Determination of Petrographic Components in Coal by Thin-Section Examination

An evaluation of the Bureau of Mines method of determining the petrographic components of coal by examination of thin sections showed that a high degree of accuracy is attained in the microscopic determination of coal components.11/ Reproducible results can be obtained irrespective of make of microscope or power of magnification used and the technician performing the work, provided the standard technique is followed with reasonable exactness. The usefulness of petrographic analyses in evaluating coal for certain purposes is discussed. It is pointed out, for instance, that quantitative determinations of the components in coal enable predictions to be made regarding amenability of the coal to hydrogenation and expected yield of liquid products. Exactness in predictions is related to completeness and accuracy of the petrographic analysis.

COAL MINING

Coal Investigation

Alaska

Coal deposits in south-central Alaska and the Kenai Peninsula were investigated by engineers of Bituminous Coal Mining Section.12/

The investigation covered reconnaissance to serve as a basis for plans for detailed investigations of minable coal reserves (see fig. 2). The Matanuska Valley Coal Field is in the valleys of the Matanuska River and its tributaries and their separating ridges. Coal exposures occur in an area approximately 25 miles long by 7 miles wide and parallel the general trend of the Matanuska Valley.

The Lower Matanuska Valley bituminous-coal field occurs in the prominent Wishbone Hill syncline, which extends 7 to 10 miles in a southwestern direction from Eska to Moose Creek (see fig. 3). Bituminous coal is restricted to the Chickaloon formation of Tertiary age; and the coal beds generally occur in the upper 1,400 feet of the formation. At present, the Evan-Jones mine, at Jonesville, on the Matanuska branch line of the Alaska Railroad, about 17 miles east of Palmer by highway and 58 miles from Anchorage via Palmer is the only mine in operation in the Matanuska coal field. The bituminous coal from this mine ships and stores well and is preferred to the subbituminous coal of the Nenan field to the north.

The Moose Creek district lies on the north limb of the Wishbone Hill syncline in the western part of the Matanuska field, about 5 miles west of Jonesville. The Pioneer, Baxter, Rawson, Alaska-Matanuska, and Premier mines have been abandoned owing to physical conditions in and surrounding the beds.

The Eska Creek area is adjacent to the abandoned Eska mine and east of Eska Creek. In an investigation of this area by the Bureau of Mines by diamond drilling, 9 holes totaling 5,158 feet were completed during the year. Data from the completed investigation indicate that the area is not favorable for the development of a mechanized mine.

11/ Parks, B. C., and O'Donnell, H. J., Determination of Petrographic Components of Coal by Examination of Thin Sections: A.I.M.E. Tech. Pub. 2492, Coal Technology, Nov. 1948, 17 pp.

12/ Toenges, Albert L., and Jolley, Theodore R., Investigation of Coal Deposits in South Central Alaska and the Kenai Peninsula: Bureau of Mines Rept. of Investigations 4520, 1949, 37 pp.

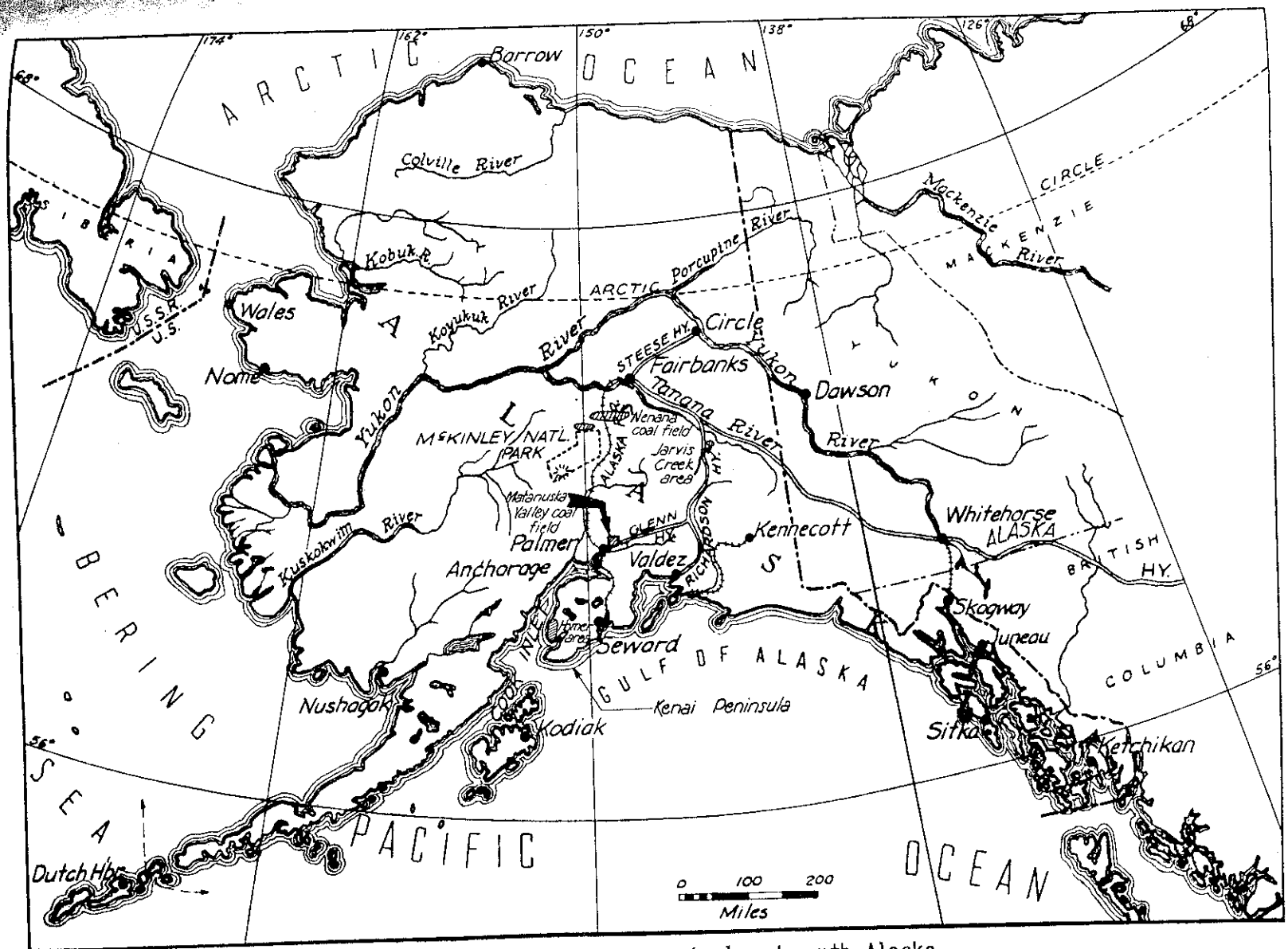

Figure 2. - Coal areas, central and south Alaska.

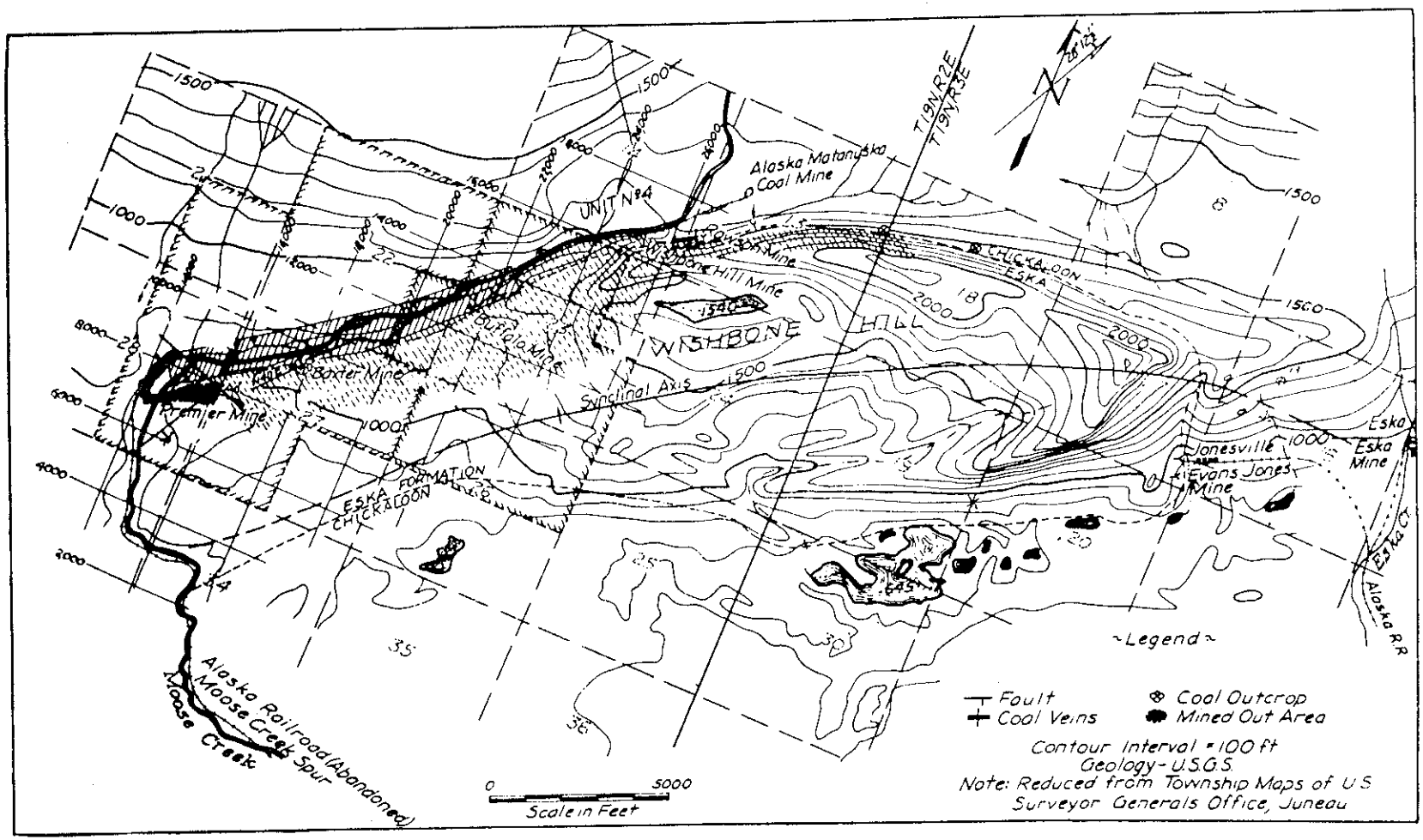

Figure 3. - Moose Creek coal district, Alaska.

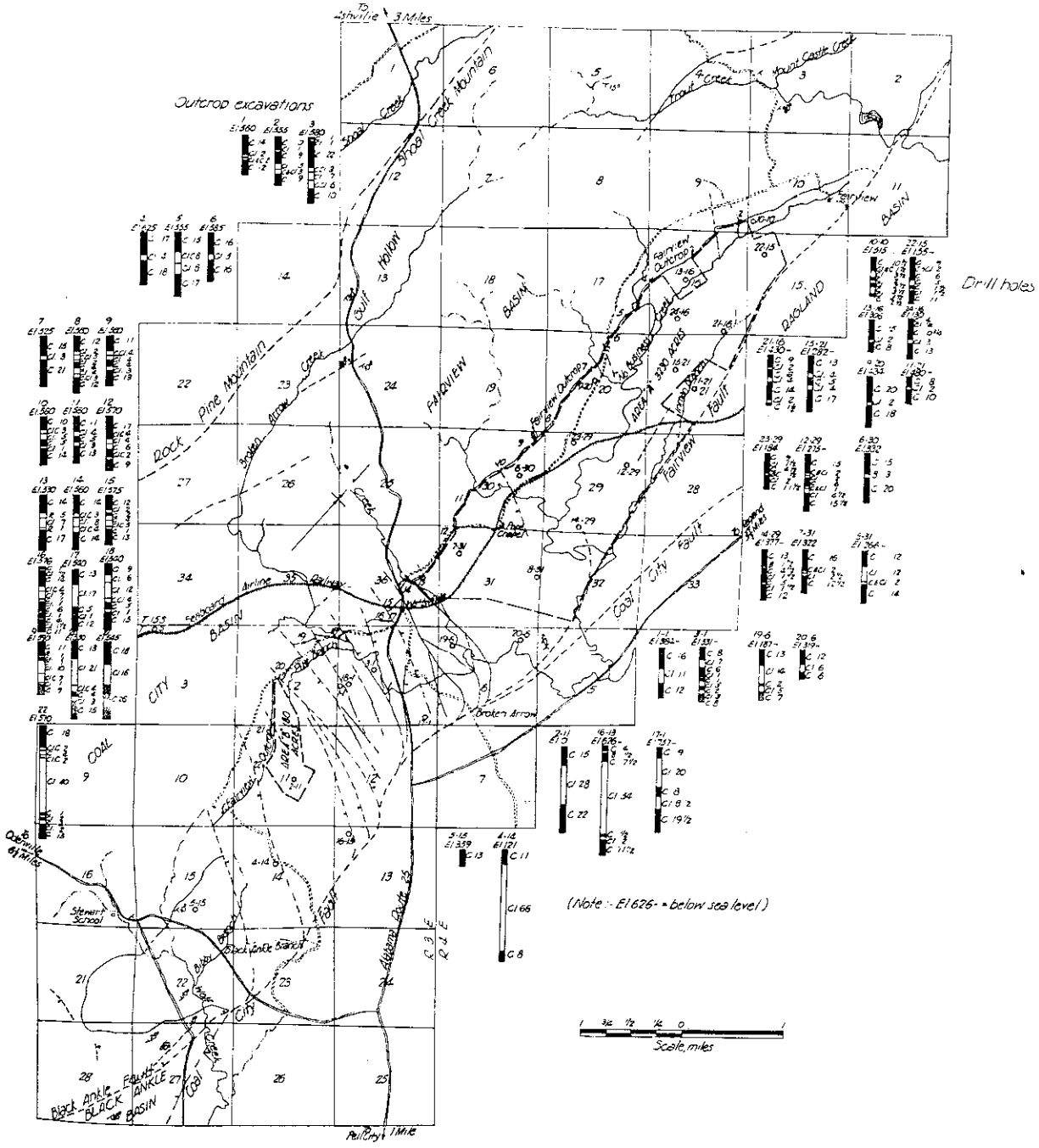

Figure 4. - Coal City and Fairview basins, Coosa coal field, Alabama, showing outcrop of Fairview bed, location of drill holes, test pits, and sections of the Fairview bed.

Investigation by diamond drilling of an area in Wishbone Hill southwest of Jonesville was begun during the year by the Bureau.

The Nenana field is situated in the northern foothills of the Alaska Range adjacent to the Nenana River and the main line of the Alaska Railroad and approximately 100 miles southwest of Fairbanks. Beds of low-rank subbituminous coal and lignite occur in the area, which is characterized by the absence of extreme structural disturbances and igneous intrusions. The thickness of the beds ranges from 6 to 50 feet and the dip from 10 to 70 degrees. In this field, coal has been produced from one underground mine, the Suntrana, of the Healy River Coal Corp., and from two strip mines, the Usibelli and the Diamond.

There is a large reserve of Tertiary coal-bearing formation along Lignite or Hoseana Creek east of the Nenana River and Alaska Railroad, which is on the west bank of the Nenana River. The potential source of coal is amenable to development, and the railroad is essential for transportation.

The Jarvis Creek area comprises about 12 to 15 square miles of Tertiary coal-bearing formations east of Donnelly, which is on the Richardson highway and on the east bank of the Delta River. This area should be considered as a potential source of coal for use along the highway.

The Kenai Peninsula coal formation contains several coal beds, and the probable area extends 10 miles east and west and 3 miles north and south in the vicinity of Homer. Reconnaissance in the vicinity of Homer indicated physical conditions favorable for a modern, mechanized mine, but the extent of minable reserves and characteristics of the bed can only be determined by an investigation by diamond drilling.

Coosa Coal Field, Alabama

Coal has been mined intermittently for many years in the Coosa field of Alabama. This field, which is east of the Warrior and Cahaba coal fields, is traversed by the main line of the Seaboard Airline Railway and is adjacent to the proposed Coosa River development.

Information regarding the continuity and character of the coal beds in the Coosa Field was too meager to encourage the development of modern mechanized mines, and an investigation was undertaken to determine the thickness and extent of the coal beds, physical conditions in and surrounding the beds that would influence mining, and the chemical and washability characteristics of the coals.13/

Operating and abandoned mines in the field, where accessible, were examined, and all maps and other available information regarding abandoned mines were obtained. Sections of the Hammond, Brewer, Coal City, and Fairview beds were measured. Face samples for petrographic study and chemical analysis were obtained and a 1-1/2-ton sample was taken from the Fairview bed for washability tests at the Southern Experiment Station, Bureau of Mines, Tuscaloosa, Ala. The thickness of the beds and the physical conditions in and surrounding these beds were determined from cores of 24 diamond drill holes. The locations of these holes are shown in figure 4. Diamond-drill cores of the coal beds also were used for petrographic examination and chemical analysis.

The strata penetrated in drilling comprised the sandstones, shales, claystones, siltstones, clays and fourteen coal beds of the Pottsville formation.

13/ See footnote 10.

The Fairview bed offers the best possibilities for future development. The reserve of coal in the Fairview bed, underlying two areas, is estimated at 14,580,000 tons, of which 11,660,000 tons should be recoverable (see fig. 4). Some areas of unmined coal may exist in the Hammond, Coal City, Broken Arrow, and Marion beds, but the reserves are small, and the areas are not favorable for large-scale mine development.

The slickensided nature of the coal and the folding of the bright bands (anthraxylon) show that the coal has been subjected to considerable contortion, probably due to folding and the resulting earth movement. The Fairview coal is classified, petrographically, as a bright coal containing a large percentage of anthraxylon.

The rank classification of the coals in the Coosa field is high-volatile A bituminous. The weighted average ash and sulfur content of samples of coal from the Fairview bed, as-received basis, are 14.0 and 3.8 percent, respectively. Analyses of sulfur forms in the Fairview coal show that about 80 percent of the total sulfur is pyritic, 19 percent organic, and 1 percent sulfate.

The as-mined ash and sulfur content of the sample obtained from the Soot Creek mine for washability studies was 12 percent ash and 3.6 percent sulfur. The results of the washability study indicate that washed coal up to 4-inch will contain approximately 10.1 percent ash and 2.47 percent sulfur if jigs and wet tables are used for cleaning. Assuming that the shale and rash partings in the mine are gobbed, a yield of about 83.5 percent of the washery feed should be obtained.

The Fairview and Coal City basins are parts of the north half of a composite structure known as the Coosa trough. Many approximately parallel transverse faults cross the bottoms of the basins. These transverse faults have not reduced the available tonnage of coal, but they have been detrimental to mining.

Minnesota Creek Area, Gunnison County, Colo.

Additional sources of coking coal west of the Continental Divide are needed for western steel plants. A reconnaissance of the Minnesota Creek area (about 6 miles east of Paonia) in Gunnison County, Colo., indicated large reserves of bituminous coal; and as regional movements have raised the rank of some western coals, it was believed that the bituminous coal in the Minnesota Creek area might have qualities suitable for the manufacture of metallurgical coke. This area was studied to determine whether the coals would produce coke of this quality.14/

Four diamond-drill holes to obtain 2-1/4-inch diameter cores and one hole to recover 8-inch cores for carbonization tests were drilled in this area (see fig. 5). The results of the investigation are summarized as follows:

At least four minable beds 4 feet or more thick and as many as 6 minable beds of high-volatile bituminous coal were penetrated in the drill holes. The area contains minable coal reserves of 781,000,000 tons, of which 164,900,000 tons are measured, 122,800,000 tons are indicated, and 493,300,000 tons are inferred. Assuming a recovery of 80 percent, 624,800,000 tons of coal should be recovered from the area. The weighted average moisture, ash, and B.t.u. values on an as-received basis for the cores from all minable beds (partings 3/8-inch or more thick removed) follows:

14/ See footnote 9.

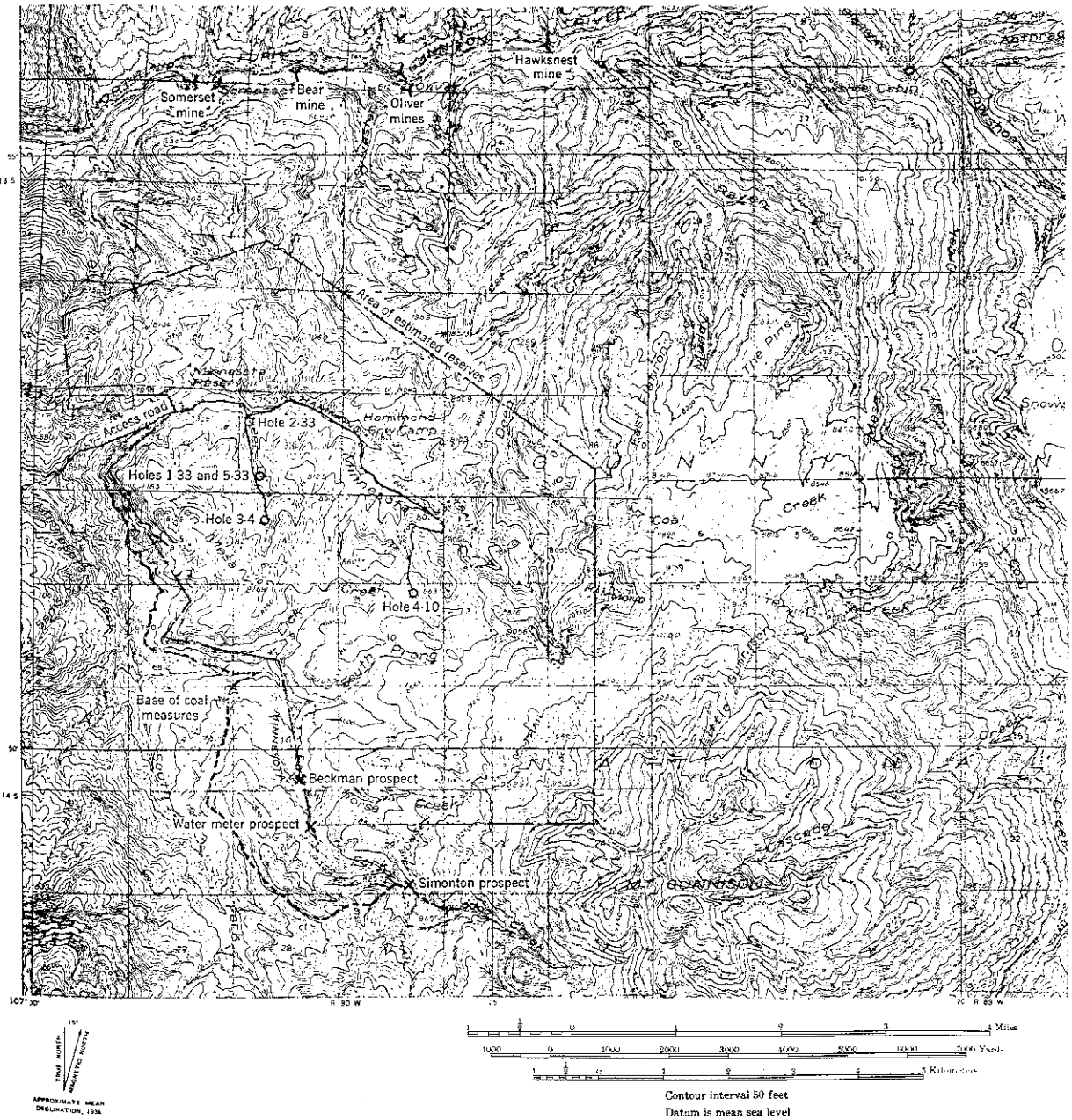

Figure 5. - Minnesota Creek coal area, Colo. (base map, U. S. Geol. Surv., Mt. Gunnison quadrangle.)

Moisture, percent	10.0
Ash, percent	6.6
B.t.u.	12,121

The weighted average oxygen content (moisture-ash-free basis) for cores of all minable beds penetrated is 12.8 percent, whereas 10 percent is usually considered a maximum in metallurgical coking coals. The coal from one bed produced only enough coke for the tumbler test, which showed that this coal produced a coke inferior to coke made from the Lower Sunnyside coal bed in Utah.

Castleman Basin, Maryland

An investigation by diamond drilling in the Castleman Basin, Garrett County, Md., was completed. Forty holes were drilled in an area of about 14,000 acres in the center of this field south of Grantsville and U. S. Highway 40. Estimates of reserves and a final report giving the results of the investigation are in preparation.

Deep River Coal Field, North Carolina

Diamond drilling in the south part of the Deep River field was completed. Two deep diamond-drill holes were completed for a total of 4,682 feet of drilling. The Cumnock bed is the only important coal bed, from a mining standpoint, in this field. This bed was 47 inches thick in the first hole drilled and 41 inches thick in the second hole.

Coal Creek, Gunnison County, Colo.

An investigation by diamond drilling to determine minable reserves of coking coal in the Coal Creek district, Colorado, was completed. Twenty holes were diamond-drilled to obtain 2-1/4-inch-diameter coal cores, and two holes to obtain 8-inch cores for carbonizing tests. The investigation resulted in the development of a reserve of over one hundred million tons of coal, from which can be produced a metallurgical coke considerably stronger than the average coke made from coal from the Lower Sunnyside bed in Carbon County, Utah.

Study of Coking-Coal Reserves

An investigation was begun to determine the known recoverable reserves of coking coal in the United States. The field work consists in obtaining all available data from present and past mining operations, exploration conducted by owners of coal lands, operators of coal mines, and Federal and State agencies. Owners of coal lands and operators of coal mines are contacted to obtain, on a confidential basis, the following:

1. Map of the property.
2. Maps of mines, showing extent of workings.
3. Thickness of the coal beds and location of coal outcrops.
4. Maps showing locations of drill holes.
5. Logs of drill holes, giving bed sections and bed names.
6. Chemical analyses of the coals.
7. Life production of each mine.

Requests for this information have met with the full cooperation of these owners and operators.

From the field data, work maps are prepared from which the average thickness of coal and the remaining coal reserves are computed. Where production for the life of a mine and the average thickness of the coal bed are known, the percentage of recovery from the bed is calculated. Tabulations of recoverable reserves are made by quadrangles and will be reported by counties or other geographical areas in such a manner that data given in confidence by the land owners and operating companies will not be revealed. Reserves are to be reported in two categories - measured (proved) and indicated (probable). In the Appalachian region, minable reserves are to be reported in the following thickness ranges: 14 to 28 inches, 28 to 42 inches, and over 42 inches.

The investigation was begun in the northern Appalachian region because of its importance as a supplier of coking coal, and the work to date has been concentrated in the medium- and low-volatile coal fields in central Pennsylvania, southern West Virginia, and eastern Kentucky.

The first field party of mining engineers began work in the Indiana quadrangle, Indiana County, Pa., in August 1948, and as personnel became available, additional parties were activated. At the end of the year, five field parties were collecting data - two in Pennsylvania, two in southern West Virginia, and one in eastern Kentucky. At the request of the National-Security-Resources Board, one of the field parties in Pennsylvania is working in the Connelsville and Uniontown areas of Fayette and Westmoreland Counties to determine the recoverable reserves of coking coal in these districts that would be available for continued operation of beehive coke ovens in the event of a national emergency.

Mining Methods and Practices

The Coal Industry of Brazil

For some years during and following the war, a vigorous program of technical improvement and production expansion in coal fields of southern Brazil was carried on by the United States Government and the Brazilian Government through the agency of Departmento da Producao Mineral.15/, 16/ This was initiated by the Foreign Economic Administration but subsequently was transferred to the Bureau of Mines.

As a result of concerted efforts in this area, the rate of production in the Santa Catarina field, which produces metallurgical fuel for the national steel industry, was raised from 268,000 tons in 1940 to 980,000 tons in 1946.

Production was increased substantially, also, in the important industrial coal field of northeastern Parana. This field was opened during the war and should become an important source of railway locomotive fuel and general-purpose fuel for the Sao Paulo industrial area.

Technologic improvements included the introduction of pneumatic mining equipment in the Santa Catarina mining field, installation of a modern central preparation plant, marked improvement in railway facilities, and the installation of improved port facilities at Imbituba and Laguna at the Atlantic coast terminal of the Dona Tereza Cristina Railway.

15/ Good, John E., Abreu, Alvaro, and Fraser, Thomas, The Coal Industry of Brazil. Part I. General Economy, Production, and Marketing: Bureau of Mines Tech. Paper 713, 1949, 38 pp.

16/ Fraser, Thomas, Amostragem e flutuacao de carvoes em liquidos pesadoes: Brazil Dept. Nacional da Producao Mineral, Avulso 7, 1947, 59 pp.

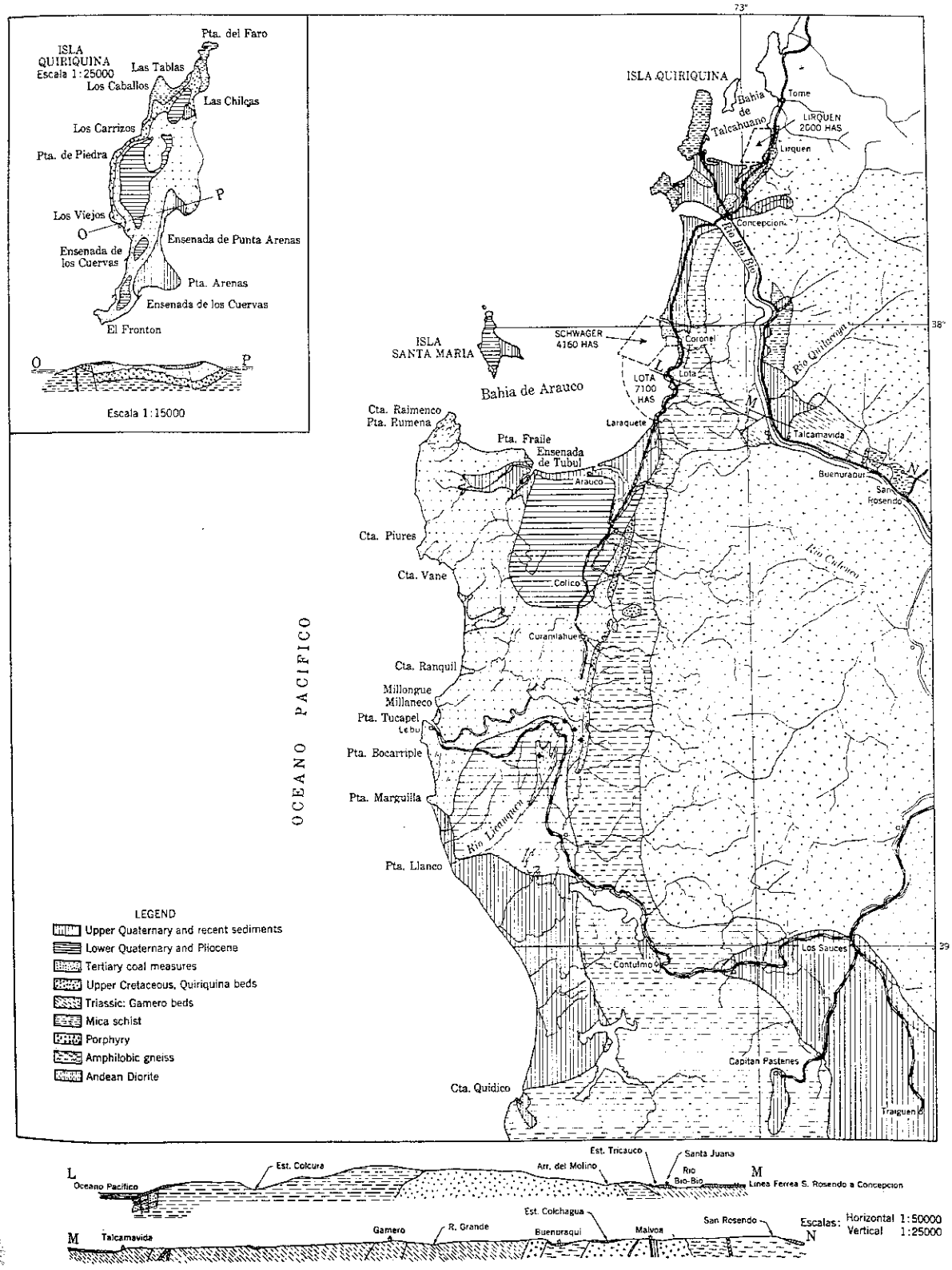

Figure 6. - Geologic map of the Arauco region, Chile.

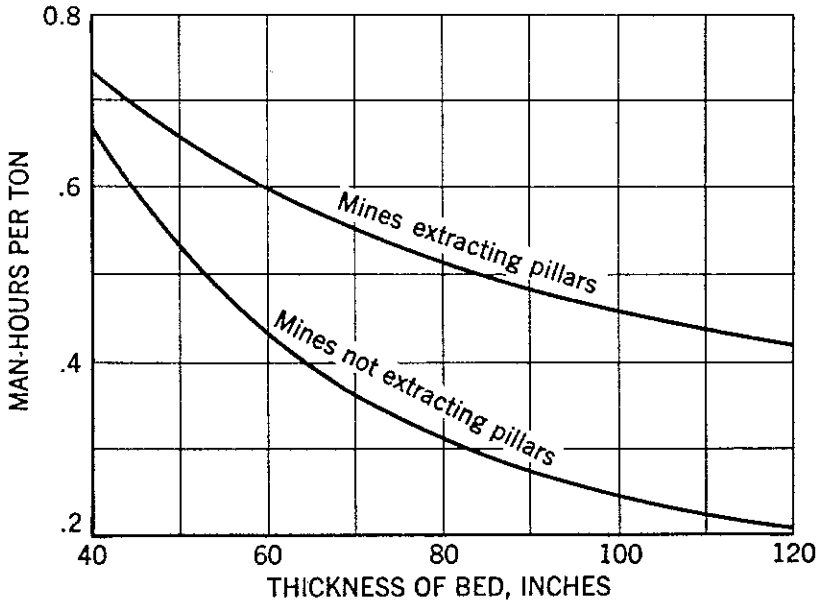

Figure 7. - Relation of man-hours per ton on mechanized units to thickness of bed. Pillars extracted and pillars not extracted. Mobile loading machines. (Man-hours computed from full 7-, 8-, or 9-hour shifts.)