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UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
JAMES BOYD, DIRECTOR

REPORT OF INVESTIGATIONS

INVESTIGATION OF THE W. E. DUNKLE COAL MINE COSTELLO CREEK, CHULITNA DISTRICT, ALASKA

BY

F. A. RUTLEDGE

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By F. A. Rutledge[2]

CONTENTS

INTRODUCTION AND SUMMARY

The W. E. Dunkle mine, sometimes called the Costello Creek coal mine, is 8 miles N. 20° W. of Colorado Station on the Alaska Railroad. The presence of coal in this area has been known since the district was extensively prospected for gold between 1911 and 1915. At that time, coal from this deposit was used by miners for blacksmithing. The increased demand for coal resulting from government defense projects in Alaska led to exploitation of this deposit in 1941.

The inability of Alaska coal mines to supply the quantity of coal required by public and private consumers and by the armed forces in Alaska was responsible for establishment by the Army of the Coal Procurement Section of its Alaska Department. It proposed to investigate the deposits and to expedite production from the Alaskan coal fields. The Bureau of Mines closely cooperated in this program.

The quality of the Dunkle coal and the favorable location of the deposit caused it to be one of the properties chosen for investigation under a joint Army-Bureau of Mines-Geological Survey program.

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgement is used: "Reprinted from Bureau of Mines Report of Investigations 4360."

2/ Mining engineer, Juneau, Alaska.

During July 1943, the coal area in the immediate vicinity of Costello Creek was geologically and topographically mapped by Clyde Wahrhaftig and Jacob Freedman, geologists, U. S. Geological Survey. F. A. Rutledge, mining engineer of the Bureau of Mines examined the property July 18 to 22, 1943, and a project of trenching, diamond drilling, and sampling was initiated on August 4, 1943. During the project Clyde Wahrhaftig remained at the Dunkle mine to interprete drill cores and assist the author in planning the exploratory program. The project was completed October 7, 1943.

ACKNOWLEDGMENTS

Field investigations were under the general direction of R. S. Sanford, acting chief, Alaska Branch, Mining Division. Coal analyses were made by Maurice L. Sharp, coal analyst for the Alaska Railroad.

Special mention is made of the cooperation and assistance received from Clyde Wahrhaftig, geologist, U. S. Geological Survey.

The many courtesies received from the owner, W. E. Dunkle, and the members of the Army Coal Procurement Section, Alaska Department, also are acknowledged.

LOCATION AND ACCESSIBILITY

The W. E. Dunkle coal mine is in the Broad Pass region on the south slope of the Alaska Range at an altitude of 2,800 feet (fig. 1). It is situated within the Third Judicial Division, headquarters of which is Valdez, Alaska. The area is situated approximately at latitude 63° 15' N. and longitude 149° 30' W. and is connected with the Alaska Railroad at Colorado Station by an 11-mile gravel road that is passable throughout the year. This road is maintained by the Alaska Road Commission. A private telephone line to Colorado Station connects with the telephone and telegraph service of the Alaskan Railroad.

The passenger rate from Anchorage, Alaska, to Colorado Station is $12.10. Freight rates are $1.60 a hundred pounds for heavy machinery and $2.66 a hundred pounds for first-class freight.

PHYSICAL FEATURES AND CLIMATE

The Costello Creek coal basin is in an area of low relief and has been dissected by numerous creeks flowing down the south flank of the Alaska Range. The Dunkle coal mine is on Coal Creek, a small tributary of Camp Creek, 1,000 feet from their junction. About 700 feet below this junction, Camp Creek joins Costello Creek, which in turn empties into Bull River 1/2 mile above the latter's confluence with the West Fork of the Chulitna River. The location of the mine is shown on figure 1.

Vegetation in the immediate vicinity of the coal deposit is entirely the low brush, grass, and moss commonly found above timber line in this part of Alaska. In the valleys, below 2,500 feet, spruce and cottonwood large enough for mine timbers may be obtained.

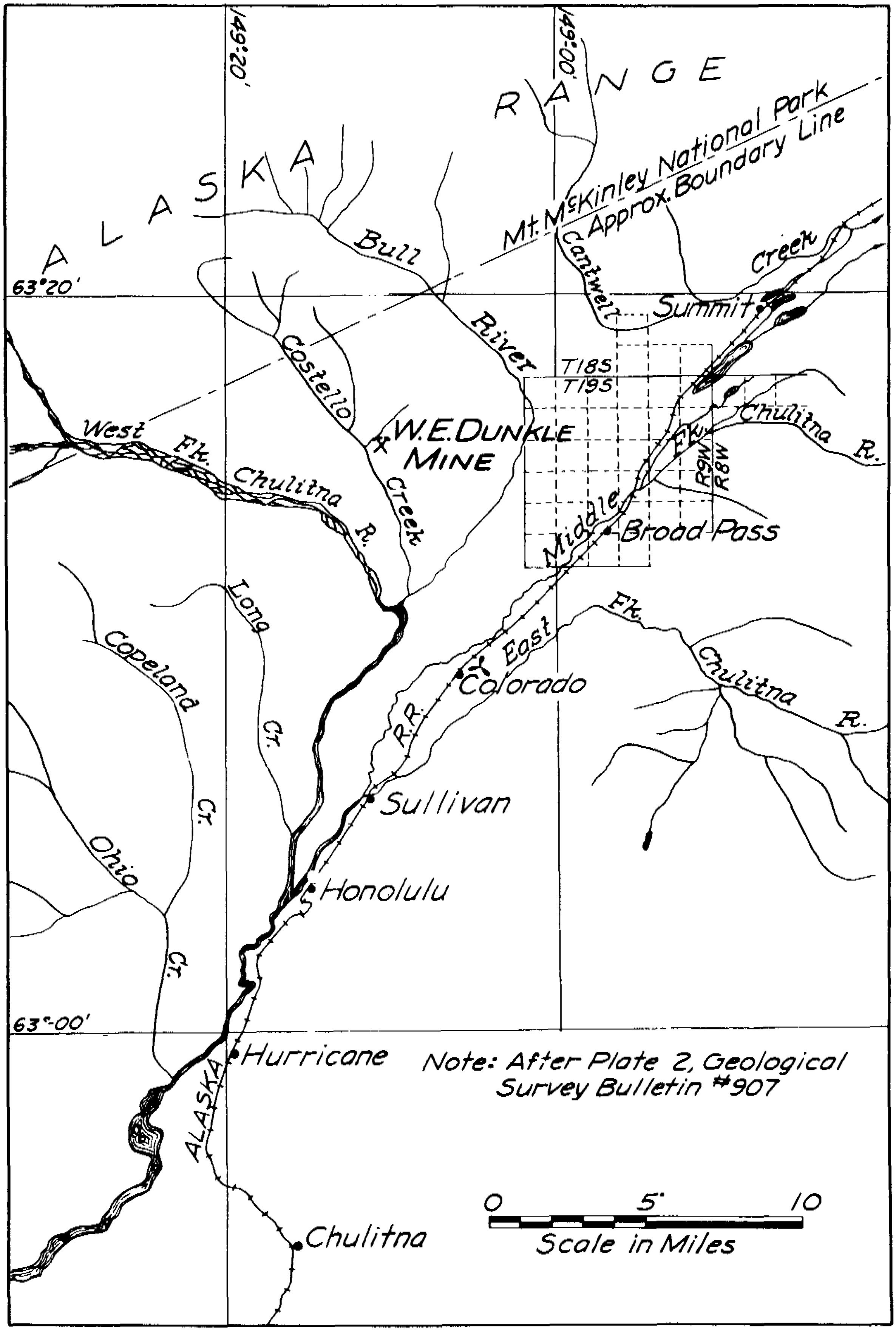

Figure 1. - Location map, W. E. Dunkle coal mine.

Precipitation in this district is approximately 35 inches a year, with snow common from September to June. During the summer months rain and fog occur frequently. Temperature extremes are reported to have ranged from a high of 90° F. to a low of -50° F. The climate is not considered objectionable by interior Alaska standards.

The water supply for the present camp is taken from Coal Creek about 300 feet above the camp. With proper precaution, this stream will serve as an excellent source of all water needed for a small camp.

HISTORY AND PRODUCTION

The earliest mining interest in this district was evinced by placer-gold prospectors in 1907. Although the prospectors were searching for the more readily extractable placer gold, certain lode deposits were recognized. The isolation of the district, however, precluded development of these prospects. Later, from 1911 to 1915, the district was prospected extensively, and it was at this time that the coal beds on Coal Creek were worked by Frank and Lon Wells. Blacksmith coal was obtained from the outcrops for use at their prospect on Costello Creek as well as for other operations on the West Fork of the Chulitna River.

The area was first examined by the Federal Geological Survey in 1917, when Capps3/ reported three coal beds, 6, 5, and 9 feet thick, in descending order, at the present site of the Dunkle mine. During the summer of 1930, Capps4/ made a more extensive survey as a part of his investigation of the West Fork of the Chulitna-Bull River region.

The problem of obtaining and maintaining an adequate supply of coal for the Alaska Railroad has been, prior to the present emergency, of prime concern. In 1930, a special committee of the United States Senate visited Alaska to study some of the railroad's problems, and they later successfully urged Congress to grant $250,000 for the investigation of mineral deposits along the Alaska Railroad. The Federal Geological Survey recommended certain areas for investigation under this act, and in 1931 Clyde P. Ross5/ made a detailed study of the deposits in the vicinity of the West Fork of the Chulitna River, including the coal area on Coal Creek.

The first coal-prospecting permit covering this area was issued to Henry Stevens and Frank Wells on July 13, 1929. It resulted in a small production to meet local needs.

Coal Prospecting Permit No. 09196 was reissued to Henry Stevens April 20, 1939, who transferred it to W. E. Dunkle on September 24, 1941. During

3/ Capps, S. R., Mineral Resources of the upper Chulitna Region, Alaska: U. S. Geol. Surv. Bull. 692, 1919, pp. 231-232.

4/ Capps, S. R., The Eastern Portion of Mount McKinley National Park: U. S. Geol. Surv. Bull. 836-D, 1930.

5/ Ross, Clyde P., Mineral Deposits Near the West Fork of the Chulitna River, Alaska: U. S. Geol. Surv. Bull. 849-E, 1931.

1941 and 1942 approximately 5,000 tons of coal was mined from Entry No. 2 (Dunkle Entry, Dunkle bed) and shipped to markets along the Alaska Railroad. The mine suspended operations March 31, 1943. The Coal Prospecting Permit under which this operation was conducted has expired.

The description of the area covered by Coal Prospecting Permit No. 09196 is as follows:

> Unsurveyed land situated on E. side of Costello Creek, about 50 feet from said creek, on the W. side of Bull River and about 1-1/2 miles from said river. The E. end line of said land is about 5 miles NW. of Broad Pass Station on the Alaska R.R.; the land is situated in the Talkeetna recording precinct, Terr. of Alaska. Said lands are described by metes and bounds as follows: Commencing at W. center end post, from which the discovery post bears due E. 1,000 feet distant, extending thence due S. 3,960 feet to SW. Cor. post; thence due E. 14,080 feet to SE. cor. post; thence due N. 7,920 feet to NE. Cor. post; thence due W. 14,080 feet to NW. Cor. post; thence due S. 3,960 feet to W. center end post, the place of beginning, containing 2,560 acres. (SM)

Under the Leasing act, a royalty of 10 cents a ton is paid the government for all coal produced under permit.

Coal Prospect Permit No. 09196 is now identified as Serial 010280 issued to Dunkle as sole owner, and an application for renewal of this permit is now pending (February 1948). The records of the Bureau of Land Management reflect that favorable action will be had.

GENERAL GEOLOGY 6/

The coal occurs as lenses and discontinuous beds in a series of partly consolidated Tertiary conglomerates, sandstones, siltstones, and shales. The series is unconformably underlain by profoundly eroded, steeply dipping, pre-Tertiary rocks and is unconformably covered by Pleistocene glacial gravels.

The coal-bearing formation is typical of those deposited by low-gradient, sluggish streams in low, basinlike areas and was deposited prior to the rising of the Alaska Range.

Because the beds lie on the margins of the region affected by the uplifting and folding processes, they are but slightly compressed and have gentle dips.

DESCRIPTION OF DEPOSITS

The position and size of the coal beds would indicate that at the beginning of the period of deposition of the Tertiary coal-bearing formation this region was gently rolling to moderately hilly. The pre-Tertiary rocks were thoroughly weathered to a depth in places exceeding 25 feet below the surface.

6/ After Capps, S. R., pp. 272-278 of footnote 4.

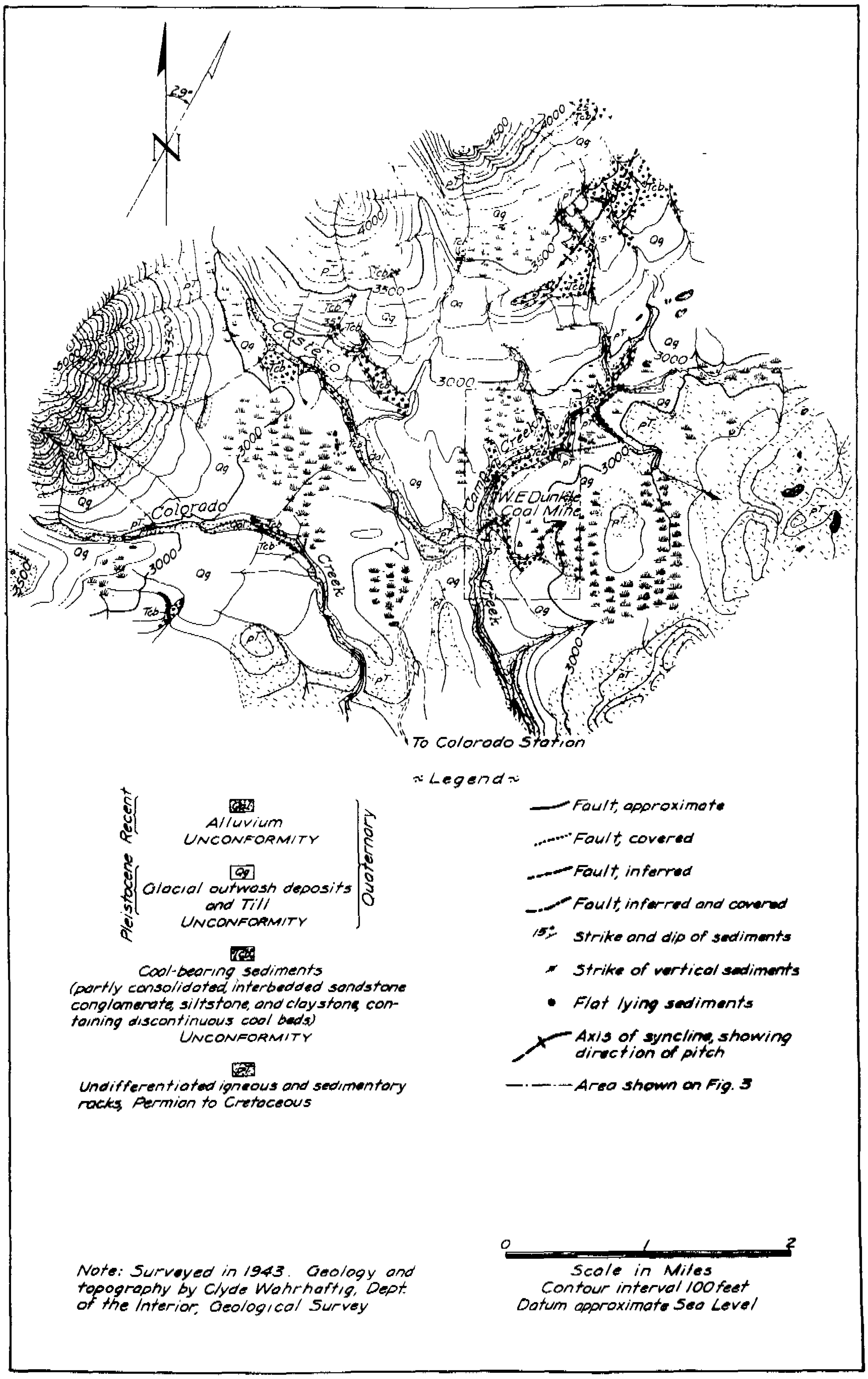

Figure 2. - Geologic and topographic sketch map of Costello Creek coal basin, Alaska.

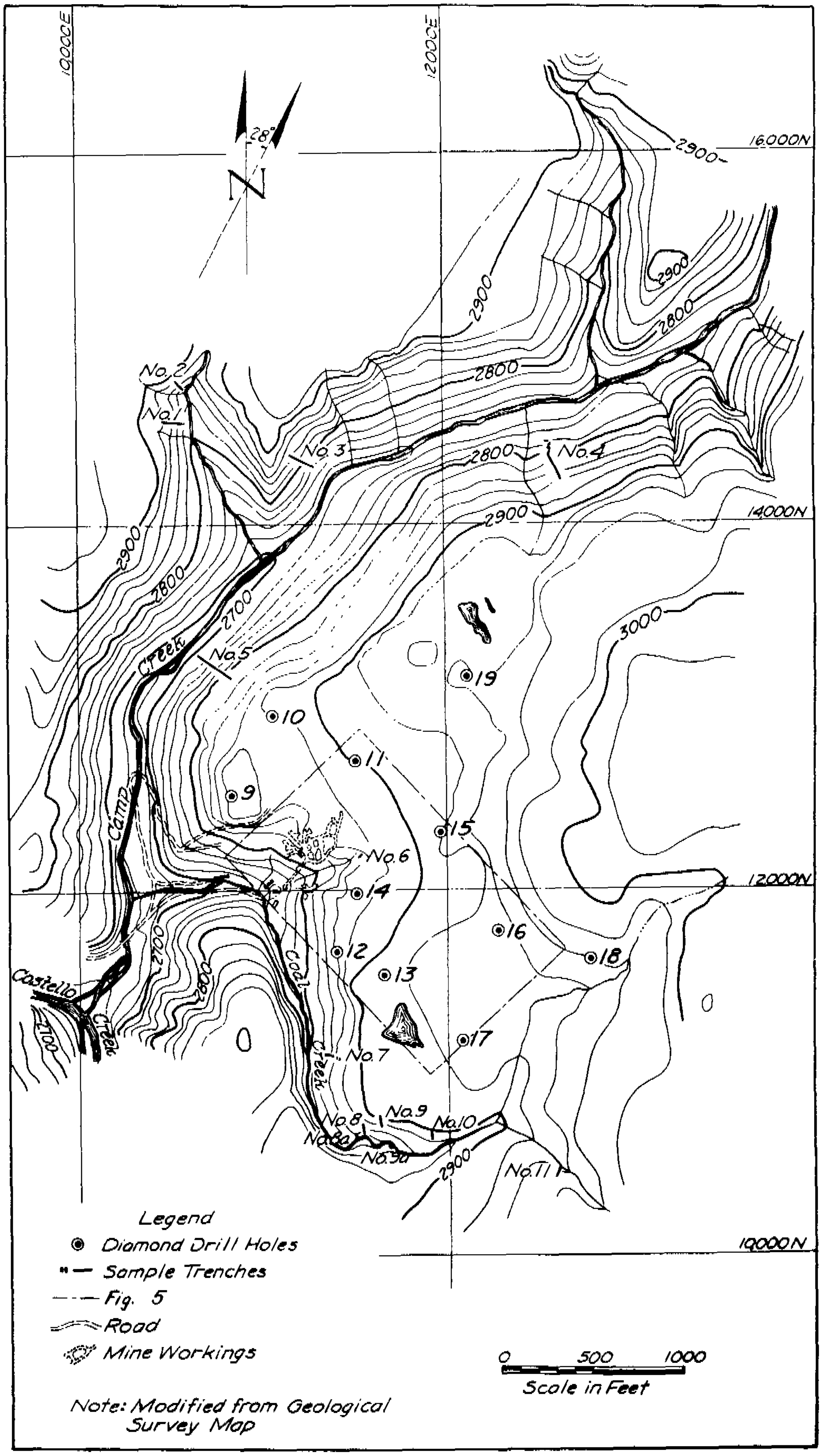

Figure 3. - W. E. Dunkle coal mine.

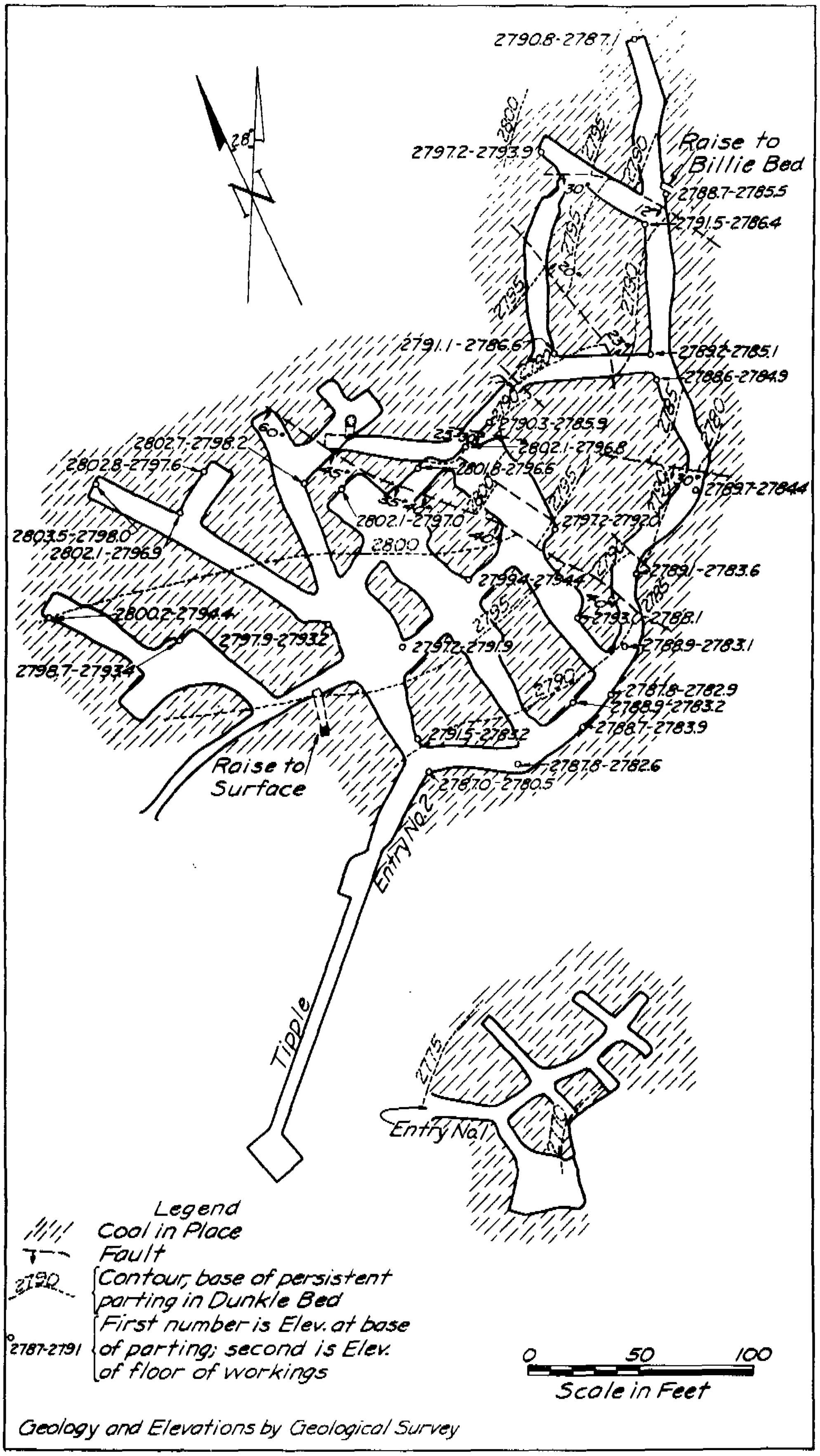

Figure 4. - Underground workings, W. E. Dunkle coal mine.

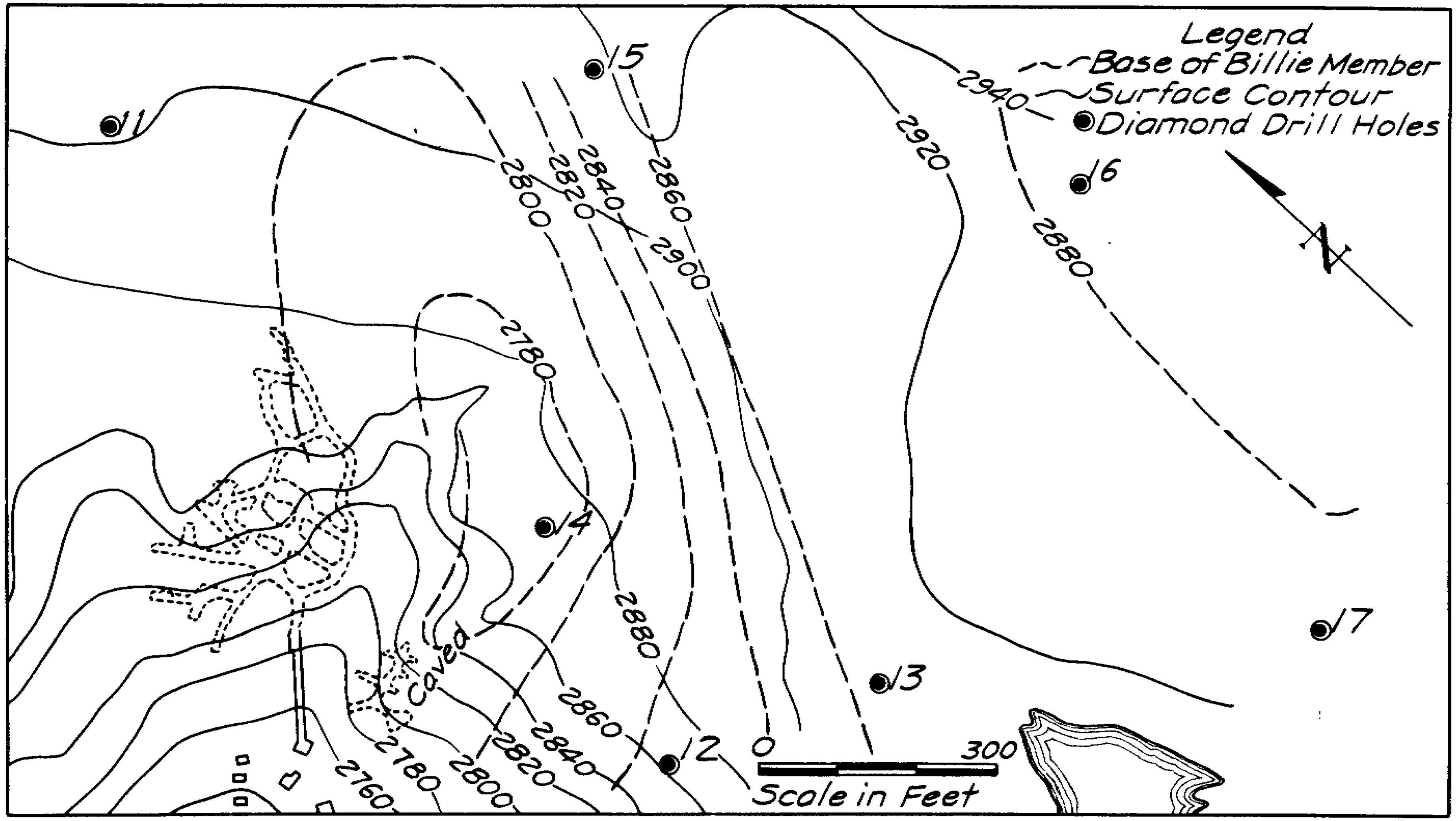

Figure 5. - Structure contour map.

At the base of the Tertiary formation is an unsorted conglomerate consisting of angular fragments in a matrix of brown silt and clay. This conglomerate is occasionally found higher in the section interbedded with coal-bearing material and suggests that the angular fragments were derived from hills that existed close by at the time of deposition. This would explain the occurrence of the coal as discontinuous lenses, interbedded with brown carbonaceous shales, yellow sand, and concretionary beds and formed in a gently rolling area of low relief, as suggested by Capps. The brown silts interbedded with the coal are frequently very carbonaceous, and all rock types, from coal to siltstone with scattered carbonaceous particles, were represented in the core.

Lying above the main coal-bearing formation, and grading into it through a thin series of blue and black clays, is a coarse bluish-gray to greenish-gray sandstone containing numerous moderately well-rounded pebbles of quartz and black argillite. Carbonaceous material and a few thin coal beds are found in this member.

Glacial outwash comprised of coarse gray gravel with interbedded sand and clay beds rests unconformably upon the Tertiary coal-bearing formation. Figure 2 is a geologic and topographic sketch map of the Costello Creek coal basin as prepared by the Geological Survey.

Trenching and diamond drilling at the Dunkle mine revealed three coal beds of minable thickness. These beds are known as the Dunkle, the "Upper", and the "Lower", the latter 2 being subdivisions of an upper member known as the Billie bed. Location of drill holes and trenches is shown on figure 3. The coal sampled in diamond drill hole No. 14 may be either the Dunkle or the Billie bed, but as the upper members of the series should naturally be more continuous, it is assumed to be the Billie bed in calculating coal reserves. The different beds are also assumed to be continuous between holes, and the arithmetical average of the thicknesses is used in calculating reserves.

Four types of structure have resulted from the deformation affecting the coal beds. One of the most important of these is a monoclinal fold that trends approximately N. 28° E. and which passes through the area drilled by holes 12, 13, 14 and 15. This structure lowers the west side of the coal beds with respect to the east. The maximum dip observed in the drill cores was 15 to 20 degrees, but it may be steeper in places not drilled.

Along the base of this monocline occurs a gentle synclinal structure in the area of entries 1 and 2. This is joined near diamond drill hole 14 by a very gentle syncline trending east and west, the axis of which passes through the workings of the No. 1 entry.

The coal-bearing formation is bounded on the southwest by a fault with a vertical displacement of several hundred feet. Other faults with displacements of equal magnitude bound the coal basin on the north and northeast.

Within the present workings are many minor reverse faults with vertical displacements of 6 inches to 10 feet. These faults strike from N. 20° W. to N. 70° W. and dip 20 to 60 degrees. A plan of the present mine workings is shown on figure 4 and a structure contour map of the coal measures on figure 5.

Another feature of structural and stratigraphic control that determines the boundary of the coal is the unconformable overlap of the glacial gravel. On the northwest side of the coal area, the coal beds have been eroded and are cut off at the sloping base of the glacial gravel. This is plainly apparent in the open cut northwest of entry 2. The coal formation dipping gently to the west has, on the east side of the area, again been eroded and is cut off at the irregular base of the Quaternary glacial gravels.

The formations cut by the diamond-drill holes are shown graphically on figures 6 and 7.

CALCULATED COAL RESERVES

Estimation of coal reserves at the W. E. Dunkle mine is difficult. The deposits are small and extremely irregular. Correlation of beds between drill holes is complicated, as indicated when sections through entries 1 and 2, only 120 feet apart, are compared. In hole 14 the only coal bed exposed may be either the Dunkle or the Billie bed, but as the upper members of a coal series are usually more continuous than the lower, it is assumed in the calculations to be the Billie bed. The tonnages for the Billie bed have been separated into an upper and a lower bed, but it is expected they will be mined as one unit. The Dunkle bed exposed in hole 16 has not been included in the reserves, as its detached position precludes mining of this section through the proposed workings.

The areas covered by the coal beds included in the reserves are indicated on figure 8, and the tentative tonnages are given in table 1.

TABLE 1. - Calculation of coal reserves

Bed	Class	Area, square feet	Thickness, feet	Volume, cubic feet	Short tons 1/	Minable tonnage 2/
Dunkle	Measured.......	138,000	6.1	841,800	3/33,670	8,400
	Indicated......	93,625	6.1	571,100	22,840	11,400
	Inferred.......	56,525	6.1	344,800	13,790	6,900
						26,700
Lower Billie	Indicated......	776,000	3.7	2,871,200	114,850	57,400
	Inferred.......	471,000	3.7	1,742,700	69,710	34,900
						92,300
Upper Billie	Indicated......	549,000	4.3	2,360,700	94,430	47,200
	Inferred.......	308,000	4.3	1,324,400	52,980	26,500
						73,700
	Total:					192,700
	Measured.....					8,400
	Indicated....					116,000
	Inferred.....					68,300
						192,700

1/ 25 cubic feet of coal equals 1 short ton.
2/ A mining extraction factor of 50 percent has been assumed.
3/ 50 percent of this amount has either been extracted or left as of pillars.

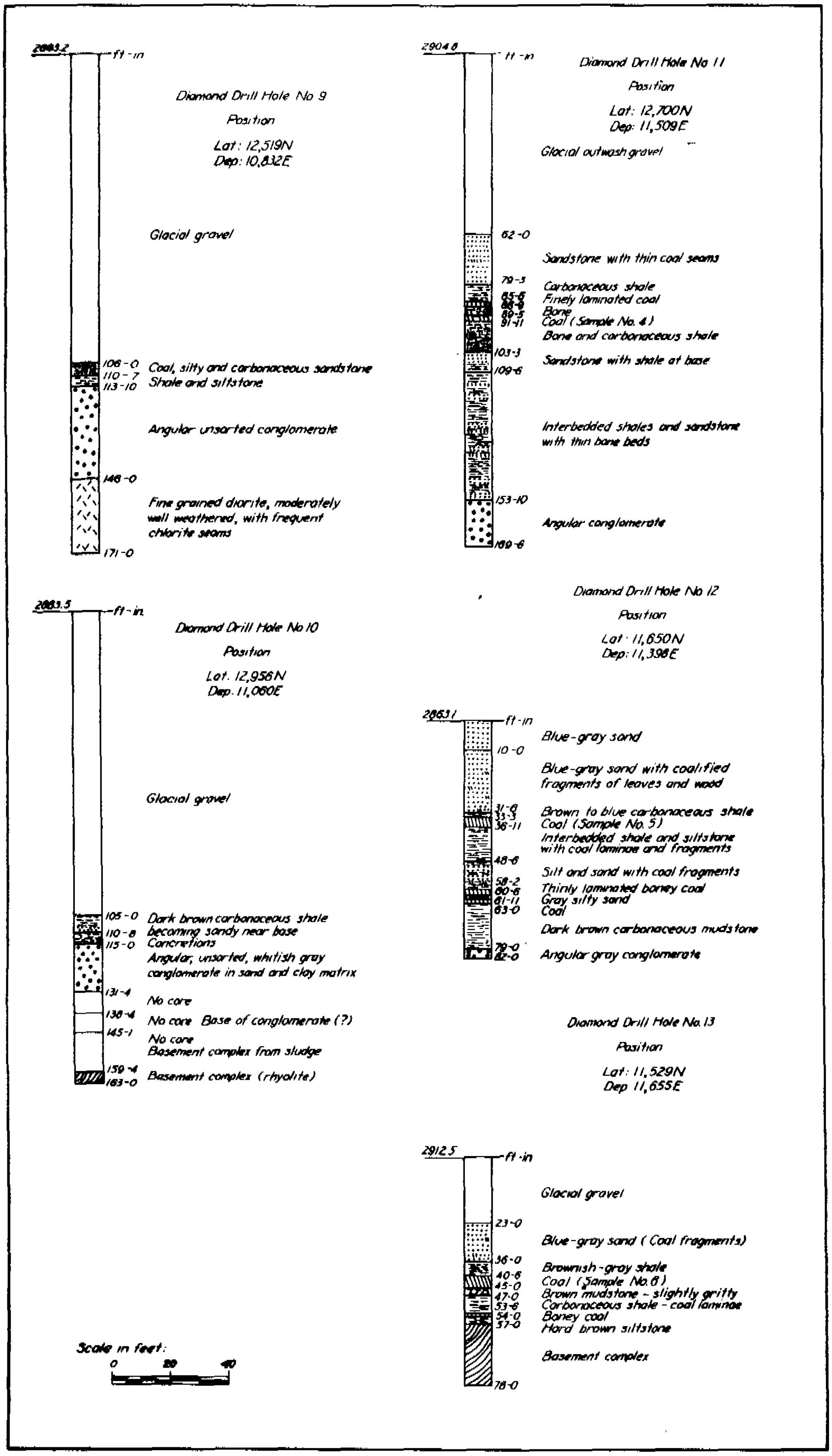

Figure 6. - Drill hole logs.

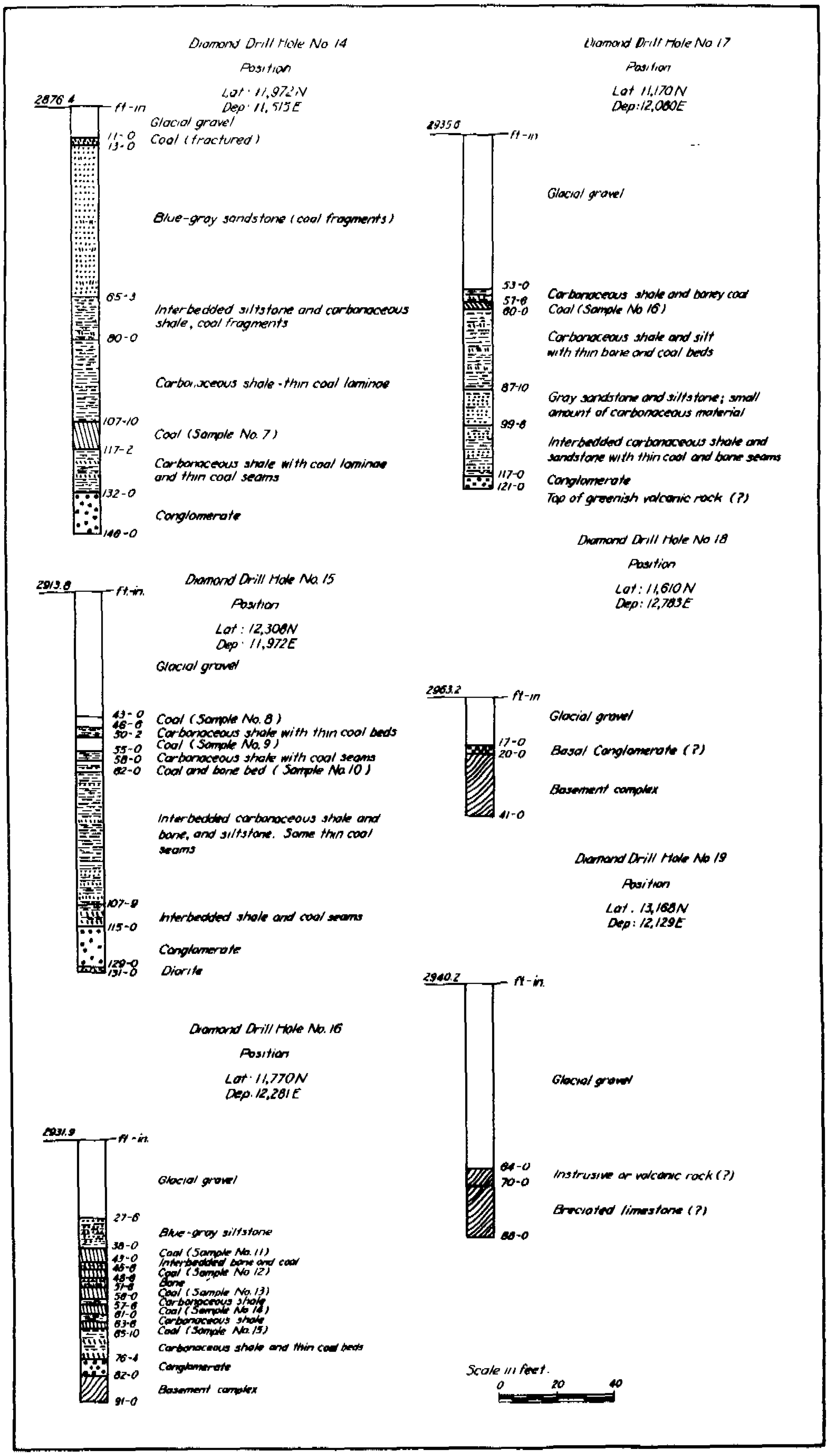

Figure 7. - Drill hole logs.

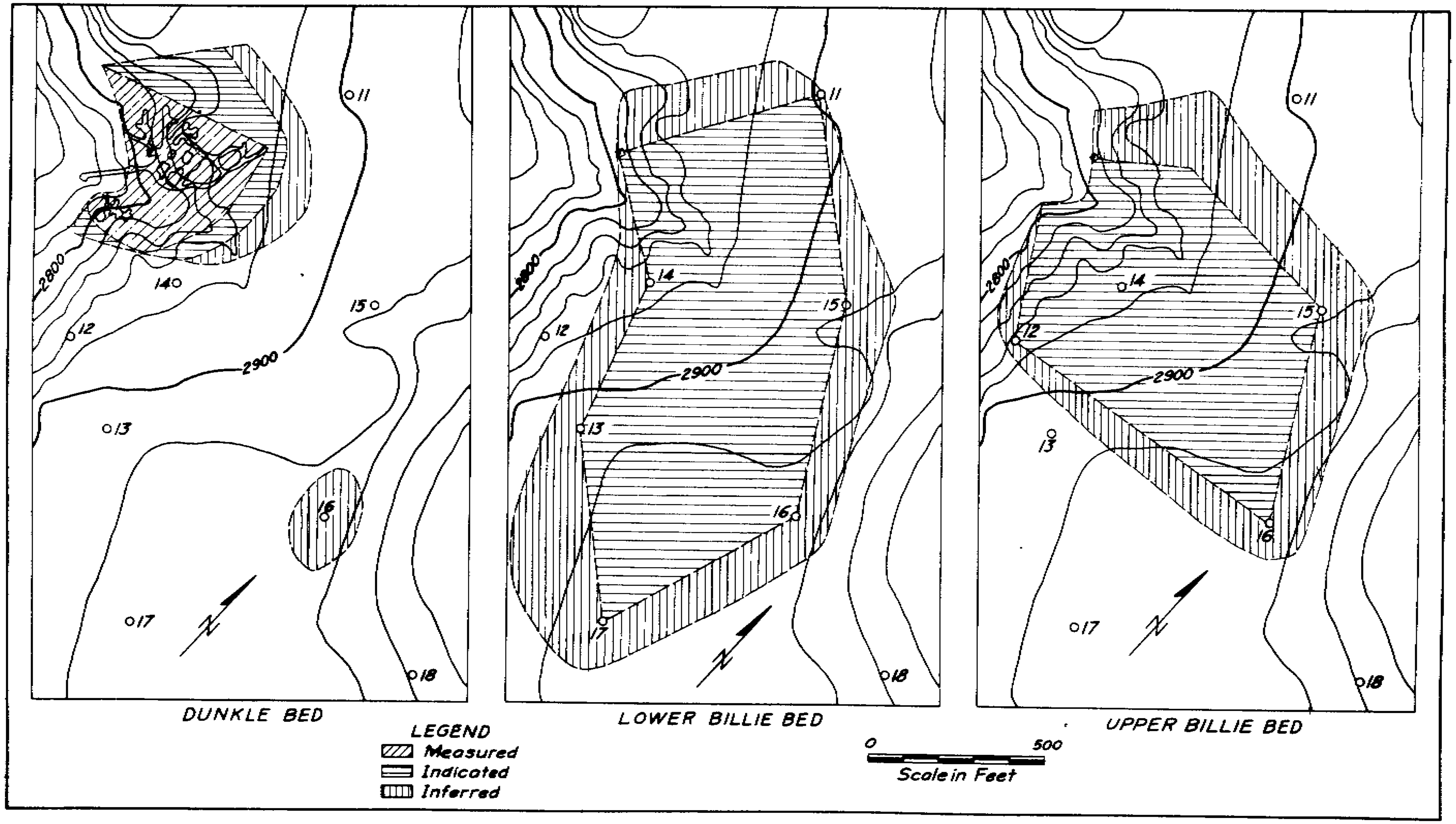

Figure 8. - Coal reserves, W. E. Dunkle mine.

MINE WORKINGS

The principal workings of the Dunkle mine consist of two separate sections shown on figure 4. The original entry was driven by Stevens and is called Entry No. 1 or the Stevens Entry. It is composed of a main entry, several lateral entries, and one room. This section is abandoned at present. Most of the production has been from the second section, through Entry No. 2, the Dunkle Entry, which was driven in 1941. This second section consists of the main entry, counter entry, numerous rooms, and break-throughs. No definite mining system was followed, although the method used is similar to the room-and-pillar system.

PRODUCTS

Analyses of samples taken in the present workings by Garrett[7] and Sanford[8] indicate that the coal is subbituminous and of a good grade. By request of the Army, a steam test of the coal was made by the Bechtel-McCone-Parsons Corp. of Los Angeles, Calif., which indicated the coal to be suitable for domestic and commercial consumption.[7] Results of these tests are as follows:

1. The coal can be burned with virtually smokeless combustion.
2. The coal produces a hot fire and is efficient for boiler operation.
3. The amount of ash and soot is low.
4. The ash and clinkers produced break up readily in normal grate dumping.
5. The clinker is very porous and does not appreciably retard draft.

Analyses of samples taken in the underground workings are given in table 2. These include four samples taken by Garrett that had not been included in his report as the analyses had not yet been received.

This coal is classified as a subbituminous A, having a noncoherent residue (NAa).[9]

7/ Garrett, C. R., Preliminary Report on Costello Creek Coal Mine: Territorial Department of Mines, Territory of Alaska, 1943.
8/ Sanford, R. S., acting chief, Alaska Branch, Mining Division, Bureau of Mines.
9/ Gilmore, R. E., Connel, G. P., and Nicolls, J. H. H., Agglomerating and Agglutinating Tests for Classifying Weakly Caking Coals: Trans., Am. Inst. Min. and Met. Eng., Coal Division, vol. 108, 1934, pp. 255-265.

TABLE 2. - Analyses of mine samples

Sample		Proximate, percent				Ultimate, percent					Calorific value, B.T.U.	Ash-softening temp., °F.	Agglomerating index
		Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen			
Dunkle bed 450 feet from portal, Entry No. 2, at face in haulage way	As-received	18.4	32.0	40.4	9.2	0.6	6.1	55.1	0.8	28.2	9,700	2530	NAa
	Moisture-free		39.2	49.5	11.3	0.8	5.0	67.5	1.0	14.4	11,880		
	Moisture and ash free		44.2	55.8		0.8	5.7	76.0	1.1	16.4	13,380		
Dunkle bed 140 feet from portal, Entry No. 1, 30 feet to face in Room No. 2, north from haulage way	As-received	18.8	33.6	41.4	6.2	0.5	6.3	57.1	0.9	29.0	10,040	2090	NAa
	Moisture-free		41.4	51.0	7.6	0.6	5.2	70.3	1.1	15.2	12,360		
	Moisture and ash free		44.8	55.2		0.6	5.6	76.1	1.1	16.6	13,380		
Dunkle bed 40 feet from portal, Entry No. 2, 120 feet to face in Room No. 1, from haulage way	As-received	15.9	35.9	42.2	6.0	0.5	6.2	59.7	0.9	26.7	10,600	2440	NAa
	Moisture-free		42.7	50.1	7.2	0.6	5.3	71.0	1.1	14.8	12,610		
	Moisture and ash free		46.0	54.0		0.6	5.7	76.5	1.2	16.0	13,580		
Billie bed 40 feet from portal, Entry No. 1, in raise 5 feet above hanging wall of Stevens (Dunkle) Bed	As-received	18.2	34.3	39.9	7.6	0.5	6.3	56.8	0.9	27.9	9,970	2520	NAa
	Moisture-free		41.9	48.8	9.3	0.6	5.3	69.4	1.1	14.3	12,200		
	Moisture and ash free		46.2	53.8		0.6	5.8	76.5	1.2	15.9	13,450		
Dunkle bed 234 feet from portal, Entry No. 2, 12 feet from face	As-received	15.4	37.9	38.0	8.7						9,820		NAa
	Moisture-free		44.8	44.9	10.3						11,605		
	Moisture and ash free		49.9	50.1							12,940		

Analyses of the samples taken by the Bureau of Mines during exploratory work are given in table 3. The location of the samples in the drill holes can be seen on figures 6 and 7.

TABLE 3. - Analyses of trench and drill hole samples

Sample	Location	Bed	Condition[1]	Proximate, percent: Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Calorific value, B.T.U.
2....	Trench 2	Billie (?)	1	12.2	36.6	31.4	19.8	0.4	8,655
			2		41.6	35.8	22.6	0.5	9,860
			3		53.8	46.2		0.7	12,730
3....	Trench 1	Billie (?)	1	15.1	43.4	23.2	18.3	0.4	7,985
			2		51.1	27.3	21.6	0.5	9,405
			3		65.2	34.8		0.8	11,995
4....	D.D.H. 11	Lower Billie	1	12.8	33.1	33.1	21.0	0.5	8,510
			2		38.0	38.0	24.0	0.6	9,760
			3		50.0	50.0		0.8	12,860
5....	D.D.H. 12	Upper Billie	1	10.4	37.1	40.1	12.4	0.6	10,050
			2		41.4	44.8	13.8	0.7	11,215
			3		48.1	51.9		0.8	13,015
6....	D.D.H. 13	Lower Billie	1	8.7	37.7	41.4	12.2	0.5	10,115
			2		41.3	45.3	13.4	0.5	11,075
			3		47.7	52.3		0.6	12,785
7....	D.D.H. 14	Billie (?)	1	8.9	38.9	38.2	14.0	0.4	9,940
			2		42.7	41.9	15.4	0.4	10,915
			3		50.5	49.5		0.5	12,890
8....	D.D.H. 15	Upper Billie	1	10.8	36.4	35.8	17.0	0.3	9,240
			2		40.8	40.1	19.1	0.3	10,360
			3		50.4	49.6		0.4	12,795
9....	D.D.H. 15	Lower Billie	1	10.1	35.5	33.2	21.2	0.4	8,875
			2		39.5	36.9	23.6	0.4	9,870
			3		52.4	47.6		0.6	12,735
10....	D.D.H. 15	Dunkle (?)	1	6.3	27.2	19.0	47.5	-	-
			2		29.0	20.3	50.7	-	-
			3		58.9	41.1		-	-
11....	D.D.H. 16	Upper Billie	1	13.0	36.6	37.2	13.2	0.4	9,635
			2		42.1	42.7	15.2	0.5	11,070
			3		46.9	50.4		0.5	13,055
12....	D.D.H. 16	Lower Billie	1	11.0	38.6	37.1	13.3	0.4	9,820
			2		43.4	41.7	14.9	0.5	11,035
			3		51.0	49.0		0.5	12,970
13....	D.D.H. 16	Dunkle[2]	1	11.2	42.5	35.6	10.7	0.5	10,185
			2		47.9	40.1	12.0	0.6	11,470
			3		54.4	45.6		0.6	13,035
14....	D.D.H. 16	Dunkle[2]	1	11.7	40.9	37.0	10.4	0.5	10,200
			2		46.2	42.0	11.8	0.6	11,565
			3		52.5	47.5		0.6	13,095
15....	D.D.H. 16	Below Dunkle	1	11.0	37.1	38.1	13.8	0.5	9,670
			2		41.7	42.8	15.5	0.6	10,870
			3		49.3	50.7		0.7	12,860
16....	D.D.H. 17	Lower Billie	1	11.7	38.7	37.6	12.0	0.5	9,920
			2		43.8	42.6	13.6	0.6	11,240
			3		50.7	49.3		0.7	13,005

1/ 1, Sample as received; 2, moisture-free; 3, moisture- and ash-free.
2/ These two samples separated by 1.5 feet of parting.