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SMITH, EMERY & CO.
Engineers - Chemists
651 Howard Street
San Francisco

September 17, 1942

Mr. H. H. Ward
St. Francis Hotel
S.W. Eleventh and Main Streets
Portland, Oregon

My dear Mr. Ward: Re: American Soda Products Company

Referring to enclosed letter from Mr. H. G. Iverson, District Engineer, of September 1st, regarding American Soda Products Company, we are pleased to make the following statement following generally, the number schedule given by Mr. Iverson.

NO. 1 GENERAL HISTORY

The original location claims were taken up on Alkali Lake many years ago by a loosely formed company in Portland, the property being reputed to be rich in borax, which later proving to be an error - the matter remained in abeyance for a number of years. Prior to the First World War we were commissioned by the Pearson Engineering Corp. of London, to make complete examinations of and bond all usable alkali properties on the West Coast of America as a basis for establishing a west coast alkali trust for supplying the area, and for export. The required examinations were made by us with three exploration crews over a period of many months, our work finally being checked by engineers sent from London. Due to ominous rumors of a First World War, and the withdrawal from foreign exploration work of the French and English banks, and later, the death of Dr. Pearson while on his way to the Coast to discuss this matter, who lost his life in the sinking of the Lusitania, we received instructions from London that the project would be abandoned, and to give up all bonds and leaseholds, including that of Searles Lake. But were advised that Alkali Lake, having proved the second largest and best deposit of sodium carbonate in the world, excepting only the one owned by them in Africa, that we have friendly interests take up this option and hold the lake as a deferred investment.

Adopting this suggestion, all claims and interests in Alkali Lake were purchased, relocations and new locations made, and assessment work faithfully performed by the American Soda Products Company. After prolonged contest between the company, the State of Oregon and the United States, the property consisting of 5320 acres was finally patented on July 12, 1918, patent #419,112-640,529. Alkali Lake, I understand was the last saline property patented by the Government. The property has since been held intact as a deferred investment.

Some time later, Dr. Eyde of Norway, head of the Eyde Nitrogen companies, bonded the property for a sodium nitrate plant to be located near Redding, California, and for that purpose all the power sites on the near-by Pit River were likewise optioned. The Eyde Company was at the time, and subsequently, making and shipping calcium nitrates in steel drums to the Hawaiian and other sugar plantation islands requiring expensive containers and means of handling. In this project they contemplated making dry nitrate of soda which could be stored and shipped at will to replace the steel drum shipments from Norway. The property was bonded for $1,250,000 and $1.00 royalty on each ton of soda removed. Dr. Eyde planned to use the nitrogen process then in

vogue in the Norwegian plants. Several million dollars were placed in escrow in bank and held for a considerable period until Dr. Eyde found it impossible for financial reasons to carry out his project, although he made three trips from Norway to California to discuss the matter with us.

During the period of assessment work and consolidation of the claims on Alkali Lake various structures for living and operating quarters were erected which were dismantled after the issuing of the patents. While the company has never planned to install operative works to handle the soda of the lake, considerable miscellaneous engineering work was done to determine practicabilities, and one member of the company, John D. Spreckels, now deceased, tried to induce a junior member of his family to make the development of the property his life's objective. For that purpose a miscellany of machinery was purchased but no plant was erected or production undertaken. However, a few tons of the soda was from time to time shipped, "as is" by the custodian of the property to grocery stores in Portland and other towns where it sold to housewives as washing soda as an experiment.

It has been stated that gay-lussite crystals had been mined as an industry on the property, which is not a fact. There is a limited area perhaps not exceeding 125 acres in one section of the Lake in which these interesting crystals are found, and the area was visited at various times by geologists, and the writer himself, who dug up and screened a limited area for their recovery which went to various geological collections.

The assessment work on this property was largely done with snow-ploughs and exploiting drill holes. All sample lots of manufactured soda carbonate, light and heavy soda ash, caustic soda, etc. were made in our San Francisco laboratories. The property was prospected at various times to a depth of from 15 to 20 feet, brines and crystallizations being found to those depths. When glass-like crystalline soda was removed from the so-called pot hole areas shown in accompanying photographs, the holes were quickly refilled with brines - crystallization rapidly taking place.

No. 2 PATENTED AREA:

The patented area is surrounded by slightly sloping hills or approaches, with low mountains on the eastern side of the lake. The lake bed is level and at the upper end of the property there are large and excellent springs of pure water flowing constantly into the lake which is available for all local development purposes. The property during the summer time, and frequently during the winter, can be driven over by wagon or automobiles most any time in the year excepting after heavy rains in the winter when the main fields become slushy and discolored from the volcanic ash content. The remainder of the year it has the appearance of snow fields, as shown in the photographs. The so-called pot hole area covers several hundred acres embodying several thousand pot holes in clear crystalline masses.

The distance from railroad terminals are from Lakeview 65 miles; from Bend approximately the same distance, and from Southeastern Oregon, a lesser distance. All of these railroads have in past years offered to build into the property for freight tonnage whenever a serious development was undertaken.

No. 11 Highway from Lakeview easterly is an excellent road passing along one side of the patented lands, and another good highway extends from Bend, Oregon, easterly along the upper end of the property.

No. 3 HOUSING & LIVING CONDITIONS:

There are no housing or living conditions in the immediate vicinity of Alkali Lake and no stores, although these facilities are found at Lakeview, Bend, Valley, Falls, Paisley, Silver Lake, and other points, all of which are reached by reasonably good roads over comparatively level or gradually sloping terrain. During the periods of patenting the properties, caretakers and workmen lived in the company houses in comfort winter and summer, the elevation making for comparatively cool summers and moderate winter conditions.

NO. 4 TOTAL AREA:

As stated, the approximate area in acres under patent, and upon which taxes have been paid since July 12, 1918, are 5320 acres though several hundred acres in addition attach.

NO. 5 DESCRIPTION OF DEPOSITS:

The deposits, as stated otherwise, is a level area covered for the most part with loose soda carbonate and having several hundred acres at one point of large cyrstalline lens deposits, as shown in photographs. Typical analyses of the soda are attached. These analyses naturally will vary somewhat in percentage of soda, their chief impurity consisting of volcanic ash which is dropped out mechanically when the soda is put into solution.

NO. 6 ANALYSES:

Typical analyses are shown by attached copies, and as already stated, drilling was done quite generally to a depth of 15 to 20 feet, there being found to those depths saturation and crystalline impregnations. No deeper drilling was undertaken. The immediately available surface soda has been estimated at about 1,250,000 tons; no estimate has been made of the several million tons held in underlying brines, crystals, etc.

NO. 7 OPERATING PLANS:

The company has not and never has made any plans for operating the property though as previously stated, engineering work of a preliminary character was done to determine practicabilities.

In regard to the dropping out of the volcanic ash, conversion of the soda into soda carbonate, light and heavy soda ash, caustic soda, etc. this does not involve any complicated chemical process, and established mechanical methods and equipments are available. As to the manufacture into dry sodium nitrate, large advance has been made in recent years in atmospheric nitrogen processes. The plan proposed by Dr. Eyde of Norway was the well known atmospheric nitrogen process then in vogue by the Norwegian companies. While conversion of this sodium carbonate into dry sodium nitrate is, we believe, entirely practical with ample hydroelectric power, careful study of the atmospheric nitrogen systems now is used and other features of the process will require chemical engineering study and technical synchronization.

We are attaching a small map showing in general the location of the property but it gives little detail of roads and other physical features. The photographs which have already been provided show the general character and appearance of thousands of acres of loose soda carbonate and of the so-termed pot hole areas.

This information is given as nearly as we can in accordance with Mr. Iverson's suggestions with the hope that it will be of service in a better understanding of the property.

Yours very truly,

/s/ Emory E. Smith

President & Manager
SMITH, EMERY & COMPANY

SMITH, EMERY & CO.
Engineers - Chemists
651 Howard Street
San Francisco

September 17, 1942

ANALYSES	SAMPLES No. 1	No. 2	No. 3
SiO_2	2.91 %	0.21 %	0.62 %
NaCl	0.29	0.61	0.13
Na_2SO_4	0.60	0.74	0.52
Na_2CO_3	42.14	45.32	43.20
K_2O	0.14	trace	trace
Fe_2O_3 and Al_2O_3	0.16	trace	trace
CaO	0.10	trace	trace
MgO	0.12	trace	trace
Water of crystallization	53.54	53.12	55.53
Arsenic	none	none	none
Purity as Na_2CO_3 $10H_2O$	95.68	98.44	98.73

But it will be readily understood that in different parts of the lake there will be differences in the amounts of volcanic ash held in the soda. The ash being held mechanically drops out when soda is in saturated solution.

Sufficient laboratory work has been done on the crude soda carbonate in the manufacture of soda ash, caustic soda, sodium nitrate, etc., to determine that no major or unusual problems are involved.

When the weather has cleared and there is sufficient evidence of interest shown, arrangements will be made to show the property and furnish any further data in our possession.

Hoping that this statement gives you a satisfactory picture of Alkali Lake, and that we may hear from you in the near future, we are,

Yours very truly,

SMITH, EMERY & COMPANY
Chemists and chemical engineers

P.S. Smith, Emery & Company, though interested as engineers, do not hesitate to recommend this property as having large and permanent value.

ALKALI LAKE

U. S. Geological Survey Bulletin 217. 1903. "Geology of S.W. Idaho & S.E. Oregon", I. C. Russell, page 35.

Several of the small playas in S.E. Oregon are covered in summer with white incrustations of the nature just described. A sample of one of these from near Dog Mtn. about 6 miles west at Narrows gave the following analysis: (Analyst, George Steiger)

Insoluble in hot water	1.25
Na_2O	47.49
H_2O (of crystallization)	10.08
SO_3	11.76
Cl	2.90
CO_2	26.33
B_2O_3	0.28
	100.09

Proximate Composition

Insoluble in hot water	1.25
Na_2CO_3	55.91
$NaHCO_3$	5.98
Na_2SO_4	20.88
NaCl	6.17
$Na_2B_4O_7$	0.46
Water of crystallization	9.44
	100.09

U. S. Geological Survey Bulletin 669. 1919. W. C. Phalen, page 130.

Alkali Lake.

A notable deposit of soda is found in and around the lake. Alkali occurs as a crust on the surface of mud in and around shallow saline ponds, and there are "pot holes" near the margin of the deposit in which almost pure soda crystallizes. These "pot holes" have been worked for soda in a small way and the deposit as a whole has been taken up by a company which plans to work it for soda and perhaps other products. Attention has been directed . . . possible source of K.

Gale, U. S. Geological Survey - Samples of brine and salts.

Brine from pool known as Little Alkali; carries 10.63% dissolved matter (ignited residue), in which potash ran 3.25% as K, or 6.19 as KCl . . . higher than many such brines in K, but not comparable to Searles Lake.

U. S. Geological Survey Bulletin 669, page 130.

Abert and Summer Lakes.

These lakes, which are of considerable size, carry alkali salts in rather dilute solution ranging, according to analyses available, from 3 - 8% in Abert Lake and from 2 - 4% in Summer Lake. Although the aggregate quantity of salts in these waters is undoubtedly large, the waters are only about as concentrated as sea water, and the potash content, as shown by authoritative determinations, is only slighter > sea water. Soda might be recovered from these waters by solar evaporation, in the same manner as salt is recovered from sea water.

Water Supply Paper 220. 1908. Geology & Water Resources of a Portion of South Central Oregon, page 74.

Salts present.

Around the lake edges and some playas of the higher lands efflorescent crusts form. Ten of these were analyzed to determine the proportion of the several salts present, and the results are given in the following table.

TESTS ON ALKALI SAMPLES (mostly crusts)
(Results show percentage, figured on material analyzed)
W. H. Heileman, analyst

No.	Locality	Sulphates (SO_4)	Carbonates (CO_3)	Bicarbonates (HCO_3)	Chlorine (Cl)	Calculated as sodium salt		
		Qualitative only except No. 7				Sodium carbonate (Na_2CO_3)	Sodium bicarbonate ($NaHCO_3$)	Sodium chloride (NaCl)
1	East side Summer Lake	Heavy	14.28	9.93	0.51	25.28	13.50	0.84
2	South end Christmas Lake	do	6.02	4.65	.38	10.65	6.32	.63
3*	West side Alkali Flat	do	6.74	4.66	6.23	11.93	6.34	10.28
4	Edge of pool in Alkali Flat	do	14.64	9.07	15.35	25.90	12.33	25.31
5	Center of Alkali Flat	do	3.74	8.77	.71	6.62	11.92	1.17
6	Eastern pool northwest of Christmas Lake	Very heavy	.60	.13	2.25	1.06	.18	3.71
7	Western pool northwest of Christmas Lake	**	———	———	———	———	———	———
8	Efflorescence in "Sucker Flat"	Heavy	.18	.30	1.67	.32	.41	2.75
9	Playa in North Alkali	do	8.07	6.43	5.15	14.28	8.74	8.50
10	North end Lake Abert	do	22.40	10.24	1.54	39.65	13.92	2.54

* An acid extract showed heavy lime-carbonate content.
** Practically pure sodium sulphate (99 + per cent)

Water Supply Paper 220, page 75.

From these analyses it is seen that the sulphate of soda (Glauber's salt) is the most abundant in all these deposits, as it is in the soils themselves.

The crust that forms over the playa of Alkali Lake is occasionally used as stock salt. As before stated, borax claims have been located in this flat, but analysis of the material shows it to consist, as elsewhere, of the sulphate, carbonates, and chloride of soda; there can be but little borax in this deposit.

EDWARDS & LAZELLE

Chemical & Efficiency Engineers.

426-29 Railway Exchange Bldg.,
Portland, Oregon.

REPORT ON SUMMER & ABERT LAKES

We report our Mr. Lazelle's examination of Summer and Abert Lakes.

Location: Summer and Abert Lakes are situated in Lake County, Southern Central Oregon.

Approximate Size: Summer Lake has an area of about 40,000 acres, and an average depth of about four feet. This lake contains approximately 160,000 acre feet of water.

Abert Lake has an area of about 40,000 acres and an average depth of about seven feet. This lake contains approximately 280,000 acre feet of water.

Water Supply: Summer Lake received its chief supply of water from the Ana River. The flow of this river is sufficient to cover the lake to a depth of three feet. There are some six or more streams flowing into Summer Lake from the Winter Ridge on its western side. The flow of these streams is sufficient to furnish 40,000 acre feet of water. The annual rainfall is approximately twelve inches, occurring chiefly in the winter months. The total water annually entering Summer Lake is sufficient to cover 40,000 acres to a depth of five feet or 200,000 acre feet.

The chief supply of water for Abert Lake is from the Chewaucan River. The flow of this stream is extremely variable, reaching its maximum in the Spring and practically running dry in the Fall. The annual flow varies from 150,000 to 300,000 acre feet annually. Crooked Creek and Coyote Creek also flow into this lake.

The physical features of the lakes are described at greater length in the report of Chas. M. Sain, attached as appendix A. and in Water Supply Paper #220, attached as appendix B. As full data as is available is attached, as to the annual flow into these lakes. This was obtained from the U. S. Geological Survey.

Composition of the Water of Summer Lake: A sample of the water of Summer Lake was collected from near its southern end. This on analysis gave the following composition:

Composition in Grams per Liter.

Silica	0.446
Sodium Chloride	5.544
Sodium Carbonate	10.536
Potassium sulphate	1.536
Sodium sulphate	.436
Total solids	18.514

Composition of the Water of Abert Lake: A sample of the water of Abert Lake was collected from a point about midway on the western shore. This on analysis gave the following composition:

Composition in Grams per liter.

Silica	0.122
Sodium chloride	28.311
Sodium Carbonate	17.425
Potassium sulphate	1.657
Total solids	47.515

The above analysis shows the waters to be saline, consisting chiefly of sodium carbonate (soda), sodium chloride (salt) and Potassium sulphate.

For convenience in calculating, the saline content of the water of both lakes is given below in pounds per 100 gallons, in pounds per cubic feet, in pounds per acre foot, and in pounds per ton of water.

Salts in 100 gallons of water.
(100-gallons - 833.56 lbs. of water)

	Summer Lake	Abert Lake
Silica	0.37	0.102
Sodium chloride	4.6	23.664
Sodium carbonate	8.8	14.554
Potassium sulphate	1.3	1.384
Sodium sulphate	.36	
Total salts	15.43	39.704

Salts in one cubic foot of water
(1 cubic foot of water = 62.4 lbs.)

	Summer Lake	Abert Lake
Silica	0.028	0.007
Sodium chloride	0.346	1.77
Sodium carbonate	.646	1.09
Potassium sulphate	.097	0.104
Sodium sulphate	0.027	
Total salts	1.144	3.034

Salts in one acre foot of water.
(One acre foot of water weighs 2,718,144 lbs. 1,319 tons.)

	Summer Lake	Abert Lake
Silica	1312.2 lbs.	313.6 lbs.
Sodium chloride	15057.7 "	76919.4 "
Sodium carbonate	28634.1 "	47263.2 "
Potassium sulphate	4212.9 "	7847.7 "
Sodium sulphate	1185.0 "	
Total salts	5041.9 "	132343.9 lbs.

Salts in one ton of water

	Summer Lake	Abert Lake
Silica	0.892	0.244
Sodium chloride	11.088	56.622
Sodium carbonate	21.072	34.850
Potassium sulphate	3.104	3.314
Sodium sulphate	0.872	
Total salts	37.028	95.030

Total Salts in Summer and Abert Lakes

	Summer Lake	Abert Lake	Total
Silica	104,976	43,904	148,880
Sodium chloride	1204,616	10768,716	11973,332
Sodium carbonate	2290,728	6616,848	8907,576
Potassium sulphate	337,032	1098,678	1435,710
Sodium sulphate	94,800		9494,800
Total salts	4032,152	18,528,146	22,560,298

It will be noted that the analyses made by us, give approximately one-half the total saline content of those made in 1901 by Stillwell and Gladding of New York. These analyses are given in Mr. Sain's report, Appendix "A". The variation may be due to the time of the year the samples were taken. Because of the lesser amounts shown by our analyses the total saline content of the lakes is less than that given by Mr. Sain. No attempt was made to check the area of the lakes as this would have involved a survey consuming considerable time.

Present Development: A dyke has been built across the Southeastern end of Summer Lake, enclosing approximately 1,000 acres. The object of this

dyke is to cut off communication between the waters of the lake and those enclosed in the dyke, thus allowing the enclosed waters to evaporate and become more concentrated.

A sample of water was collected from this enclosure and this gave on analysis the following results.

Composition of water in 1000 acre vat "Summer Lake"

Silica	0.194
Sodium chloride	11.619
Sodium carbonate	24.781
Potassium sulphate	3.327
Sodium sulphate	.980
Total Solids	40.901

The above analysis shows that the water in the vat has about twice the concentration of that in the lake. That is, the vat waters contain about twice the total salines of those of the lake.

About half a mile east of the southern end of Summer Lake and at a higher level, a dyke has been constructed enclosing about 500 acres. It was the intention to use the 1000 acre vat to concentrate the waters from the lake nearly to the point of which the dissolved salts would be precipitated, and then to pump the concentrated waters to the 500 acre higher level vat, when all the salts would be precipitated.

Present Saline Content of Water 1000 acre Vat.

	Lbs. of Salts in 8 acre ft. of water		Tons of salts 1000 acre vat. 2 ft. deep.	
Silica	527.9	lbs.	527.9	tons
Sodium chloride	31,580.4	"	31,580.4	"
Sodium carbonate	67,354.7	"	67,354.7	"
Potassium sulphate	9,042.7	"	9,042.7	"
Sodium sulphate	2,680.4	"	2,680.4	"
Total	111,166.1	lbs.55.58 tons	111,166.1	tons

At the time of our visit no development work had been done at Abert Lake.

Solar Evaporation: Assuming that the present inflow to Summer Lake is sufficient to furnish 5 feet of water over its area, the rate of evaporation must equal this, which would give a rate of 1.15 inches per week. Mr. Sain states that he had obtained as high a rate of evaporation as 2.5 inches per week.

A rate of evaporation of 1.15 inches per week is equivalent to a loss of 130.0 tons of water per week or 6795 tons per year per acre. At this rate of evaporation each area of one acre would produce 251,415 (125 tons) of salt from the present water of Summer Lake per year.

At a rate of evaporation of 2.5 inches per week is equivalent to a loss of 282.5 tons of water per week or 14,690 tons per year per acre. At this greater rate of evaporation each area of one acre would produce 543,530 lbs. (272 tons) of salt from the present water of Summer Lake per year. This rate of 2.5 inches appears to us high, and we have used the lower rate of 1.15 inches per week in our calculation. This rate of 5 feet per year is higher than that of 3.94 feet given in "Water Supply Paper #220."

The 1000 acre vat at Summer Lake at the lower rate of evaporation would produce 125,000 tons of salt per year.

Methods of Treating the Water: Owing to the comparatively small amount of salines dissolved in the water, the only method of concentrating which would prove economical is that of solar evaporation, that is, allowing the water to evaporate from the action of the sun and the winds.

Proposed Method of Concentrating the Waters of Summer Lake: From our study of the conditions at Summer Lake the most feasible method of concentrating these waters would be by constructing a dyke across the north end of the lake, thereby cutting out the flow of Ana River into the lake. Such a dyke to provide storage for the annual flow of the Ana River would be about 36,000 feet long by about 12 feet high. If this dyke was 6 feet on top and both sides had a 1 to 1½ slope, it would contain 32 cubic yards per yard of length, equivalent to 384,000 cubic yards. At 12 cents a cubic yard, such a dyke would cost $46,380.00. Assuming the reservoir behind this dyke to have a depth of 6 feet, this reservoir would have an area of 20,000 acres, and the cost of this submerged land would have to be included in the cost of the reservoir.

It is our opinion that cutting out the flow of the Ana River would reduce the area of the lake to about two-fifths of its present size and would at least correspondingly increase the concentration of the water two and one-half times. Summer Lake water would then contain 38.5 pounds of salts per 100 gallons or 126,004.7 lbs. (63 tons) of salt per acre foot of water. The increase in concentration would probably be much greater than two and one-half times, since the volume of the lake, after cutting out the flow of Ana River, will depend on the contour of the bottom of the lake.

With an evaporation of 1.15 inches per week or five feet per year, an acre of this concentrated water would produce 63 x 5 = 315 tons of salt per year.

Abert Lake contains 61 tons of total salts per acre. Each acre at the above rate of evaporation would give 305 tons per year.

In order to produce 100,000 tons of total salts per year the following areas for solar evaporation would be required:

Summer Lake, present concentration	800 acres
Summer Lake, concentration after cutting out the flow of Ana River	317 acres
Abert Lake, present concentration	328 acres

100,000 tons of salines would contain the amount of salts given below:

	Summer Lake	Abert Lake
Silica	2400 tons	260 tons
Sodium chloride	29950 "	59563 "
Sodium carbonate	56910 "	36672 "
Potassium sulphate	8380 "	3485 "
Sodium sulphate	2350 "	
Total	100,000 tons	100,000 tons.

It is our opinion that it is not feasible to evaporate the lakes until the water becomes concentrated, owing to the loss of valuable salts in the mud bottom of the lakes.

Investigations have shown that at a concentration of 214 grams per liter (equivalent to 1.78 lbs. per gallon) the carbonate is thrown out.

Investigations made in our laboratories show that the sodium carbonate is the first salt thrown out, followed by the sodium chloride.

Any method of treating the water of Summer Lake should, in our opinion, include cutting out the flow of Ana River. We estimate the cost of doing this as follows:

Dykes across north end of Summer Lake	$50,000.
20,000 acres feet of land for reservoir at $5.00 per acre foot	100,000.
Total	$150,000.

If the impounded water is used for irrigation, this investment will probably more than pay for itself. We have, therefore, not included this in our estimate of cost of producing salt.

Two methods may be used to further concentrate the water of Summer Lake by solar evaporation. One, the Vat Method, two, Graduation Tower Method.

#1 Vat Method, to produce 100,000 tons of salts per year.

300 vats 208' x 208' x 3' deep at $5000 each	$1,500,000.00
Pumps, evaporating pans, dryer and sheds	156,000.00
	1,656,000.00

#2 Graduation Tower Method: The rate of evaporation from an open tank is very slow, being only 1.15" per week or .16 of an inch per day. A much higher rate can be obtained by using the so-called "Graduation Tower". The tower consists of an elevated trough carrying the liquid to be evaporated, supported on a trestle. From the top of this trestle bundles of brambles are suspended so that the liquid overflowing from the trough trickles down over the bundles, thus exposing a large surface to the action of the air. The trestles are built at right angles to the direction of the prevailing wind. This system has been quite extensively used in Germany for concentrating weak brines and an evaporating efficiency of 13 gallons of water per square foot of brambles has been obtained. It would seem feasible to employ this system for further concentrating the water of Summer Lake, after cutting off the flow of Ana River; to the point of which the dissolved carbonate would be

precipitated; to complete the evaporation and precipitate the carbonates and chlorides in open vats and finally recover the potash by heat.

Such a Graduation Tower 20' high would have 20 square feet of evaporating surface on one side. If 10 gallons of water were evaporated to each square foot of surface each running foot of the Tower would evaporate 200 gallons, equivalent to the production of 77.15 pounds of salts from the water of the concentrated lake. In order to reduce the concentrated water to the point of saturation (1.78 lbs. per gallon) would require 1630' of Tower. Such a Tower would be expected to reduce 415,000 gallons to 90,000 gallons daily evaporating 325,000 gallons.

We estimate such a Tower 20' high constructed of wood and carrying a galvanized iron trough would cost not to exceed $10.00 per foot or $1,630.00.

A concrete trough at the bottom 14' wide by 1625' long would cost about $2700.00. Such a Tower would have an evaporating efficiency per square foot 100 times greater than a vat. The saturated water after having passed over the Tower would be further concentrated in open vats until most of the carbonates and the chlorides had been precipitated. About 60 acres of vats would be required for this purpose.

We estimate the cost of this system as follows:

1630 feet Graduation Tower	$16,300.
1630 foot concrete trough	2,700.
60 acres of vats at $5,000	300,000.
Pumps, evaporating pans, dryer and sheds	150,000.
Total	$469,000.

We estimate the value of these salts at Portland as follows:

Salt 29,950 tons at $8.00 per ton	$239,600
Soda ash 2000 tons at $20 per ton	40,000
Potassium sulphate 8000 tons at $40	320,000
Total	$599,600

Cost of Producing Salts.

	Vat Method	Tower Method
Int. on Plant at 6%	$102,000.00	$30,000.00
Depreciation at 10%	170,000.00	50,000.00
Cost of Mfgr. at $2 per ton	134,000.00	134,000.00
Royalty, state	50,000.00	50,000.00
Freight at $4.00	268,000.00	268,000.00
Bags	33,500.00	33,000.00
Selling 10%	170,000.00	170,000.00
Totals	$927,500.00	$735,500.00

In estimating the value of the salts produced in the Portland market, we have only allowed for the sale of 2000 tons of soda. This amount represents practically the total consumption of the Pacific Coast States at the present time. If the total 56,910 tons of soda produced could be sold as low as $10.00 per ton, the project would be feasible. It is our opinion, however, that at the present time this amount of soda could not be disposed of in this market and we are doubtful if the material would bear the transportation charges East and meet the competition there.

We have no reported upon the irrigation possibilities in connection with diverting the streams from both Summer and Abert lakes, as we were not requested to do this.

The same systems outlined above could be used at Abert Lake and practically twice the amount of salt produced.

We estimate the value of the salts produced from Abert Lake as follows:

59,563 tons salt at $8.00 per ton	$476,504
2,000 tons soda ash at $20 per ton	40,000
34,856 tons of potash at $40 per ton	139,400
Total	$655,904

As stated above, it is impossible to correctly estimate the concentration of the waters of the lakes after the inflowing rivers have been cut out. The area would be reduced proportionately to the amount of water cut out, as the evaporation would remain approximately the same. Even if the concentration was considerably increased over that allowed for in the estimate, the only saving would be in the costs of the vats.

It might be possible to concentrate the waters to such an extent on the Graduation Towers that the carbonate would be largely precipitated. This would reduce the number of vats required but would mean a constant removal and replacing of the brambles.

As stated above we do not consider it feasible to precipitate large amounts of the salts in dirt vats since we are of the opinion that the potash would be largely lost by sinking into the sandy bottom. The only method of determining this would be to concentrate a fairly large amount of the water in a dirt vat and determine the loss in potash.

Respectfully submitted,

August 14,1913

Edwards & Lazelle,

By (signed) E. W. Lazelle.

To MacArthur Brothers,
11 Pine Street,
New York, N. Y.

SUMMER AND ABERT LAKES

Report by

Chas. M. Sain.

Summer and Abert Lakes in Lake County, Oregon, contain in round numbers forty million tons of salts, as follows:

Tons of Salts.

	Summer Lake	Lake Abert	Totals
Sodium chloride	3,905,000	14,880,000	18,785,000
Silica	122,000	55,000	177,000
Sodium carbonate	6,231,000	7,769,000	14,000,000
Sodium bicarbonate	2,869,000	2,397,000	5,266,000
Potassium sulphate	531,000	863,000	1,394,000
Potassium chloride		36,000	36,000
Sodium sulphate	342,000		342,000
Totals	14,000,000	26,000,000	40,000,000

Percentages.

	Summer Lake	Lake Abert
Sodium chloride	27.90	57.23
Silica	.87	.21
Sodium carbonate	44.51	29.88
Sodium bicarbonate	20.49	9.22
Potassium chloride		.14
Sodium sulphate	2.44	
Totals	100.00	100.00

The area of each lake is computed at 40,000 acres, and the average depth of each lake is seven feet.

One hundred pounds of water from Summer Lake contains 3.54 pounds of salts; from Lake Abert 6.40 pounds of salts.

Physical Features.

Summer Lake.

Summer Lake has a mud bottom, of blue clay. This mud has been penetrated to a depth of ten feet with testing pole. This mud, of course, contains a high percentage of water. The water is saturated with the salts of the lake.

The shores of the lake are very low and level. The water at times, in a high wind, will roll out on the shore for a mile.

The principal stream flowing into Summer Lake is Ana River. The Ana River is unique in itself. Its flow is constant the year round. It is about 60 feet wide, 5 or 6 feet deep, and 5 miles in length. Its source is in five large springs, whose depth has not yet been sounded. The temperature of the water in the river varies but little, winter or summer.

This stream empties into Summer Lake 110,000 acre-feet per year. This is sufficient to fill the lake to a depth of 3 feet. The precipitation from rain and snow, directly upon the surface of the lake, is about 12 inches. The inflow from other small streams makes about another foot. Thus, we have 5 feet of inflow into Summer Lake annually, and as the evaporation equals the inflow the evaporation, therefore, is 5 feet in the year.

At the southeastern corner of Summer Lake is a natural bay or gulf; covering, approximately, 2000 acres. By building a dyke across the mouth of this bay it can be easily converted into an evaporating vat.

Running parallel to the shore of this bay, about half a mile to the East, is an old shore line of cement gravel which forms a natural dyke one and one-half miles in length. Behind this dyke is an evaporating ground, included in the lease, of about 500 acres. The dyke, itself, is cut in only one place by Dry Creek. There are at the present time behind this dyke seven small ponds, that evaporate to dryness in the fall of the year.

Around the shore line of the bay, under the bluff at the south side, are numerous springs.

The mountains rise on the Western side of Summer Lake to a height of 6500 feet. The lake, itself, has an altitude of 4200 feet.

These mountains are heavily covered with pine timber. This timber is available for fuel and for building purposes. A saw mill is located in the forest at the present time. Part of this land is in a national forest reserve and the rest is held by private ownership.

In one or two places the slopes of the mountains, which are very steep, come down almost to the edge of Summer Lake.

A wagon road 50 miles in length takes one entirely around the borders of Summer Lake.

The West side of Summer Lake is fine agricultural land. The East side is alkali desert. An irrigation enterprise, now under way, will reclaim much of this desert land.

Lake Abert

Lake Abert differs greatly from Summer Lake. Much of its bed is rocky, and the rocks come down to the water's edge. Only at the north end, where is located a big spring that waters the I.X.L. ranch, is there any agricultural land worth consideration.

Lake Abert is fed by the Chewaucan River, which carries 95% of the inflow into the lake. The volume of this stream is very irregular, varying from 150,000 acre-feet to 300,000 acre-feet annually.

The mountain range on the east side of Lake Abert rises almost perpendicularly for 2000 feet.

The water at the north end of Lake Abert is very shallow for the entire width of 6 miles, and the lake at that point has a mud bottom.

Along the western shore of Lake Abert, within a few feet, runs the survey of the Southern-Pacific railroad. This is a branch line of the Oregon Eastern, now building from Ontario ~~to~~ across the State to Coos Bay. This branch line, known as the Coos Lake Southern, is projected as a part of the main line

into San Francisco. The highest point on this line is Antlers Pass, 18 miles south of Lake Abert. The grade is so light through this pass that it is crossed with .8 of 1%.

The distance between Lake Abert and Summer Lake is 30 miles. The valley is from 5 to 10 miles in width and about 30,000 acres of it was originally swamp land, which is now being reclaimed.

The Chewaucan River usually goes dry early in September. The heavy flow comes in June.

A large storage reservoir is now being built near the head waters of the Chewaucan River, for irrigation purposes.

The town of Paisly is situated at the mouth of a canyon where the Chewaucan River enters the marsh.

Lakeview is the County seat of Lake County, 28 miles south of Lake Abert, which is the nearest railway point.

Lake County has an area equal to the State of Massachusetts. Its population is 4000, and it has the lowest tax levy in the State of Oregon, 14 mills. The county is a large producer in sheep and cattle and is rich in agricultural possibilities.

Advantages over other Deposits.

There are other alkali waters in the Western states, Wyoming, Utah, Nevada, California, Mono Lake, also, contains 92,000,000 tons of soda and Owens Lake 22,000,000 tons. However, Summer and Abert Lake possess natural advantages that completely eliminate all other soda deposits from the list of competitors.

Even on an equal footing with all other sources of supply, there is a certain market for the salts of Summer and Abert Lakes. However, in four particulars the advantage rests largely on the side of the Oregon deposits. These are:

Quality of salts.
Initial capital.
Cost of marketing.

Quality of Product.

Prof. T. M. Chatard in his report on "Natural Soda", Bulletin No. 60 of the Geological Survey, speaking of Lake Abert says:

> "Its low percentage of sulphate is its greatest merit, since it is of all the impurities the most difficult to remove and the most deleterious when present."

At that time it was thought Lake Abert contained small quantities of sodium sulphate, of which Mr. Chatard was speaking. It is now known, however, that Lake Abert contains no sodium sulphate. A number of noted chemists, among them Messrs. Stilwell & Gladding, chemists for the New York Stock Exch., have made analyses of the waters of Summer & Abert Lakes. The latter say:

> "The solids in Lake Abert contain potash enough to saturate all the sulphuric acid. So there is no soda sulphate present."

Thus it is seen that a pure soda and a pure salt can be obtained from Lake Abert.

The percentage of bicarbonate of soda in Summer Lake is almost five times that in Owens Lake. On the other hand, the percentage of soda sulphate in Summer Lake is only one-fifth of that in Owens Lake, and only an eighth of that in Mono Lake. Thus the ratio of this deleterious sulphate in Owens Lake is 25 times greater than it is in Summer Lake. And, with the absence of sulphate in Abert Lake, it is apparent that none of them can compete in quality with the soda and table salt of Summer and Abert Lakes.

Capital Required.

There is probably no other enterprise in the world fraught with such possibilities for profit where the initial capital required is so small. It will take $10,000.00 to build a vat at Summer Lake out of the bay heretofore referred to. This vat would have a capacity, of evaporating not less than 200,000 tons of salt a year.

It will require half that sum to build a vat at Lake Abert, having an equal capacity.

It will cost $10,000.00 to build calcining furnaces; furnaces with a capacity to make 15,000 tons of soda each per year. It will cost $5000.00 to build a flume down the mountain to carry fuel to the furnaces.

$5000.00 will provide for the necessary drying sheds for stock and table salt. Stock and table salt will be available for the market in the fall of 1913, and thus will provide an immediate revenue from the property.

Cost of Production.

It costs $6.00 a ton, according to the Mineral Industry, to produce soda ash at Owens Lake, and at that they get an impure soda that has been shut out of the San Francisco and Japan markets.

The cost of soda ash by the Solvay process is about $9.00 a ton. The high cost at Owens is due to pumping the water from the lake and the 300 mile haul for fuel.

At Summer and Abert Lakes the water will flow into the vats by gravity. The fuel is right at hand. At Summer Lake a flume can be built to carry the fuel right into the works. At Lake Abert a similar flume would land cord wood within five or six miles of the lake.

On the southern side of Summer Lake, high above the present lake level, are several smaller lakes which afford an excellent opportunity to furnish cheap water power. A fall of 1000 feet, or more, can be obtained from these lakes.

At Owens Lake, vats costing $1000.00 per acre were constructed. At Summer Lake, a 2000 acre vat can be built for $10,000.00 which is but $5.00 per acre.

At Stassfurt, potash salts are pumped from a depth of 5000 feet. At Summer and Abert Lakes the salts are right on top of the ground and can be

evaporated to dryness at a cost of 5 cents per ton.

Soda Ash should be manufactured for less than $1.00 a ton, and in the manufacture of soda ash and other products the stock and table salt will be recovered as a by-product free of all cost.

Thus, it is seen that the natural advantages of Summer and Abert Lakes more than offset any possible disadvantages.

Cost of Marketing.

The one big item in marketing any product is the cost of transportation. In railway transportation, the cost depends upon distance and grades. The old rule was that the freight cost was one cent per ton per mile. The Great Northern on a six-tenths of one per cent grade has reduced the cost to two-fifths of one cent per ton mile.

In the early days of the Inyo Development Company, the freight charge on soda from Owens Lake to San Francisco, a distance of about 600 miles, over two mountain ranges on two per cent grades, was $5.00 a ton.

There will soon be railway communication from Summer and Abert Lakes with three Pacific Coast ports. The distance to San Francisco via Lakeview, Alturas and Pitt River is about 500 miles. Straight west from Summer Lake to Coos Bay the distance is about 250 miles. Coos Bay is the natural outlet for the salts of these lakes. The distance from Summer Lake via Bend and the Deschutes to Portland is about 300 miles.

The Cascades to Coos Bay are crossed on less than an eight-tenths grade. The heaviest grade to San Francisco from Lake Abert is eight-tenths. The grade to Portland is much less. In fact, from the lakes it is practically a down hill haul to Portland, Coos Bay and San Francisco.

Wheat, which is worth less per ton than potash, bears transportation charges from Idaho all the way to Europe.

In no case should transportation to tide water be more than $5.00 on

these salts, and it will probably be no more than $2.50 per ton.

Even at the present time freight is sent around the Horn from San Francisco to New York, twelve thousand miles, for $6.00 a ton. By the Panama Canal the distance is but 5000 miles, and on ship loads the charge should not be more than $4.00 a ton.

Let us say that the cost of transporting the sodas is $6.50 per ton to the East coast of the United States and South American countries. Add to this $1.00 for royalty and $1.00 for manufacture and $1.50 for contingencies. The total cost is thus $10.00 per ton.

The sodas, sal soda, soda ash, bicarbonate and caustic should easily bring an average of $20.00 per ton on the Atlantic Coast.

The Panama Canal will make prices on the Pacific Coast about the same, but the cost of marketing will be a little less. Japan offers a good market for sodas at still higher prices.

The twenty million tons of soda at $10.00 net per ton thus yield a profit of $200,000,000. The profit to be realized on the potash contained in the lakes is estimated at $50,000,000., while from the remaining salts enough profits should accrue to make up the $270,000,000.00; total profits estimated in this report.

In considering the foregoing summary of conditions at the lakes, three important factors stand out strongly, viz. the quality of the product is purer, the capital required is less; and the cost of production is lower at Summer and Abert Lakes than at any other place on the globe.

Evaporating Vats.

There is a large acreage of desirable ground for these vats. The acreage required by the lease can easily be doubled without practically any additional expense.

I have demonstrated that there is not a particle of doubt about the completed vats holding water. At the present time there is a stretch of a mile at the South Side of the Summer Lake Bay where springs come out from under a bank ten to twenty feet high. These springs collect in pools that very seldom run out into the bay. This proves that the shore soil holds water. Out in the bay there is much sand drifted in and mixed with the clay bed in the lake. It does not have to be leveled. The bottom is smooth as a floor and has a slope of about one foot to the mile.

Building the dyke across the mouth of the Summer Lake bay is much like dyking the tide flats down at Coos Bay, where fine crops are grown on land reclaimed by dyking along the inlets. A simple mud bank is thrown up four or five feet and about as wide. The embankment is not rip-rapped in any way. It holds water and is never in danger of washing out with wave or high water.

The problem at the lakes is practically just as simple. A dirt dyke would probably answer every purpose. But to make the work doubly secure, I have provided for rip-rapping the dyke with stone. I first figured on logs but the alkali water eats out the wood in a short time, and I found the logs would cost more than stone. The mud in the lake bed is too soft to stand without rip-rapping and some dirt will have to be brought in from the shore.

A dyke three or four feet wide would suffice, but provision has been made for a dyke ten feet wide. This will permit the dyke to be used as a wagon road. In this way material can be hauled into the vat, and salts hauled out. The wagon road is necessary, and using the dyke for this purpose will tend to keep it from leaking.

But even if the dyke should leak, it would be from the lake into the vat and not from the vat into the lake. There is a constant flow into Summer Lake, mainly from the Ana River.

There would be no outside water flowing into the vat. It would be fed through tide gates into the dyke. The spring and rain water around the edges would be drained off in a ditch.

The principal work on the dyke will be a section 3,000 feet long and four feet high. The maximum depth of water in the spring of the year is three feet.

The same reasoning applies to the Lake Abert vat. The flow into Lake Abert is more variable, the Chewaucan River going dry in the late fall.

Evaporation.

Annual evaporation is never less than five feet in Summer and Abert Lakes. In a shallow vat the evaporation will be still more rapid.

A cubic foot of Summer Lake water contains two pounds of salts; Lake Abert about four pounds. In round numbers, an acre of Summer Lake water, one foot deep, 43,560 cubic feet, holds fifty tons of salts; two thousand acres, 100,000 tons of salts.

If five feet of water is evaporated in the 2,000 acre vat, the annual production of raw salts will be a half million tons. Our lease calls for only 100,000. It is possible to keep on storing salts in this vat from year to year.

The complete plan is to store all the water now flowing into Summer and Abert Lakes, use this impounded water for generating electric power and for irrigating land, and thus wholly dry up both lakes. In this way the cost of evaporating each lake will not exceed $1,000,000; or $2,000,000 for both lakes.

In impounding this water ample horse power can be developed to meet all demands in connection with the operation of this project, in addition to furnishing a large surplus for market.

The annual consumption of potash in the United States is equivalent to 250,000 tons of the potassium oxide, or perhaps half a million tons in the form of

the lower grade salts.

We send to Germany $15,000,000 a year for potash salts and the consumption is doubling each decade.

Separating the Salts.

Prof. Russell, in "Lakes of North America" page 73, says

> "The fact that various salts are deposited in a regular succession when mineral waters are evaporated, is of great service in separating certain ones in a pure state by the method known as fractional crystallization."

The law is that the salts will be precipitated "inversely as the order of their solubility".

Russell, speaking of the Ragtown Lakes in Nevada, says:

> "Sodium sulphate and sodium carbonate are precipitated previous to the crystallization of common salt".

However, Russell says when concentration has reduced the water to about two per cent of the original volume,

> "Spontaneous evaporation cannot go much further. The residual mother-water will not dry up at the ordinary temperature, even in the hottest regions of the globe".

Every body of water has an order of precipitation of its own, following general laws. At Owens Lake the first precipitation is urac, a combination of carbonate of soda with bicarbonate of sodium. The precipitation depends upon temperature and also upon the presence of other salts.

Summer and Abert Lakes have a less number of salts than any other known saline bodies. Therefore, their separation can be more easily affected.

The following table, compiled from Lunge, gives the approximate figures showing how many parts of the several salts at different temperatures it takes to saturate one hundred parts of water:

Salt	32 Deg.F.	60 deg.F.	100 deg.F.
Sodium sulphate	5.02	12.	49.
Sodium bicarbonate.	6.90	9.	13.
Sodium carbonate.	6.97	16.20	46.
Potassium sulphate.	10.	10.38	17.
Sodium chloride	35.52	36.	37.
Potassium chloride	29.21	35.	38.

From the foregoing it is seen why Glauber's salts give rise to the origin of winter soda and summer soda.

Potash.

Germany at the present time practically monopolizes the potash industry. The United States sent to Germany approximately $15,000,000 for potash salts last year, and the consumption in this country is rapidly increasing.

With free access to the market of the United States the potash supply at Summer and Abert Lakes would be rapidly absorbed. There can be no doubt, even with other potash discoveries in the United States, but that a market is available for the potash of Summer and Abert Lakes. The practical way to recover the potash is to evaporate the entire lakes, thus more than 1,000,000 tons of potash is immediately available for market.

Soda Manufacture.

There was, in round numbers, produced in the United States for the year 1909 a little over 1,000,000 tons of soda. This includes 20,000 tons of soda carbonate used in the manufacture of borax. The total value of the soda products was a little over $11,000,000.

The chief industries in which soda is used are soap, glass and paper manufactures. In the past decade the value of the products in each of these industries doubled, or more than doubled. The soap product is now worth $114,000,000. and glass $92,000,000.

In the manufacture of soap 121,016 tons of soda ash were used, the

average price being $19 per ton; and 52,172 tons of caustic soda at $42 per ton.

The production of soda is about 10,000 tons for each million people, a little more in fact. The last census gave the Pacific Coast states between 60,000 and 70,000 tons. The population on this coast by the time we are ready to ship, in 1914, will not be less than 10,000,000 and the consumption of soda 100,000 tons.

There is no reason why the entire Pacific Coast trade in soda should not be supplied from Summer and Abert Lakes at the average price for the United States. In addition we should be able to command the Japanese and South American trade.

In any event, I think it is safe to say that to start with 100,000 tons of soda could be marketed at an average price of $20 per ton, and an average profit of $10.00 per ton, or a profit of $1,000,000 a year.

The soda should increase each year, and in ten years there should be marketed a half million tons a year.

To begin with, the raw soda could be shipped as it is evaporated from the lakes to San Francisco for refining. But the better plan would be to build calcining and manufacturing plants at the lakes.

The following data is obtained from the special report of the U. S. census, 1905, Volume IV. Manufactures.

Soda produced in 1904.

	Tons	Value	Price per ton.
Total	734,209	$13,357,983	$18.19
Bicarbonate . . .	68,867	1,135,610	16.49
Caustic	86,840	3,185,959	36.69
Sal soda	59,548	831,869	13.99
Soda Ash	518,954	8,204,545	15.81

The following is taken from a census bulletin on manufactures of 1910, and gives the soda production for the year 1909.

	Tons	Value	Price per ton.
Total- - -	915,244	$21,417,982	$22.44
Bicarbonate	82,800	1,515,031	18.30
Caustic	112,152	4,230,954	37.72
Sal soda	78,285	977,712	12.81
Soda Ash	646,007	10,361,756	16.04

In addition to the foregoing, 110,000 tons of soda were produced in 1909, 76,540 salt cake (sulphate of soda) used in glass manufacture for which no price is given, 14,000 tons as by-products, and 20,000 tons in the manufacture of borax.

It is seen that the average price of soda has risen in five years $4.25 per ton.

As per the census of 1905, the following grades of soda are manufactured:

Soda Ash . . . .
58 per cent.
Dense 58 per cent.

Soda Ash . . . .
48 per cent.
Special 48 per cent.
36 per cent.

Caustic Soda . . . .
High test 76 per cent.
74 per cent.
70 per cent.
60 per cent.
Special 60 per cent.

Soda Crystals (sal soda) . . .
Monchydrate crystals
49.8 per cent.
Snow flake crystals
40.9 per cent.

Bicarbonate . . . .
Pure bicarbonate
99 per cent.
for baking soda
anchor dust, which is an impure grade.

used as a source of carbon dioxide in charging "soda water".

"The percentages refer to the Na_2O contents in each case, except that of the bicarbonate where it refers to $NaCO_3$. In the census returns no cognizance is taken of these many grades, so that the figures given for any item in the tables are the gross amounts for all grades".

It is easily seen how the cheaper grades of soda bring down the average price. The rule is to quote soda as in New York as "48/58". The price is for the 48 per cent, but the grade sold is 58 per cent and charged for accordingly. If the quotation is $20 per ton for 48, the price of 58 would be above $24, or twenty per cent more. The same is true of caustic and bicarbonate.

Summer and Abert Lakes will produce the higher grades of soda.

It is interesting to follow the process for the manufacture of caustic. The soda is dissolved in hot water and lime is added. The carbon combines with the lime and forms calcium carbonate. The remaining solution is evaporated and caustic soda obtained.

There is a large lime belt 18 miles south of Lake Abert and on the line of the railway survey. Thus Summer and Abert Lakes are admirably situated for the manufacture of caustic soda. It is quite apparent that there is more profit in the manufacture of caustic than in other sodas.

Common Table Salt

The common table and stock salt of Summer and Abert Lakes is destined to monopolize the market in the Northwest. The Oregon deposit is the only one in the states of Idaho, Washington, Oregon and in the Western Canadian provinces. The supply of salt throughout this territory at present comes from Liverpool, Kansas, Utah and San Francisco. The price ranges from $8.50 per ton for stock salt in Portland to $40.00 a ton at interior points.

The table salt at Summer and Abert Lakes will be a by-product, and its only cost to the owners will be the royalty of 50 cents and the sacking.

This Northwestern territory contains a tributary population of 5,000,000 people, and the per capita consumption is one ton to each 25 inhabitants.

Thus it is seen that there is a market for 200,000 tons of Summer and Abert Lakes' salt, and the population of this territory is doubling each decade.

The salt product offers a strong inducement for the building of railroads. It is tonnage that the railroads want. The lessees could afford to give this salt traffic to the railroad without profit for the mere sake of getting their soda and potash to the seaport.

However, it is safe to say that the salt alone will yield a profit of $5.00 per ton to the owners of the lakes.

The census for 1910 shows that the production of salt in the United States as over 31,000,000 barrels, and the average price was $2.10 per ton. However, the low price is caused by the much inferior salt used in Eastern manufacturies. The price of salt at Summer and Abert Lakes, f.o.b., should never be less than $10 per ton.

Even if one estimates that Summer and Abert Lakes will secure only half the market of the northwest, the property will have a sale of 100,000 tons of salt a year, at a profit of $5.00 a ton, or $500,000.00.

Railroads.

In the last few years the railroads have been rapidly building into Central Oregon. In the summer of 1909 both Hill and Harriman commenced to build up the Deschutes and have spent $25,000,000 in constructing lines to Bend, Both have projected lines farther south.

The Southern Pacific is building the Oregon Eastern across the State

from Ontario to Eugene and on to Coos Bay. It is announced that this road will be near the Lake County boundary by the summer of 1913. By 1914 it should connect with the Klamath Falls branch at Crescent Lake. It will run about thirty miles north of Lake Abert and twenty miles north of Summer Lake.

The Southern Pacific has filed its maps in the Lakeview land office for a line south via Lake Abert to Lakeview and on down the Pitt River to San Francisco.

The Nevada-California-Oregon built into Lakeview last summer and its stockholders have voted to extend the line to the Columbia River via Lake Abert. Lakeview, its present terminus, is twenty-eight miles south of Lake Abert.

There is a fine fruit and agricultural district and large stock and timber interests tributary to the lakes. All these things make up the resources that bring railroads.

Moreover, it is practical to build electric lines to connect with the present steam roads. Central Oregon is almost level and roadbeds can be laid at small expense.

Title.

The title to Summer and Abert Lakes is vested in the State of Oregon. The state has leased the lakes, for a term of forty years, to Ellis Mallery, W. G. Young and C. M. Sain. Copy of this lease is submitted herewith.

The lease is even more advantageous than an ownership in fee. If the property were held as mining claims, it would cost practically $1,000,000 to patent the property.

The minimum royalty to the State, $50,000 per year, is no more than the interest on this sum for patenting, and if the property were owned outright it would have to bear taxes and the taxes, alone, would be more than the minimum royalty.

Recapitulation.

Profit on soda.	$200,000,000
Profit on potash	50,000,000
Profit on salt.	20,000,000
Total - 40 years	$270,000,000

This is an average of almost $7,000,000 a year.

This estimate of profits is meant to be very conservative. It is my firm belief that in the actual working of the property this estimate will be found too low.

Respectfully submitted,

(Signed) C. M. Sain

Los Angeles, California.
August 15, 1912.

C
O
P
Y

Southern Pacific Company.

J. Kruttschnitt,
Assistant to President, Vice-President,
and General Manager.

San Francisco, Calif.

New York, October 7, 1902

Mr. C. M. Sain,
President, the Oregon Potash Co.,
Lovelock, Nevada.

Dear Sir:

Referring to your communication of September 29th, which has been forwarded to me at this point, I take pleasure in quoting below analyses of waters obtained from Abert and Summer Lakes:-

	Grains per U. S. Gallon.	
	Abert Lake	Summer Lake
Sodium chloride.	2477.99	517.69
Silica	9.04	16.21
Sodium carbonate . . . . .normal .	1293.49	825.79
Sodium bi-carbonate.	399.30	380.00
Potassium sulphate	143.69	70.33
Sodium sulphate.		45.25
Potassium chloride	5.95	
Totals	4329.46	1855.27

Yours truly,

Signed- J. Kruttschnitt.

C
O
P
Y

Thomas S. Gladding, A. M. Established 1868
Associates
Ralph W. Bailey, B.S.
Henry E. Cutts, A. M.

Office and Laboratory
of
Stilwell and Gladding.

Analytical and consulting Chemists.
No. 35 Fulton Street, Cor. Cliff Street.
New York.

Analysis No. 94577 Oct. 2, 1901.

Certificate of Analysis

of a sample of Water
marked "Summer Lake"
received from Mr. C. M. Sain, September 28th, 1901.

Specific Gravity at 15.5 degrees C. 1.0319

grams per litre.

Silica	0.260
Chloride of sodium	10.032
Sulphate of soda	0.798
Carbonate of soda	22.759
*Sulphate of Potash	1.572
Total solids	35.421

*Equivalent to Potash 0.850 grams per liter.

Signed- Stilwell & Gladding,
Analytical Chemists,
New York.

Same letter head.

Analysis No. 94779 Oct. 19, 1901.

Certificate of analysis

of a sample of Water
marked "Abert Lakes"
received from C. M. Sain, Oct. 14, 1901.

Specific gravity at 15.5 degrees C. 1.0515

grams per liter.

Silica	0.285
Chloride of sodium	35.056
Carbonate of soda	26.448
*Sulphate of Potash	2.210
Total solids	63.999

*Containing potash 1.195 grams per liter.

Signed- Stilwell and Gladding.

Measurements of the Flow of the Chewaucan River Year 1906.

Month	Acre-feet.
January	4,050
February	3,480
March	10,600
April	33,500
May	41,200
June	24,700
July.	6,760
August	1,870
September	2,260
October	2,290
November.	2,840
December.	3,200
Total	136,750

Record of Four Years' Precipitation at U. S. Weather Station, Woodward Hot Springs, South of Summer Lake, Oregon.

Month	1906	1907	1908	1909
January		73	34	2 60
February		1 67	58	55
March		2 15	11	1 02
April	44	09	21	00
May	1 11	1 28	95	91
June	55	2 80	56	81
July	1 03	30	1 07	23
August	94	50	04	06
September	15	1 35	40	81
October	89	78	1 42	98
November	75	*	41	2 06
December	1 09	*	30	74
	6.95	11.65	6.39	10.77

*Months missing.