactive blacks" refers to columbium, tantalum, uranium, thorium, and certain rare earths. Mineral constituents in the black sands of the Pacific Northwest vary considerably from place to place depending upon the source rock. For example, Idaho has placer deposits that contain large concentrations of monazite and radioactive blacks. Oregon and Washington have extensive deposits of beach sands, but, so far as has been determined, these sands contain only small quantities of monazite with larger proportions of chromite, zircon, ilmenite, and garnet.

Interest has been focused since 1950 on monazite because of the short supply of this critical mineral. But interest in the other heavy-mineral constituents of black sands is growing, and research and development programs directed toward their utilization are steadily increasing. According to the Bureau's report, development of heavy minerals from the Pacific Northwest alluvial deposits will depend largely on availability of markets within a reasonable distance.

The report, designated as Information Circular 7767, may be obtained free of charge from the U.S. Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pennsylvania. It should be identified by number and title.

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GEOLOGY OF IZEE AND LOGDELL QUADRANGLES MAPPED

Reconnaissance geologic map of the Izee and Logdell quadrangles, Oregon, by Robert E. Wallace and James A. Calkins, has just been published by the U. S. Geological Survey. It is designated as MF 82 and is one of the Mineral Investigations Field Studies map series.

Formations exposed in the area are metamorphosed rocks of probable Paleozoic age, marine sedimentary rocks of Triassic and Jurassic age, numerous basic and silicic extrusive rocks of Tertiary age, and intrusive rocks including basaltic dikes and sills, dioritic dikes, peridotite, and serpentine. Major folds and faults are shown on the map as are attitudes of beds, fossil localities, and mines and prospects.

The map and a text describing the geology are printed on a single sheet. The map is in black and white with patterns and symbols to differentiate rock units; it requires coloring for

easy readability. Base for the map is the 1951 edition of the Forest Service map, which shows roads, streams, and the more prominent topographic features. Scale is 1:62,500 (1 inch = 1 mile).

MF 82 may be obtained from the U.S. Geological Survey, Denver Federal Center, Denver, Colorado. Price has not been announced. 5¢

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LONG-RANGE MINERALS PROGRAM

The long-awaited, long-range minerals program of the Department of the Interior is still not completed and there is no definite indication as to when it will be announced. This was the implication to be drawn from a statement made recently by Interior Assistant Secretary Felix E. Wormser. Wormser said, "nothing is firm yet in spite of much hard work by all available staff." He told the Colorado Mining Association that some of the long-range mining aids under consideration are possible changes in tax laws affecting mining, stepped-up technological research and possible revision of the mining and leasing laws.

Of extreme import to the mining industry was Wormser's statement, "We have also examined the extremely controversial area of international trade in mineral commodities to determine if Federal action is needed to equalize competition between foreign and domestic producers, and to find out if appropriate action might be taken without jeopardizing other national objectives." (From The American Mining Congress Bulletin Service, February 15, 1957.)

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FEDERAL LEGISLATION

United States Senators Magnuson and Jackson, Washington, have recently introduced Senate Joint Resolution 49 to establish a public lands' study group. The resolution would establish a temporary commission of fifty members appointed by the President to investigate the division of authority and control over public lands among Federal agencies to determine the feasibility of a uniform program by such agencies, determine the most effective long-range conservation adaptable to the lands, and determine the most effective multiple uses of such lands. The commission would submit its recommendations to the President and Congress.

S. 1004-PERMIT MINING ON RECLAMATION SITES - Dworshak (Idaho) and Barrett (Wyoming). Committee on Interior and Insular Affairs. Would open all public lands belonging to the United States heretofore or hereafter withdrawn or reserved for reservoir sites under the reclamation laws to entry for location and patent of mining claims and for mining, development, beneficiation, removal, and utilization of the mineral resources. The United States, its permittees and licensees could not be held liable for damage, destruction or loss resulting from the use of such lands. (From The American Mining Congress Bulletin Service, February 20, 1957)

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FEDERAL MINERAL PURCHASES

Mineral purchasing by the U.S. Government is expected to begin in March. The Senate passed the appropriations bill containing the $30-million for buying tungsten, acid grade fluorspar, asbestos, and columbium - tantalum. The bill will go into joint Senate-House conference soon. Most observers believe it will go through. (From E&MJ Metal and Mineral Markets, February 21, 1957.)

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