[redacted]

MR-195-25

DEPARTMENT OF MINES
RECEIVED
JUNEAU, ALASKA

COPY

January 6, 1943.

MEMORANDUM TO Dr. A. C. Fieldner: - From S.A.Ash.

SUBJECT: Alaska Coal Situation.

As stated to you verbally, the results of my visit to Alaska were not very fruitful insofar as yielding data on the subject of coal through personal observation of the coal beds other than what could be observed in present mine workings in the Healy and Matanuska coal fields.

The main reason for this with particular reference to the Roth prospects, where cannel coal is said to exist, was due to the intense cold weather and other factors incident to the winter season in these parts of Alaska.

The temperature on my arrival at Fairbanks was 35° below zero and during my stay ranged from 38° to 53° below zero being more oftenbetween 40° and 50° below zero.

While en route to and from Alaska, I contacted Dr. H. F. Yancey at Seattle and we discussed matters relating to the coal situation.

On arrival at Fairbanks on December 7th I met Mr. Harry F. Kasee of the Safety Division who accompanied me to the office of Mr. Doheney, mining engineer for the R.F.C. I met Mr. Robert S. Sanford who happened to be in Mr. Doheney's office in the Federal Building at Fairbanks. I discussed the purpose of my visit with Messrs. Sanford and Doheney and learned from Mr. Sanford that he had not received the letter of November 19 and 21 addressed to him from Washington and he made copies of these letters from the copies I had brought along.

It developed that Mr. Doheney, who is a mining graduate of the Alaska University, had visited the Roth prospect some years ago and his observations were contradictory to those he states were in a report by Mr. Ernest F. Patty, a mining engineer at one time connected with the University of Alaska. I know you understand that what I have to say regarding the difference of opinions regarding Mr. Patty's report are what I was told and not from personal observation. Apparently Mr. Patty's report would indicate the presence of cannel coal in some amount, while on the other hand, from conversations with Messrs. Doheney, E. D. Stewart and Maurice Sharp, who have all visited the area, just the opposite is indicated.

Doheney stated that the coal bed in question lies in a synclinal basin with rather steeply inclined limbs outcroping in a steep hillside of the riverbank. The trough lies near the water's edge and it was at this point that the samples were taken that were used by Mr. Patty and the section covered by the sampling is questionable, except that it was confined to the trough. Doheney states that to sample the exposures on the limbs it would be necessary to use ladders or ropes and that about 100 feet up on each limb there is no evidence of cannel coal and that the best is very bony. It appears that the cannel coal lenses are concentrated in the trough section only.

The statements made by Mr. Dohoney are also confirmed by Mr. E. D. Stewart, who spent some time with Mr. J. J. Corey, formerly of our Bureau in this area and at the same time as Mr. Patty was in the area concerned. Mr. Stewart's statements give no support whatsoever to Mr. Patty's observations while just the opposite is indicated. Furthermore, one might question Mr. Patty's veracity in this instance as it appears he had some personal interest in having this coal area developed and as a result is said to have lost his job.

It is stated by Messrs. Kazee, Dohoney, Stewart and Sharp that it was physically impossible to visit the area at this time and certainly none of them would consent to go along. The trip would necessitate a 24-mile journey over snow in low sub-zero weather and crossing a glaciated river several times. Special winter traveling and camping equipment would be required and at this time of the year, and under the circumstances, the prospects could not be located even by anyone familiar with the area.

I called at the office of Mr. Sharp at Anchorage and during our discussion I gathered that the cannel coal theory in the Roth section at least was not indicated by the facts at hand. He seemed to be more in favor of the lignite area farther to the north and towards Fairbanks.

Mr. Kazee and I visited the Jonesville mine in the Matanuska area. At the time of our visit the mine was having labor difficulties and the miners had been out on strike. The bunkhouse had burned to the ground a day or so before our arrival. This left meager housing facilities congested. On account of the labor difficulties the Superintendent, Mr. Fiedler, was involved in a meeting with Lt. Rash, coal procurement representative of the Army, in connection with the possibility of taking military measures. Lt. Rash desired to go underground and Mr. Evan Jones, mine foreman, accompanied him. The time, occasion, and circumstances were of such a nature that I did not consider it wise to become involved in what looked like a rather unhealthful situation. I spent the time available with Mr. Fiedler, but did not the opportunity to hastily observe the surface layout before the train left for Eska, which was not reached before nightfall and we had 2½ miles to hike in darkness in 35° below-zero weather to reach our car left near the highway. I believe Yancey's date will yield you information regarding Matanuska.

I observed that the washery equipment at Eska was still uncrated and lying on the snow-covered ground. If labor is short in the States it is more so in Alaska.

As you are aware, and from information given to me by Sanford, they are diamond drilling at Moose Creek to determine the possibilities in the Buffalo-slope section. A section of the railroad to the mine was washed out at the time of my visit and there was no rail travel.

There is considerable controversy concerned with the development of the W. E. Dunkle Coal Company, Costello Creek Mine, the development of which revolves around a R.F.C. loan of some $125,000, which has been turned down I understand, by Lt. Stull. This matter appears to be rather unsavory and controversial and is one of the matters being investigated by a private mining engineer, Neil Robinson of the consulting engineering firm of Stuart, James and Cooke of Charleston, West Virginia. This investigation of the Alaska coal situation, I am informed, is being

done at the request of the Army from Washington. I have the feeling that I will have a call from Mr. Robinson, but if now, in due time will hear more of this investigation. In any event, I agree with Sanford that some drilling, probably churn drilling, be done now and later on in any event diamond drilling should be done to determine the future possibilities of this area.

I visited the Suntrana mine in the Healy River district and investigated the fire now hampering mining operations. If the recommendations made by Messrs. Stewart, Kazes and myself are carried out, there is no good reason why this mine should not and could not secure normal production.

In order to answer satisfactorily and in detail all of the questions appended to the letter of November 21, it would be necessary to visit the Alaska coal areas in question during the late spring or summer season, and frankly if an action program is contemplated, this should be done, and I believe that Yancey, Sanford and I could do an acceptable job. My trip at least demonstrates the futility of such an investigation during the winter months. However, I believe I can give some answers that indicate that further study would prove to be not too far afield.

Production figures at present available show that any program contemplating a daily production of 2000 tons means practically starting from scratch and confirm figures given to me by Mr. Stewart in that the present daily production of about 600 tons per day, on a 25-day month or a 300-day year, is practically within the present demand of about 620 tons.

The following is production data on the active code member producers in Alaska, namely:

Healy River Coal Co., Healy Coal Mine, Healy River Valley, Suntrana mine
Evan Jones Coal Co., Jonesville Mine, Jonesville
Anchorage Coal Co., Premier Mine, Premier
W. E. Dunkle Coal Co., Costello Creek Mine, Colorado Station

The tabulation does not include the Eska mine operated by the Government.

1942 - PRODUCTION TO LAST DATE REPORTED

	Healy River Coal Corp.	Evan-Jones Coal Co.	Anchorage Coal Co.	W. E. Dunkle Coal Co.	TOTALS
1942					
Jan.	12,732	6,788	241	none	19,761
Feb.	9,979	7,448	179	431	18,037
Mar.	8,314	7,476	382	778	16,950
Apr.	9,690	6,821	779	623	17,813
May	10,912	4,126	1,010	no. prod.	16,048
June	10,950	3,326	1,000	"	15,276
July	13,166	3,660	629	"	17,455
Aug.	14,914	1,853	842	"	17,609
Sept.	11,637	5,716	475	10	17,836
Oct.	439	rep.not recd.	481	none rep.	920
TOTALS	102,633	47,214	6,016	1,842	157,705
average per mo. (9 mos.)	454	209	27	8	697

The foregoing data was furnished by Jas. L. Ash, Secretary, Bituminous Coal Producers Board for District No. 23, 2010 Smith Tower, Seattle, Washington.

The following tabulation of production at the Eska mine, which is operated by the government (Alaska Railroad) was furnished by H. I. Smith, U.S.G.S.

Production of Eska mine, January - August, 1942:

	Jan. 4307.7	tons
	Feb. 4879.7	"
	Mar. 4347.9	"
	Apr. 3829.6	"
	May 3707.3	"
	June 4254.9	"
	July 4930.7	"
	Aug. 4995.2	"
Total (8 mos.)	35453.0	"
Average daily production	178.0	"

From the foregoing data it is observed that the average daily production from all mines during the first nine months of 1942 was about 875 tons. It is also indicated, considering the high months at the present operations, that it is possible to produce 1000 tons daily, under conditions and markets that have existed during the past year. Considering a demand of 650 tons daily would mean an additional mining of about 1850 tons to furnish 2000 tons for hydrogenation purposes if productio from all mines is considered.

Considering the questions set forth in your letter of November 21, 1942:

Question 1 - Is there enough coal for the development of a mine or mines in the Matanuska or Chickaloon coal fields to produce 2000 tons of high-volatile bituminous coal perday for a period of at least five years?

The present possible production from the Matanuska and high-volatile bituminous area is about 450 tons daily. The proven area lies principally at Jonesville. To increase the production with dependability would lie largely with this operation, as Eska is a railroad operation, and in all probability its output would be consumed by this agency. Furthermore, the requirements of the towns of Anchorage and Matanuska Valley and the Army need the production of this area. On the other hand, the Army requirements in the coastal area can and are being supplied to some extent by ships from the states. It would appear to me that a 2000-ton daily production would have to be obtained in addition to that from the present operations in the bituminous coal area. The Moose Creek area is in the prospective stage and I am not informed on the Premier mine. I believe an additional 1000 daily production for at least a five-year period could be safely projected, and I would hesitate to be committed beyond this figure without further study on the ground. Mining costs in this area are very high at the present time and from what I could ascertain are about $6 per ton. Coal should be produced for no more than $3.50 to $4.00 at the mine. To provide mines in this area would require an investment of from $5.00 to $10.00 per

ton-year.

Question 2 - Same question for subbituminous coal in Healy River field?

I believe there is sufficient coal proven in the Healy River field for the development of mines in the Healy River area to produce 2000 tons of coal per day for a period considerably in excess of five years.

The cost of the mines would be from $2.00 to $5.00 per ton-year.

Question 3 - Same question for cannel coal in Healy River District or elsewhere in Alaska?

There is no authentic evidence to indicate that cannel coal exists in any amount that would indicate the possibility of a mine that could produce cannel coal in any amount, if at all.

Question 4 - If the coal is available and approval is given to the project on January 1, 1943, how soon after this date could the mines be developed and put into operation?

Under normal conditions such mines should be developed and put into operation in about five years. To maintain production would require an expenditure of about 30 cents per ton as a charge against development during regular mining operations.

Question 5 - What is/rough estimate of the cost of the mines?

The cost of the mines would vary from $2.00 to $10.00 per ton-year, or for 600,000 tons yearly an average initial figure of $3,000,000 would be required.

There are several factors that may have an important bearing on locations for hydrogenation plants and I believe that before satisfactory mining costs and layouts can be obtained, there must be some rather radical departure from the hand mining methods now in use to mechanized methods. The operating officials now in Alaska come from the pitching sections of western Washington or are following methods learned in Alaska, except for Evan Jones and even his principal experience has been gained in areas where spontaneous combustion and fires are of infrequent occurrence and not due to mining systems.

It is realized that the lignite areas would have to produce more coal than in the bituminous areas. On the other hand, mining costs are or should be lower and production more easily obtained.

Spontaneous combustion is naturally inherent to the lignite or subbituminous areas while the dump at Jonesville indicates that the coal here does not readily fire. The requirements for oil indicate a preference of locations in the subbituminous area, not overlooking the Richardson Highway connecting with the Alcan Highway.

I believe the attached cost figures, which I know are accurate, should give an idea as to costs that could be obtained in Alaska. The costs of King County, Washington, can be applied for the subbituminous areas, while those of Pierce County

are applicable to the bituminous area.

Attached herewith is a letter received today from Mr. B. D. Stewart.

(sgd) S. A. Ash, Chief,
Metal and Non-Metallic Mining Section,
Mineral Production Security Division.

Typical Mining Costs in King County, Washington

	Cost per ton (a)	Cost per ton (b)	Cost per ton (c)	Cost per ton (d)	Cost per ton (e)	Percentage of total cost (a)	Percentage of f.o.b. mine cost (e)
I. DEVELOPMENT							
Labor	$0.210	$0.210	$0.210	$0.210	$0.210		8.02
Timber	0.028	0.030	0.030	0.030	0.030		1.15
Other material	0.062	0.060	0.060	0.060	0.060		2.29
Total	0.300	0.300	0.300	0.300	0.300	8.77	11.46
II. MAINTENANCE							
Labor	0.135	0.163	0.214	0.135	0.149		5.69
Timber	0.026	0.025	0.023	0.020	0.023		0.88
Other material	0.090	0.045	0.043	0.045	0.045		1.72
Total	0.251	0.233	0.280	0.200	0.217	6.31	8.29
III. DRAINAGE							
Labor	0.010	0.056	0.041	0.040	0.040		1.52
Material	0.002	0.003	0.002	0.002	0.002		0.09
Total	0.012	0.059	0.043	0.042	0.042	1.21	1.61
IV. VENTILATION & LIGHT							
Labor	0.059	0.100	0.075	0.070	0.070		2.67
Material	0.021	0.028	0.011	0.015	0.021		0.80
Total	0.080	0.128	0.086	0.085	0.091	2.64	3.47
V. Mining							
Labor	0.875	0.873	1.040	0.942	0.940		35.91
Timber	0.066	0.102	0.118	0.070	0.087		3.32
Other material	0.218	0.050	0.027	0.220	0.129		4.93
Total	1.159	1.025	1.180	1.232	1.156	33.63	44.16
VI. HAULAGE							
Labor	0.213	0.300	0.310	0.208	0.258		9.86
Material	0.048	0.023	0.019	0.020	0.028		1.07
Total	0.251	0.323	0.329	0.228	0.286	8.36	10.93
VII. PREPARING & LOADING							
Labor	0.130	0.080	0.173	0.103	0.122		4.66
Material	0.025	0.013	0.027	0.010	0.019		0.72
Total	0.155	0.093	0.200	0.113	0.141	4.12	5.38
VIII INTERDEPARTMENTAL							
Labor	0.100	0.110	0.130	0.060	0.100		3.82
Material	0.020	0.020	0.016	0.015	0.018		0.69
Power	0.112	0.149	0.270	0.150	0.170		6.49
Total	0.232	0.279	0.416	0.225	0.288	8.38	11.00
IX. SUPERINTENDENCE							
Labor	0.053	0.100	0.104	0.060	0.079		3.01
Material	0.017	0.020	0.020	0.015	0.018		0.69
Total	0.070	0.120	0.124	0.075	0.097	2.83	3.70

	Cost per ton(a)	Cost per ton(b)	Cost per ton(c)	Cost per ton(d)	Cost per ton(e)	Percentage of total cost(e)	Percentage of f.o.b. mine cost(e)
F.O.B. MINE COST							
Labor							
Inside					1.653		
Outside					0.315		
Total	1.785	1.992	2.297	1.828	1.988	57.31	75.16
Timber	0.120	0.157	0.186	0.120	0.140	4.08	5.36
Other material and power	0.615	0.411	0.495	0.652	0.510	14.88	19.48
Total	2.520	2.560	2.958	2.600	2.618	76.25	100.00
X. GENERAL EXPENSE							
Royalties	0.250	0.035	0.023	0.125	0.150		
Coal Depletion	0.030	0.175	0.100	0.035	0.090		
Depreciation	0.150	0.082	0.150	0.100	0.121		
Selling expense	0.150	0.220	0.210	0.100	0.170		
Property insurance	0.007	0.009	0.008	0.010	0.008		
Employees liability	0.070	0.062	0.070	0.070	0.070		
Taxes; state, county, municipal	0.015	0.027	0.016	0.015	0.018		
Federal taxes							
Salaries and expenses general officers	0.025	0.034	0.035	0.025	0.030		
Salaries and expenses office clerks and attendants	0.010	0.015	0.026	0.010	0.015		
General office supplies and expenses	0.010	0.010	0.010	0.010	0.010		
Law expense	0.005	0.007	0.007	0.005	0.005		
General office stationery and printing	0.004	0.004	0.004		0.004		
Casualties extraordinary of contingencies				0.010			
Industrial relations	0.100	0.120	0.164		0.124		
Total	0.826	0.800	0.812	0.515	0.815	23.75	
GRAND TOTAL	3.346	3.360	3.780	3.015	3.433	100.00	

(a) A typical mine in which sheet-iron pitch is necessary (dip 25 to 30 degrees) and the coal will not run on footwall. Gassy, but of comparative shallow depth, and has particularly good roof. Seams are from 6 to 10 feet in thickness. Vertical depth of seam 250 to 500 feet. Slope operation with comparatively little pumping. Reject of from 15 to 20 per cent.

(b) and (c) Deep slope operations, with dips ranging from 30 to 50 degrees, and coal from 4 to 6 feet in thickness, the overburden ranging from 700 to 2500 feet in thickness. Classed as gassy mines. Average roof conditions requiring heavy timbering. Pumping varies from 700 to 1000 gallons per minute for each 24 hours during the entire year. Reject of (b) 5 to 10 per cent; reject of (c) averages 35 per cent.

(d) Typical small mine operations. Output from 200 to 300 tons per day. Reject runs from 10 to 20 per cent. Connections afford a minimum overhead.

(e) Typical average mine of from 500 to 1000 tons per day output, opened up by means of a slope to average depths, and worked with closed lights. Dips average about 35 degrees.

Typical Mining Costs in Pierce County, Washington

	Cost per(a) ton	Cost per(b) ton	Cost per(c) ton	Percentage of total (c) cost	F.O.B. mine (c) cost
I. DEVELOPMENT					
Labor	$0.210	$0.196	$0.210		6.771
Timber	0.028	0.020	0.028		0.905
Other material	0.062	0.010	0.062		2.000
Total	0.300	0.226	0.300	7.66	9.674
II. MAINTENANCE					
Labor	0.150	0.264	0.207		6.675
Timber	0.021	0.021	0.021		0.678
Other material	0.068	0.068	0.068		2.193
Total	0.239	0.353	0.296	7.56	9.545
III. DRAINAGE					
Labor	0.010	0.030	0.202		0.645
Material	0.002	0.005	0.003		0.097
Total	0.012	0.035	0.023	0.59	0.742
IV. VENTILATION & LIGHT					
Labor	0.093	0.217	0.093		3.000
Material	0.010	0.025	0.010		0.321
Total	0.103	0.242	0.103	2.63	3.321
V. MINING					
Labor	1.096	1.306	1.201		38.732
Timber	0.137	0.137	0.137		4.416
Other material	0.025	0.032	0.028		0.903
Total	1.258	1.475	1.366	34.88	44.051
VI. HAULAGE					
Labor	0.260	0.332	0.296		9.544
Material	0.014	0.023	0.018		0.581
Total	0.274	0.355	0.314	8.02	10.125
VII. PREPARING & LOADING					
Labor	0.138	0.172	0.155		5.000
Material	0.002	0.002	0.002		0.065
Total	0.140	0.174	0.157	4.02	5.062
VIII. INTERDEPARTMENTAL					
Labor	0.100	0.129	0.114		3.671
Material	0.020	0.005	0.012		0.387
Power	0.150	0.378	0.264	6.74	8.519
Total	0.270	0.512	0.390	9.97	12.577
IX. SUPERINTENDENCE					
Labor	0.120	0.143	0.132		4.257
Material	0.020	0.021	0.020		0.645
Total	0.140	0.164	0.152	3.86	4.902

	Cost per(a) ton	Cost per(b) ton	Cost Per(c) ton	Percentage of Total cost(c)	Percentage of f.o.b. mine cost(c)
F.O.B. MINE COST					
Labor*	2.177	2.789	2.427	62.00	78.295
Timber	0.186	0.178	0.186	4.75	5.997
Other material and power	0.373	0.569	0.487	12.43	15.708
Total	2.736	3.536	3.100	79.18	100.000
I. GENERAL EXPENSE					
Royalties			0.125		
Coal depletion			0.055		
Depreciation			0.100		
Selling expense			0.160		
Employees liability insurance			0.100		
Taxes; state, county and municipal			0.070		
Taxes; federal					
Salaries and expenses of general officers			0.035		
Salaries of general office clerks and attendants			0.025		
General office supplies and expenses			0.015		
Law expense			0.006		
Stationery and printing			0.004		
Industrial relations expense			0.100		
Total			0.815	20.82	
Grand total			3.915	100.00	

* Inside labor cost, 65.77 per cent of labor cost.
Outside labor cost 12.53 per cent of labor cost.

(a) This heading covers costs in a typical water level operation under the present daily wage scale. The miners work under a contract system and have net earnings of $7 to $8 per day. The vertical lift varies from 400 to 1000 feet, and the production from 400 to 1000 tons per day. The dips vary from 45 degrees to vertical. The mine is classed as gassy and is worked with closed lights. The thickness of the seams worked varies from $2\frac{1}{2}$ to 18 feet.

(b) This heading covers costs in a typical slope operation with operating conditions similar to those in (a), except that the vertical depth is increased to 1500 feet. Pumping will average 1000 gallons per minute for all days throughout the year. Slopes are driven on an average dip of 45 degrees, in some cases across the pitch if this becomes necessary. Advantage is often taken to drive a slope on a lighter dipping seam if possible, on a dip of 30 degrees.

(c) This heading covers the costs of the average mine where there is a combination of conditions as given in items (a) and (c), which permits some district of the mine to be operated as a water level development. The seams average from 4 to 12 feet in thickness.

The reject in items (a),(b), and (c) runs from 30 to 40 per cent of the tonnage taken to the cleaning plant. In the yield of washed coal, about 60 per cent is minus ¼-inch, the plus1-inch will vary from 5 to 10 per cent, and the plus 2½-inch size may be negligible.

TERRITORY OF ALASKA
DEPARTMENT OF MINES
Juneau, Alaska

COPY

December 24, 1942

MEMORANDUM

For S. H. Ash,

Following are the estimates of the coal requirements and the offsetting coal production in The Alaska Railroad belt, which is the region supplied by the coal mines of the Matanuska and Nenana fields, as of November 20, 1942:

Requirements	Tons per Day	
Army (all current requirements)	250	
Fairbanks - civilian	120	
Anchorage - "	90	
Seward, etc. - "	20	
The Alaska Railroad	140	620

Production	Tons per Day	
Jonesville Mine	300	
Eska Mine	180	
Premier Mine	30	
Buffalo Mine	10	
Dunkle Mine	20	
Suntrana Mine (new opening)	80	620

Note: The above estimate of Army requirements was furnished me by Lieutenant Nash who is in charge of the coal procurement office of the Army at Anchorage and whose functions include supplying coal to all Army bases and camps, including Ladd Field. The estimate of the civilian needs at Fairbanks was given me by Mr. Earling, Manager of the U. S. Smelting, Refining & Mining Co., and is based on a careful survey that had been made by him in Fairbanks. The estimate of the civilian needs at Anchorage, Seward, etc. was based on a survey made by Leo H. Saarela, Territorial Department of Mines representative at Anchorage with the assistance of representatives of the coal companies and the coal distributors at Anchorage. The estimate of the needs of the Alaska Railroad was based upon official reports of their coal consumption over a period of many months.

(Signed) B. D. Stewart
Commissioner of Mines.

July 1942

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

LAST MONTH — 1942 June 1942

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

NEXT MONTH — 1942 August 1942

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

D. D. STEWART
[illegible]

Stewart —
Had Ailes refer
of Alaska copied and
am enclosing a copy
for your records. Thanks
for Telegram about Healy.
H.I.

USE OF DRY ICE TO PREVENT MINE FIRE REVIVIFICATION

Though mine fires may smolder and die for lack of oxygen, they still may retain enough heat that they will reviveon the advent of fresher air. Consequently the extinguished embers must be sufficiently cooled that when air is admitted, spontaneous rekindling will not occur. But these embers will be cooled only slowly behind seals if the latter are tight. Recirculation of the vitiated air within the fire area apparently solved the problem at Sunnyside, Utah, in a fire that occurred many years ago, but with dry ice introduced behind the seals, the temperature should be far more greatly and rapidly reduced, and the revival of the fire made entirely unlikely.

Compressed carbon-dioxide gas in escaping from a manifold also creates a low temperature, but unfortunately the gas freezes, and blocks the manifold's small exists. To avoid this, the manifold must be heated, which probably will cause the carbon dioxide to be delivered at a temperature too high to have much cooling effect on the fire or may even make that heavy gas so light that it will be unable to resist the action of drafts which, accordingly, may carry it away as fast as liberated. With dry ice, however, the gas is extremely cold and will blanket the area into which that heavy gas may flow.

The technique of placing the ice blocks where they will do most good is one that demands careful consideration. It is useless to put them too far below the fire or even above the fire, if the gas can pass alongside it without making contact with it. Perhaps the ice should be placed above the expiring fire, and a tight brattice erected below it, so as to hold the gas in place.

Information from the Lummus Co., dry ice manufacturers, shows that a 10x10x10-in. cake of dry ice evaporated to gas at 55 deg. F. will occupy 537 cu.ft. Hence a cubic foot of ice will occupy at that temperature 928 cu.ft., almost 1,000 times its original bulk. Under natural conditions, the cooling of the fire causes a shrinkage of the atmosphere around the sealed area through pillar and stopping leaks. If dry ice is added the cooling of the fire is accompanied by expansion of carbon dioxide, and the result is not only an application of inert gas by the creation of a pressure which will maintain such pressure, below or above atmospheric, as exists behind the seals or will even create such a pressure as will cause some of the air in the sealed chamber to be forced out through cracks in pillars and stoppings.

This correction of the air contraction within the seals perhpas is more important than the actual cooling of the fire. The addition of inert gas by the dry ice may be needed only to correct that contraction, for in many instances enough inert gas is present to subdue the fire if only the cooling would not introduce enought oxygen to revivify it. Dry ice therefore provides for cooling, exclusion of oxygen and addition of inert gas. It seems, therefore, to have a place in fire fighting, provided that the fire area is not insufficiently sealed, or that, in placing the dry ice, too much oxygen is not introduced.

It must be remembered that the dry ice must be delivered through an airlock by men in breathing apparatus and must be handled with extreme care because of it extremely low temperature.

COAL AGE, January, 1943, pp. 68.