THE ALASKA COAL FIELDS.

By G. C. MARTIN.

INTRODUCTION.

The coal resources of Alaska have been the subject of a large amount of investigation by the Geological Survey in recent years. Since 1902 special coal investigations have been in progress each year and have yielded a fairly accurate knowledge of the more important coal fields. In addition to this a large amount of information concerning coal has been gathered each year since regular geologic work was begun in Alaska, by Survey parties that were working primarily on other problems.

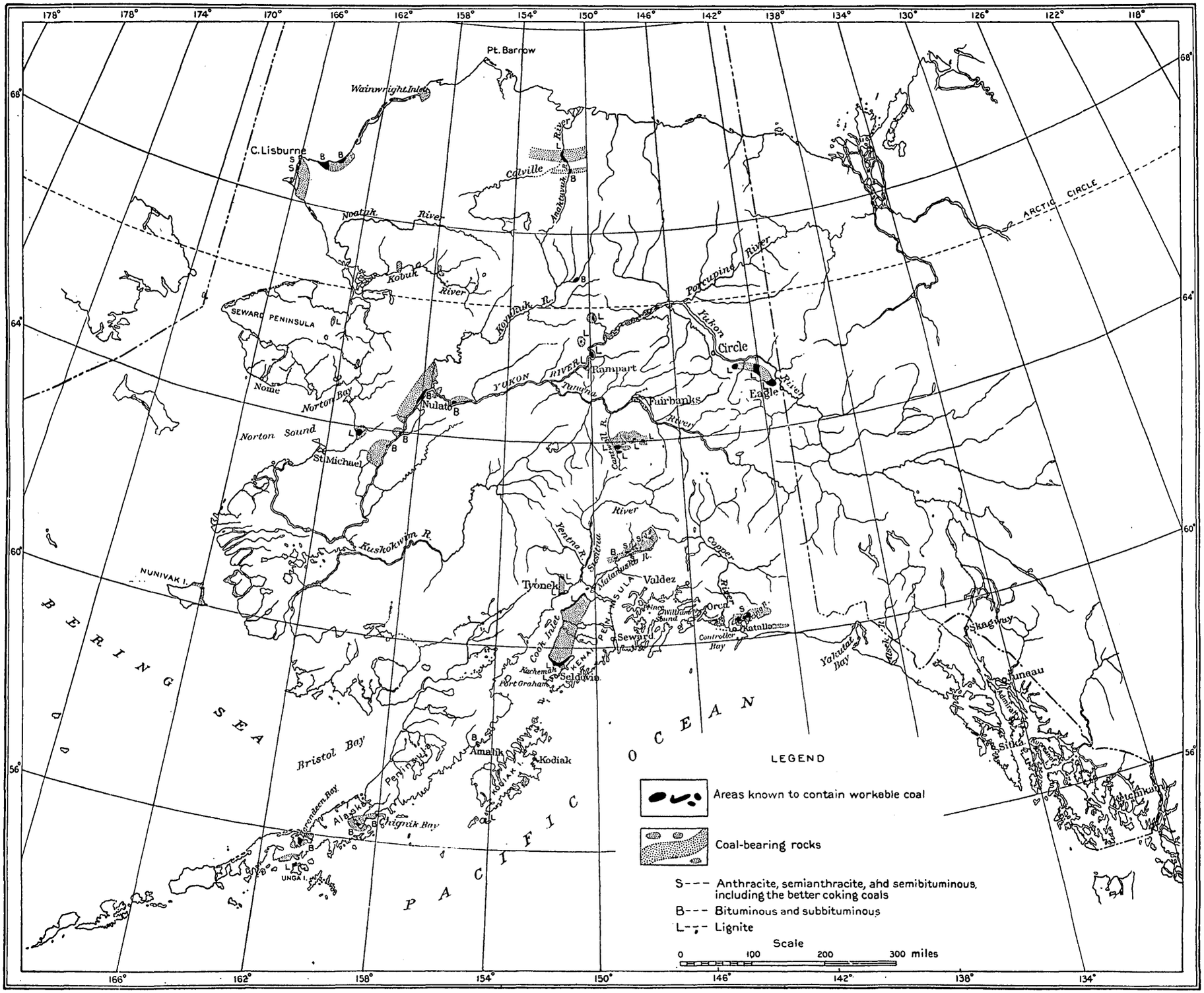
Existing knowledge of the coal of Alaska was summarized by Dall[a] in 1896 and again by Brooks[b] in 1902; but the large increase in detailed information in the last few years makes it desirable to bring together the following brief summary, which will lay greatest emphasis on the larger problems which have recently been or which are yet to be solved. It is not intended to be complete in itself, but is supplementary to the more comprehensive summaries already published and preliminary to more detailed discussions which will be possible on the completion of the investigations now in progress.

DISTRIBUTION AND AREA.

The distribution of the coal fields of Alaska is indicated on the accompanying map (Pl. II), which shows (1) known areas of high-grade coal (anthracite and semibituminous) of workable thickness; (2) known areas of lower grade coal (bituminous and sub-bituminous) of workable thickness; (3) known areas of workable lignites, and (4) areas of coal-bearing rocks. The last item includes those areas which are known to contain some coal but in which beds thick enough to be mined have not yet been discovered; areas in which coal has been authentically reported but concerning which detailed information is lacking, and areas in which the character of the rocks is similar to that in neighboring coal fields and where consequently the occurrence of coal is to be expected. These statements apply also to the subjoined table of areas. The areas mapped as "coal-bearing rocks"

[a] Dall, W. H., Report on the coal and lignite of Alaska: Seventeenth Ann. Rept. U. S. Geol. Survey, pt. 1, 1896, pp. 769-908.

[b] Brooks, A. H., Coal resources of Alaska: Twenty-second Ann. Rept. U. S. Geol. Survey, pt. 3, 1902, pp. 515-571.



MAP OF ALASKA, SHOWING DISTRIBUTION OF COAL AND COAL-BEARING ROCKS, SO FAR AS KNOWN.

are consequently not well defined and must be regarded as subject to considerable changes by subsequent exploration. They are intended to indicate the regions in which new discoveries of coal seem, in the light of our present knowledge, to be most probable. The extent of the various areas noted above, as well as the area of each individual coal field, is shown in the following table, which gives a total of at least 1,238 square miles, or 792,320 acres, of known workable coal and 12,644 square miles, or 8,092,160 acres, of "coal-bearing rocks."

Areas of Alaska coal fields.[a]

	Known coal areas.	Areas of coal-bearing rocks.[b]
Anthracite:	*Square miles.*	*Square miles.*
Bering River	26.4	.....
Matanuska River	4.2	.....
	30.6	.....
Semibituminous:		
Bering River	20.2	620
Matanuska River	20.3	.....
Cape Lisburne	14.2	.....
	54.7	620
Bituminous:		
Matanuska River	22	900
Alaska Peninsula	69	657
Yukon basin	167	2,490
Cape Lisburne	205	1,255
Anaktuvuk River	9	68
	472	5,370
Total anthracite and bituminous	557.3	5,990
Lignite:		
Southeastern Alaska	10	50
Cook Inlet region	304	2,565
Southwestern Alaska	16	300
Copper River	.....	20
Yukon basin	216	1,557
Bering Sea	52	426
Northern Alaska	83	1,736
	681	6,654
Grand total	1,238	12,644

[a] The differences between the areas given here and those published elsewhere are due chiefly to the recognition of four classes of coal instead of three, and the consequent division of the Lisburne areas into semibituminous and bituminous and of the Yukon areas into bituminous and lignite, and of similar changes in other smaller areas.

[b] See explanation on p. 40.

GEOLOGY OF THE COAL-BEARING ROCKS.

The geologic position of Alaska coals is distributed through horizons in the Carboniferous, the Jurassic, the Cretaceous, and the Tertiary. The abundance of the coal and the extent of the areas increase progressively from the older to the younger horizons, reaching their culmination not later than the Miocene.

It should be noted in this connection that the old belief that the age of coal is an index of its quality does not hold uniformly in Alaska or elsewhere. This belief contains a partial truth in Alaska as in other regions, but other factors are always locally of greater weight. The

Carboniferous coals of Alaska are of higher grade than those of the Jurassic or the Cretaceous, and the Jurassic coals are better than some of the Cretaceous coals. The Cretaceous in turn includes some coal which is of better quality than much of the Tertiary coal. Thus far it would seem as if the theory of the increase in quality of coal with its age were supported by the evidence from Alaska. But when the Tertiary coals are considered it is found that they include many beds and considerable areas which outrank in quality all the other coals of Alaska and which are equaled only at a few areas in other regions. The truth of the matter is that the conditions favorable for the formation of high-grade coal, including character of sedimentation and degree of alteration, are dependent on local conditions and are independent of the age of the coal.

Carboniferous coal is known to exist in commercial quantities at Cape Lisburne and smaller amounts are known at other localities. The Carboniferous coal beds at Cape Lisburne are in the lower Carboniferous, which there comprises a lower group consisting of slates, shales, and limestones and containing several coal beds; a middle group of black cherts, slates, shales, and cherty limestones; and an upper group of massive limestones of great thickness, which seem to shade off into massive white cherts. Coal beds of Permian age have been worked near Nation River on the upper Yukon, but they appear to be of slight extent and of little importance, although the quality is good. Rocks of probable Carboniferous or Permian age are known to contain coaly shales and thin coal seams at various localities in the valley of White River and indicate that workable coal beds may yet be discovered in them.

Jurassic rocks have a wide distribution in Alaska, and they are known to be coal bearing in several places. The largest known area of Jurassic coal is at Cape Lisburne, where a horizon of undetermined position in the Jurassic is represented. The Wainwright Inlet coal is probably of the same horizon. At least part of the coal at Herendeen Bay may be Jurassic, though other coal-bearing horizons are represented. The eastern extension of the Matanuska coal field includes large areas of middle and upper Jurassic rocks in which some coal is present.

Cretaceous rocks cover large and widely distributed areas in Alaska and are coal bearing at many localities. Cretaceous coal is present on Anaktuvuk River, a tributary of the Colville, which flows into the Arctic Ocean, in the lower Yukon Valley, possibly at the headwaters of the Matanuska, and at Chignik Bay and Herendeen Bay, in southwestern Alaska. All these deposits except that in the Matanuska Valley represent the upper Cretaceous.

Tertiary coal is widely distributed in Alaska, being known from many localities along the Pacific coast, from the interior, and from the Arctic slope. The position of the coal within the Tertiary is

rather indefinite, the evidence being incomplete and conflicting. The Tertiary coal-bearing rocks on the Yukon rest upon the Cretaceous with an apparent conformity, thus suggesting that the lower beds are basal Eocene or even transitional from the Mesozoic to the Cenozoic. Other evidence, including the relation of the floras of the Kenai formation to those of other regions and the relation of these beds to the overlying Miocene, indicates that the Kenai coal is upper Eocene or Oligocene. The coal floras on Bering River include forms suggesting those of the Kenai and other forms which are strangers to those beds and which Knowlton considers possibly Miocene. Still younger coal occurs at Yakutat Bay, where there are no rocks of Kenai age and where the floras belong very high in the Tertiary. The total evidence thus suggests that the Tertiary coal of Alaska occurs at several distinct horizons.

OCCURRENCE OF COAL.[a]

PACIFIC COAST REGION.

The Pacific coast coal fields are of moderate area but of wide distribution. They include both Mesozoic and Tertiary coals, with the complete range in composition from a good quality of anthracite, through high-grade semibituminous steam and coking coals and ordi-

[a] The following references include the latest and most complete reports on each region. Earlier reports of importance, when referred to in later ones, are not mentioned here.

PACIFIC COAST REGION.

MARTIN, G. C., The distribution and character of Bering River coal: Bull. U. S. Geol. Survey No. 284, 1906, pp. 65–77.

——— A reconnaissance of the Matanuska coal field, Alaska, in 1905: Bull. U. S. Geol. Survey No. 289, 1906, 36 pp.

——— Geology and mineral resources of the Controller Bay region. (In preparation.)

PAIGE, SIDNEY, The Herendeen Bay coal field: Bull. U. S. Geol. Survey No. 284, 1906, pp. 101–106.

PAIGE, SIDNEY, and KNOPF, ADOLPH, A reconnaissance in the Matanuska and Talkeetna basins. (In this volume, pp. 104–115.)

STONE, R. W., Coal resources of southwestern Alaska: Bull. U. S. Geol. Survey No. 259, 1905, pp. 151–171.

——— Coal fields of the Kachemak Bay region: Bull. U. S. Geol. Survey No. 277, 1906, pp. 53–73.

WRIGHT, C. W., A reconnaissance of Admiralty Island, Alaska: Bull. U. S. Geol. Survey No. 287, 1907, pp. 151–154.

INTERIOR REGION.

COLLIER, A. J., Coal resources of the Yukon basin, Alaska: Bull. U. S. Geol. Survey No. 218, 1903, 71 pp.

MENDENHALL, W. C., Geology of the central Copper River region, Alaska: Prof. Paper U. S. Geol. Survey No. 41, 1905, pp. 123–125.

PRINDLE, L. M., The Bonnifield and Kantishna regions. (In this volume, pp. 221–226.)

BERING SEA AND ARCTIC SLOPE.

BROOKS, A. H., Coal resources of Alaska: Twenty-second Ann. Rept. U. S. Geol. Survey, pt. 3, 1902, pp. 515–571.

COLLIER, A. J., Geology and coal resources of the Cape Lisburne region: Bull. U. S. Geol. Survey No. 278, 1906, 54 pp.

MOFFIT, F. H., The Fairhaven gold placers, Seward Peninsula, Alaska: Bull. U. S. Geol. Survey No. 247, 1905, p. 67.

SCHRADER, F. C., Reconnaissance in northern Alaska across the Rocky Mountains, along Koyukuk, John, Anaktuvuk, and Colville rivers and the Arctic coast to Cape Lisburne, in 1901: Prof. Paper U. S. Geol. Survey No. 20, 1904, pp. 106–114.

nary bituminous coal, to lignites of various character. Many of the coal beds are of great thickness, especially where the coal is of high carbonization, but unfortunately the high grade of coal and the great thickness of the beds are as a rule accompanied by an irregularity of the geologic structure that is unfavorable to mining conditions. The Pacific coast coals are in general favorably situated for shipment, and in this respect, as in the character of some of the coal, offer possibilities for a larger, more regular, and wider market than any of the other Alaska coals.

INTERIOR REGION.

The interior region, which is here defined to include the valleys of Copper and Yukon rivers and their tributaries, contains Cretaceous bituminous coal on the lower Yukon and Tertiary lignite and subbituminous coal on the upper Yukon and in the Tanana, Koyukuk, and Copper river basins. None of this coal is suitable for export, but it may be of considerable importance as local fuel.

BERING SEA AND ARCTIC SLOPE.

The coal of the Bering Sea and Arctic slope region includes great range in geologic age and great variety in character. Coal is present in the Carboniferous, Jurassic, Cretaceous, and Tertiary. The Cape Lisburne coal includes Carboniferous semibituminous and Jurassic bituminous, and in the Colville basin Cretaceous bituminous coal and Tertiary lignite are present. The other coal, as far as is now known (except the Wainwright Inlet coal, which is Jurassic), is all lignite of Tertiary age.

It is not likely that any of this coal is of immediate value for other than local use. The high-grade coal at Cape Lisburne may find an extensive market at Nome, but the shipping problems are serious. The other coal is of such character that its market must be restricted to local regions in which the cost of better imported coal is high. It may be of extreme importance and of great value in local operations, but it is not good enough to ship very far from the mines.

CHARACTER OF THE COAL.

The character of the coal in the Alaska fields has been stated in the previously published descriptions of the various fields and has been referred to in the preceding pages. A detailed discussion of this subject is consequently not necessary here. The following table is a summary of all the analyses of Alaska coal which have been made for the Geological Survey, and shows approximately the character and value of the coal from the known areas:

Analyses of Alaska coal.

	District and kind of coal.	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Fuel ratio.
	ANTHRACITE.						
1	Bering River, average of 7 analyses	7.88	6.15	78.23	7.74	1.30	12.86
2	Matanuska River, 1 sample	2.55	7.08	84.32	6.05	.57	11:90
	SEMIBITUMINOUS.						
3	Bering River, coking, average of 11 analyses	4.76	13.27	74.84	7.12	1.51	5.68
4	Cape Lisburne, average of 3 analyses	3.66	17.47	75.95	2.92	.96	4.46
5	Matanuska River, coking, average of 16 analyses	2.71	20.23	65.39	11.60	.57	3.23
	BITUMINOUS.						
6	Lower Yukon, average of 11 analyses	4.68	31.14	56.62	7.56	.48	1.90
	SUB-BITUMINOUS.						
7	Matanuska River, average of 4 analyses	6.56	35.43	49.44	8.57	.37	1.40
8	Koyukuk River, 1 sample	4.47	34.32	48.26	12.95	.....	1.40
9	Nation River, 1 sample	1.39	40.02	55.55	3.04	2.98	1.39
10	Alaska Peninsula, average of 5 analyses	2.34	38.68	49.75	9.22	1.07	1.30
11	Cape Lisburne, average of 11 analyses	9.35	38.01	47.19	5.45	.35	1.24
12	Anaktuvuk River, 1 sample	6.85	36.39	43.38	13.38	.54	1.20
	LIGNITE.						
13	Port Graham, 1 sample	16.87	37.48	39.12	6.53	.39	1.04
14	Southeastern Alaska, average of 5 samples	1.97	37.84	35.18	24.23	.57	1.02
15	Wainwright Inlet, 1 sample	10.65	42.99	42.94	3.42	.62	1.00
16	Colville River, 1 sample	11.50	30.33	30.27	27.90	.50	1.00
17	Upper Yukon, Canadian, average of 13 analyses	13.08	39.88	39.28	7.72	1.26	.99
18	Upper Yukon, Circle province, average of 3 analyses	10.45	41.81	40.49	7.27	1.30	.97
19	Upper Yukon, Rampart province, average of 6 analyses	11.42	41.15	36.95	10.48	.33	.91
20	Seward Peninsula, 1 sample	24.92	38.15	33.58	3.35	.68	.88
21	Chitistone River, 1 sample	1.65	51.50	40.75	6.10	.....	.79
22	Kachemak Bay, average of 6 analyses	19.85	40.48	30.99	8.68	.35	.77
23	Cantwell River, 1 sample	13.02	48.81	32.40	5.77	.16	.66
24	Kodiak Island, 1 sample	12.31	51.48	33.80	2.41	.17	.66
25	Unga Island, average of 2 analyses	10.92	53.36	28.25	7.47	1.36	.62
26	Tyonek, average of 4 analyses	8.35	54.20	30.92	6.53	.38	.58
27	Chistochina River, 1 sample	15.91	60.35	19.46	4.28	.....	.32

1. Bull. U. S. Geol. Survey No. 284, p. 74, analyses 1 to 7.
2. Bull. U. S. Geol. Survey No. 284, p. 98, analysis 1.
3. Bull. U. S. Geol. Survey No. 284, p. 74, analyses 10 to 20.
4. Bull. U. S. Geol. Survey No. 278, p. 47, analyses 13 to 15.
5. Bull. U. S. Geol. Survey No. 284, p. 98, analyses 2 to 17.
6. Bull. U. S. Geol. Survey No. 218, pp. 62, 63, analyses 26, 28 to 38.
7. Bull. U. S. Geol. Survey No. 284, p. 98, analyses 18 to 21.
8. Bull. U. S. Geol. Survey No. 218, p. 62, analysis 28.
9. Bull. U. S. Geol. Survey No. 218, p. 62, analysis 17.
10. Bull. U. S. Geol. Survey No. 284, p. 27.
11. Bull. U. S. Geol. Survey No. 278, p. 47, analyses 1 to 7, 9 to 12.
12. Prof. Paper U. S. Geol. Survey No. 20, p. 114, analysis 607.
13. Bull. U. S. Geol. Survey No. 259, p. 170.
14. Bull. U. S. Geol. Survey No. 284, p. 27.
15. Prof. Paper U. S. Geol. Survey No. 20, p. 114, analysis 653.
16. Prof. Paper U. S. Geol. Survey No. 20, p. 114, analysis 620.
17. Bull. U. S. Geol. Survey No. 218, pp. 61, 62, analyses 3 to 15.
18. Bull. U. S. Geol. Survey No. 218, p. 62, analyses 16, 18, 19.
19. Bull. U. S. Geol. Survey No. 218, p. 62, analyses 20 to 25.
20. Bull. U. S. Geol. Survey No. 247, p. 67.
21. Prof. Paper U. S. Geol. Survey No. 41, p. 125.
22. Bull. U. S. Geol. Survey No. 259, p. 170, analyses 3, 4, 7 to 10.
23. Bull. U. S. Geol. Survey No. 218, p. 62.
24. Bull. U. S. Geol. Survey No. 259, p. 170.
25. Bull. U. S. Geol. Survey No. 259, p. 170.
26. Twentieth Ann. Rept. U. S. Geol. Survey, pt. 7, p. 23, analyses 1 to 4.
27. Prof. Paper U. S. Geol. Survey No. 41, p. 124.

DEVELOPMENTS AND PRODUCTION.

The coal-mining industry of Alaska is still in a practically undeveloped condition. Coal has been mined intermittently and on a small scale at several places for many years, but the industry has never been

of much importance. This has been because the better coal has not been well known until recently and can not be shipped without railway connections from the mines to tide water, and also because no adequate provision has been made for granting title to sufficient tracts to assure profits on the large investments which are required.

The most active mining operations have been on Cook Inlet, in southwestern Alaska, on the Yukon, in Seward Peninsula, and at Cape Lisburne. All of these were for the purposes of local fuel on small coastwise or river steamers, at mining camps, and at canneries.

The amount and value of the coal produced in the last ten years are stated in the following table:

Production of coal in Alaska, 1897–1906.[a]

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1897	2,000	$28,000	1902	2,212	$19,048
1898	1,000	14,000	1903	747	6,582
1899	1,200	16,800	1904	694	1,725
1900	1,200	16,800	1905	3,774	13,250
1901	1,300	15,600	1906	6,600	20,000

[a] The production for 1897, 1898, and 1906 is estimated. That for the other years is according to returns from the operators as published in Mineral Resources of the United States. These figures are known in some cases to be considerably below the true production, several operators not having reported at all.

The most important developments which are now going on are preparatory to mining the high-grade Matanuska and Bering River coal on a large scale for shipment away from the coal fields. These coals are adapted to use [a] on ocean steamers and railways and for the manufacture of coke, and for other purposes for which high-grade coal is required. Before they can be mined it will be necessary to build about 150 miles of railroad [b] to reach the Matanuska coal, and from 25 to 100 miles (according to the harbor chosen) to reach the Bering River coal. It is believed that either of these projects is legitimate, and that if favorable title can be obtained both fields will be producing on a large scale within a few years. Railroads are now under construction to both these fields.

The coal of the interior and northern parts of Alaska will probably be dependent on local demands [a] for its market as long as better coal remains nearer the seaboard. These local markets will depend chiefly on mining camps and will be transient or permanent according to whether the mining camps are placer or lode. Such coal fields of the interior as may be on the line of railroads or near lode mines, especially if the ores are smelting ores and the coal capable of coking, will attain considerable importance, but these conditions are contingent on future discoveries and developments which can not be foretold.

[a] Martin, G. C., Markets for Alaska coal: Bull. U. S. Geol. Survey No. 284, 1906, pp. 18-29.

[b] Brooks, A. H., Railway routes: Bull. U. S. Geol. Survey No. 284, 1906, pp. 10-17.