cases the bitumen may be removed and treated to yield fuel oil or other products. This paper, however, does not attempt to appraise the economic possibilities of the deposits.

In the several areas mapped to date, the Monterey shale (Miocene) is present and is considered the source of hydrocarbons.

In the McKittrick district bituminous sandstones occur in the lower part of the Tulare formation (Pliocene and Pleistocene (?)). This formation also contains small asphaltite veins. The Tulare is strongly deformed in a broken anticlinorium with a core of Monterey shale. Asphalt oozes from the Monterey and also from tar sands of the Tulare. Some adjacent alluvium is also soaked with tar.

Near Maricopa there are three areas in which asphalt issues from the vicinity of an inclined unconformity between Monterey shale and overlying beds of either the San Joaquin or Tulare formation. Adjacent sandstone and alluvium have locally been impregnated with bitumen.

In the Edna region the Monterey is overlain by shale, sandstone, and conglomerate of the Pismo formation (Miocene-Pliocene). Large, irregular masses of the sandstone are bituminous. They occur on both limbs of a broad syncline which shows subsidiary folds. Some of the asphaltic sandstones have gentle dips, are readily accessible, and have very little overburden.

The Santa Cruz bituminous sandstones are nearly horizontal and are found within and beneath the Monterey shale. Some of the rich sandstones are undisturbed beds, but others are clastic dikes.

At Point Arena, tar sands occur interbedded with Monterey shale and shaly sandstone. The bituminous beds are involved in a syncline and dip rather steeply.

JOHN ELIOT ALLEN AND EWART M. BALDWIN, Geology and Coal Resources of the Coos Bay Quadrangle, Oregon

The Coos Bay coal field is situated on the coast of southwest Oregon, readily accessible to railroad and to the harbor of Coos Bay. It lies within a roughly elliptical structural basin measuring 35 miles north and south by 11 miles east and west.

Mesozoic sediments, schists, and volcanics, tentatively correlated with the Franciscan-Knoxville group of California, are exposed in the southern part of the quadrangle and are overlain unconformably by the middle Eocene Umpqua formation, consisting of more than 1,800 feet of tuffaceous sandstone and shale with thick lenticular basalts and pyroclastics. The Tyee massive feldspathic sandstone, about 2,000 feet thick, overlies the Umpqua and occupies the northeastern corner of the quadrangle.

About 6,000 feet of upper Eocene Coaledo sediments are confined to a complex structural basin occupying the central portion of the quadrangle. The lower and upper Coaledo members consist of medium-bedded tuffaceous sandstones made up largely of basaltic glass, separated by the middle Coaledo member consisting of 400 to 2,300 feet of dark tuffaceous shale of more acidic composition. The principal coal beds occur in the upper and lower sandstone members of the Coaledo formation.

The Bastendorf shale and Tunnel Point sandstone represent the transitional and Oligocene strata, and their outcrops appear mainly on the western edge of the basin, although the Bastendorf is also found in remnants farther eastward. The Bastendorf is 2,900 feet thick, composed predominantly of basaltic glass, and the Tunnel Point with a minimum thickness of 850 feet is composed of basaltic with less amounts of andesitic glass.

The Coaledo and the later Oligocene formations in the major basin were compressed during the Miocene into north-trending folds, and faulted by major north-trending faults and by more numerous transverse faults. The Pliocene Empire formation, comprising at

least 2,000 feet of poorly bedded sandstone, unconformably overlies the Oligocene and Eocene strata in the South Slough syncline and has been folded along the same axis to a lesser degree than older formations. Pleistocene terrace and estuarine deposits cover the coastal plains and major valley bottoms.

Coal was first mined in 1854, and production reached 100,000 tons a year during the early part of the century, but since the increased use of fuel oil during the twenties coal has been mined only for local needs. The total production for the field is probably of the order of 3 million tons.

The Beaver Hill bed, lowest coal of the upper group, has been mined more extensively than any other bed; with a few exceptions other beds of the upper and lower groups have not yielded great tonnages; these beds are ordinarily higher in ash and contain more numerous partings.

Detailed mapping and drilling on four properties have resulted in developing 541,000 tons of measured coal; an additional 800,000 tons was indicated and 3,200,000 tons was inferred. More than 160 mines, prospects, and outcrops were examined and are described; 60 of them were sectioned and sampled. Coos Bay coal is subbituminous in rank, with a heating value of 9,000 to 10,000 B.t.u. per pound as received, with a low sulphur content, moderate percentage of ash, and a relatively high moisture content. The coals of the lower group have a higher heating value and a higher ash content, but mining conditions are relatively unfavorable.

MORTIMER KLINE, Oil for the Lamps of America

The author was recently general counsel for the Petroleum Reserves Corporation at Washington, D. C. He discussed the future of the development of the great oil reserves of the Middle East, emphasizing the importance of American participation and outlining the efforts of the Government to improve the position of American interests. He considered the acquisition of the early concessions, described their present control and the great potentialities of the region, and pointed out the need for more global thinking on the part of most American geologists.

JOHN C. HAZZARD, Some Features of Santa Susana Thrust, Vicinity of Aliso Canyon Field, Los Angeles County, California

This paper discusses a 6 mile segment of the Santa Susana thrust, a feature in which the northern block is thrust southward for 18 miles along the southern side of the Santa Susana Mountains. In part the surface trace of the thrust is relatively straight but in canyons such as Mormon and Brown's Canyons it is extremely lobate, due to deep dissection of its relatively flat part. Likewise in Aliso Canyon the fault is exposed in a small fenster. Features of the overthrust sheet include large scale folding and fault imbrication as well as several transcurrent or tear faults along which there has been both vertical and horizontal displacement.

Studies based on outcrops of the thrust plane and subsurface data indicate that in transverse cross-section the structure has the form of a crude inverted "L." The short segment varies from gently north-dipping to slightly south-dipping. There the thrust plane is smoothly irregular with culminations or structural highs developed in Aliso, Mormon, and Brown's canyons. The long segment of the "L" is steeply north dipping and well data show that this segment maintains its near-vertical character to at least 6,900 feet subsea. A hypothetical northward flattening at an undetermined depth is suggested.

An extensive shear zone, developed below the main plane of movement, is considered a portion of the static block. This zone includes material from all of the stratigraphic units recognized below the thrust. A minimum estimate of 8,000 feet is made for the north to south displacement; the vertical displacement appears to be close to the same amount.