

Lead Refining

26

*Cerro de Pasco Copper Corporation*

*44 Wall Street,*

*New York,*

December 9, 1927

*Office of E. V. Drew,  
15th floor,  
Telephone Beekman 3900-4*

*Cable Address:  
"Cerrocop, New York,"  
"Cerrocop, Lima."*

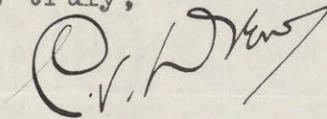
CONTENTS NOTED  
DEC 13 1927  
LAWRENCE ADDICKS

Mr. L. Addicks,  
51 Maiden Lane,  
New York City.

Dear Sir:

I asked Mr. Sawyer to make a comparison of liquidations on lead bullion of a composition expected from material on hand at Oroya and enclose herewith copy of his memorandum of December 2 on this subject. When you come next week I will show you the figures and would like to talk to you further about the American Metal proposal.

Yours truly,



enc.

December 2, 1927.

Memorandum to - Mr. Drew

Subject - Refining Proposals

Referring to the different proposals for the refining of lead bullion, I am attaching hereto, some pencil work sheets showing the estimated returns for bullion refined under these different proposals. Such returns are, of course, variable, depending upon two assumptions:

- 1 - Assay of the bullion
- 2 - Prices used.

With reference to the first variable, the lead ore and concentrates in the Smelter stock pile on October 1st, was of the following grade:

Lead - 43.1%  
Silver - 181.43 ounces per Ton.

If smelted, the bullion produced should be of approximately the following grade, which has been assumed in making up the attached figures:

Silver	-	1.37%	(400 ounces per Ton)
Lead	-	97.1 %	
Arsenic	-	.50%	
Antimony	-	.50%	
Copper	-	.20%	
Bismuth	-	.10%	
Gold	-	nil	
Miscellaneous	-	<u>.23%</u>	
Total	-	100.00%	

First, with reference to the American Metal Company's proposal dated October 25th, 1927, for "B" or low bismuth bullion, the attached sheet shows the return under this proposal, as compared with other proposals.

To - Mr. Drew  
Subj- Refining Proposals

December 2, 1927.

You will note that with the exception of the payment for silver, this new proposal is little better than the others due to the high silver charge. It is unfair to compare the American Metal Company's proposal of September 16th, 1924, with the others because this proposal is based on turning back to the shipper both lead and silver, while the other proposals are based on the refiner selling both products. Note, however, that the charges for refining under the October 25th, 1927, proposal are higher than any of the others with the exception of the Associated Metals' proposal of September 28th, 1927. While the proposal may be attractive for low grade bullion, it certainly is not a favorable tariff for bullion running as high as 400 ounces of silver per ton of bullion.

To me, the most interesting phase of the new proposal from the American Metal Company is the tariff for the treatment of the "A" or high bismuth bullion. This proposal is similar to the plan proposed by the A.S.&R. early this year and it is interesting to note the charges for the same grade of bullion under the "A" proposal as compared with the charges under the "B" proposal.

	<u>"A"</u>	<u>"B"</u>
Base Charge	\$11.00	\$ 4.00
Extra for Silver	1.20	8.00
"    "    Lead	.03	.03
Impurities - Arsenic	--	.17
"    General	2.46	1.00
Drossing Charge	<u>.50</u>	<u>.50</u>
	\$15.19	\$13.70

From the above, you will note that without amortization, it is almost as cheap to refine this grade of bullion under

To - Mr. Drew  
Subj- Refining Proposals

December 2, 1927.

the "A" proposal as under the "B". In fact, I told you when discussing the matter that the charges were equal and at that time, I thought that they were because I had interpreted the impurity clause in both tariffs to read the same, that is, the impurities were determined by deducting from 100% the combined percentages of the lead and the silver. If this were the case, the charges would be almost exactly the same, but under the high bismuth tariff, the impurities are determined by deducting from 100% the percentage of lead, which naturally penalizes 1.37% silver at 85 cents per unit.

The financial plan naturally has some objectionable aspects although there are many good arguments which can be advanced in favor of such an arrangement. However, there is another objectionable feature, and that is the method of returning the bismuth. It is proposed to return this in the nature of a slag and the shipper to account to the refiner for a certain percentage of the silver and lead contained in this slag. Due to the fact that the refiner pays for 100% of the silver in the bullion and the shipper is required to account for only 99% of the silver in the bismuth slag, it would, of course, be to the refiner's advantage to keep this slag as low in silver as is possible, yet, nevertheless, the burden of separation is placed on the shipper. This separation is a function of the refinery and a flat charge should be made if the shipper wishes the bismuth returned. The A.S.&R. proposal was made on this basis, there being no charge in case the bismuth was not returned but a charge of 35 cents per pound for all bismuth returned.

To - Mr. Drew  
Subj- Refining Proposals

December 2, 1927.

Doubtlessly, the grade of material to be sent to the lead furnace will decrease and therefore, the proposal for low bismuth bullion might work out quite satisfactorily. To me, however, the above figures emphasize the important part the bullion assay will play in the refinery tariff and therefore, very little can be accomplished until some bullion is actually produced.

G.P.Sawyer.

CERRO PROBLEMS

1. Proper course to pursue in regard to disposal of bismuth. Only experimental quantities will be produced during 1928 and 1929. Beginning 1930 from 50 to 75 tons a month will have to be sold or stored.

2. Proper division of lead bullion into grades. By the time production starts there will be 40,000 to 50,000 tons of flue dust on hand running

50% Pb.	5.30% As.
10 ozs. Ag.	1.75% Sb.
2.25% Bi.	7.3% S.
0.31% Cu.	4.0% Zn.

and at least 50 tons a day of such dust will continue to be produced. Putting 100 tons a day into production will produce:

(a) if smelted direct:

50 tons a day bullion running

92.2% Pb.	0.1% Cu.
18.5 ozs. Ag.	0.1% As.
4.15% Bi.	3.2% Sb.

(b) If separated by partial reduction:

35 tons a day bullion running

95.5% Pb.	0.1% Cu.
5.5 ozs. Ag.	0.1% As.
0.6% Bi.	3.6% Sb.

and 14 tons a day bullion running

84.0% Pb.	0.22% Cu.
111.5 ozs. Ag.	0.02% As.
15% Bi.	0.05% Sb.

It is probably possible to change this ratio to say 40 tons a day bullion running 1.0% Bi and 9 tons a day bullion running 20.0% Bi.

(c) If mixed with present output of low bismuth lead:

100 tons a day running:

92% Pb.	0.08% Cu.
154 ozs. Ag.	0.1% As.
2.1% Bi.	3.6% Sb.

Note: Present lead output is taken as:

50 tons a day running

92% Pb.	0.06% Cu.
290 ozs. Ag.	0.1% As.
0.14% Bi.	4.0% Sb.

3. Development of market demand for bismuth. The project is advanced for discussion of the establishment of available funds not to exceed \$50,000 a year for five years for research and commercial exploitation of new uses for bismuth. This fund to be underwritten in suitable proportions by Cerro de Pasco, A.S. & R., U.S. Smelting and Anaconda. Its expenditure to be directed, under proper control, to

- (a) publicity in technical circles as to the problem.
- (b) collection and publication of all existing data.
- (c) research along suggestive lines.
- (d) discussion of possibilities with technical heads of principal industries of the country.

I should suggest that Dr. Colin G. Fink of Columbia (if persona grata to all concerned) be retained as he has shown the rather rare faculty of getting concrete results on problems put up to him rather than the interesting but irrelevant discoveries in collateral fields which usually result from research undertakings. Also the establishment of a research fellowship at the Bureau of Standards to get contact with the government. Finally the assignment of an engineer with as diversified experience as possible to make the contact with the industrial world.

Molybdenum, cadmium and selenium have all been lifted from a similar situation by intelligent attention and it is only by widening the uses of bismuth that there is going to be any satisfactory market for the oncoming total which must be produced to refover the associated lead and silver.

April 12, 1933

MR. DREW:

Betts Plant

The proposal to treat mixture of lead concentrates and converter Cottrell dust for the production of lead bullion and to treat this bullion in the Betts plant introduces several new factors.

Most of the lead concentrates available carry high silver values as well as other impurities; hence the bullion to be treated will yield a slime, high in silver, antimony, lead, arsenic, and relatively low in bismuth. This slime would have to be processed for the recovery of silver first and bismuth second. The ratio of silver to bismuth in the crude bismuth metal would be so high that the silver can not be removed by zincing, rather the silver will have to be separated by a two-stage oxidization as used at East Chicago.

This means two reverberatories, a baghouse and other equipment. Considerable silver and bismuth will be tied up in furnace linings and circulating by-products.

In other words, the metallurgy of a high silver, low bismuth slime is not as simple as it is for a low silver, high bismuth slime.

W. C. SMITH

G

OFFICE MEMORANDUM.

August 17, 1931

When Mr. Hall was in the office to-day I asked him what he knew about the use of calcium for taking bismuth out of lead. He told me that, according to his recollection, the Perth Amboy people were producing ~~calcium from~~ calcium lead alloy by adding calcium carbide to molten lead and that they use this calcium lead alloy to eliminate bismuth from refined lead only - that it is of no use in trying to treat lead containing other impurities as the calcium may combine with antimony and other elements almost as well as with bismuth.

He said his recollection was that it cost them about \$2.00 per ton to reduce the bismuth content of a 15% bismuth lead bullion down to .09 bismuth. This information checks fairly well with the rate which the Guggenheims are charging us for bismuth above .07.

Mr. Hall also advises in adding the calcium carbide to the lead it is their aim to produce a 4% calcium lead alloy - that is, 4% calcium and 96% lead. This alloy is then added to the bismuth-bearing lead in proper proportion to bring the bismuth down as low as possible.

C. V. DREW

February 15, 1935

Cerro de Pasco Copper Corporation,  
44 Wall Street,  
New York.

Dear Sirs: Lead Refinery

Acknowledgment is made of your letter of February 1st  
on above subject.

A copy of your letter was referred to Mr. Harper and now  
you will please find attached copy of his memorandum of February  
18 to Mr. Spilsbury, in which he has answered, as closely as possi-  
ble, the questions asked in your letter.

If there is any additional information that you may desire,  
will you kindly advise.

Yours truly,

HAROLD KINGSMILL

General Manager.

Mr. R. Spilsbury,  
Assistant General Manager,  
La Oroya.

La Oroya  
Feb. 13, 1935

Dear Sir: Lead Refinery

With reference to New York Office letter of Feb. 1, on this subject.

The success of the process lies in having sufficient impurity, whether antimony or bismuth, to form a hard residue or slime, that will be adherent to the anode and allow for handling through the wash tanks, also in limiting the time of corrosion to prevent anodic solution of impurities. Obviously these two points are related to one another. In general, the impurities should be over 5%, leaving less than 95% Pb. The impurities may increase to 20%, with 80% Pb. With lead 90-95% the period of anode corrosion is 2 days. With one day corrosion lead of less than 80% may be treated. In all cases the grade of the refined lead is 99.99 plus.

This discussion seems to answer the first two questions.

As to the third question:

For a small plant, 25-30 tons per day, in treating 90% Pb bullion, the tank house labor is two man-hours per ton. For twice this capacity it would be reduced to 1 1/2 man-hours per ton. These figures include transportation of electrodes between kettle house and tank house, washing of anode residue and servicing of electrolyzing tanks. We have no experience in treating high grade bullion (98% Pb) and so are unable to state what the corresponding labor would be. In this matter it should be borne in mind that Peruvian labor is not so efficient as labor in the United States.

Question four cannot be definitely answered since the process for treating the slime will depend on the impurities in the bullion and the cost will vary accordingly.

The answer to question five is that the acid loss is not dependent on whether the impurity is antimony or bismuth, but depends on the thoroughness of washing the anode residue. In our experience the acid loss should be between 4 and 10 lb. H<sub>2</sub>SiF<sub>6</sub> per ton of lead.

The following bullions have been treated successfully:

<u>Ag Oz/t</u>	<u>Cu %</u>	<u>Pb %</u>	<u>Sn %</u>	<u>As %</u>	<u>Sb %</u>	<u>Bi %</u>
3.3	.14	90.7	1.1	2.1	5.8	.16
33.7	.20	84.0	nil	3.4	2.4	10.0
25.0	.05	91.0	nil	.5	3.2	4.7
26.1	.16	89.0	nil	2.5	3.4	4.9

Yours very truly,

S/ T. E. Harper, Jr.

Airmail 2/1

February 1, 1935.

Lead Refinery

Mr. H. Kingsmill, General Manager,  
Cerro de Pasco Copper Corporation,  
Lima, Peru.

Dear Sir:

Under date of December 12 you sent us the following analysis of the anodes from which refined lead, lots 14, 15, 16, were produced:

Ag.oz./t		6.5
Cu	%	.11
Pb	%	93.4
Sn	%	.005
As	%	.70
Sb	%	5.7
Bi	%	0.18

Recently we have had some tentative interviews with some of the refining people in this country having in the back of our minds the possibility of making some profit out of the refining patents. The question has been raised as to whether the secret of the process lies actually in the antimony content of the anode and the resultant hard slime, also as to whether a critical point will be found of the amount of bismuth in the anode above which the cathode will foul.

If the information is available we should like to have our metallurgical staff answer as fully as they can the following questions:

- 1) Can antimony in the anodes be varied over considerable limits
- 2) Can high bismuth anodes be refined economically and high grade lead be obtained, low in bismuth, as well as when refining high antimony anodes
- 3) What are tankhouse man-hours per ton and what would they be for normal Betts anodes with normal drawing age
- 4) What are slimes treatment costs
- 5) What are acid losses:
  - (a) when using high antimony anodes
  - (b) " " " bismuth anodes

Any information that you can send us on these questions will be very useful to us in possible negotiations with respect to patent rights.

Yours truly,

Date: Sept. 8, 1934.

To: Mr. B. T. Colley, Metallurgical Engineer, La Croya.

From: T. E. Harper Jr.

SUBJECT: Refined Lead Lot #9.

<u>Ag.%</u>	<u>Cu.%</u>	<u>Zn.%</u>	<u>Sn.%</u>	<u>As.%</u>	<u>Sb.%</u>	<u>Bi.%</u>	<u>Fe.%</u>	<u>Pb (diff.)</u>
.00004	.0006	nil	.0001	nil	.0016	.0004	nil	99.997

0.012 g.p.t.

Sgd. T. E. Harper Jr.

$$\frac{4}{100,000,000} = \frac{1.2}{30,000,000} = 0.012 \text{ g.p.t.}$$

$$1 = 30$$

$$.012$$

$$30,000 = 100\%$$

$$3,000 = 10\%$$

$$300 = 1\%$$

$$30 = 0.1\%$$

$$3 = 0.01\%$$

$$0.3 = 0.001\%$$

$$0.03 = 0.0001\%$$

$$0.003 = 0.00001\%$$

$$0.012 = 0.00004\%$$



A-499

November 18, 1934

Mr. C. V. Drew, Vice-Pres.,  
Cerrode Pasco Copper Corp.,  
44 Wall Street, New York City.

Dear Mr. Drew:

LEAD REFINERY

Noting the very gratifying analyses of the  
reined lead lots 14, 15 and 16 in Mr. Spilsbury's letter of  
November 7th, I should like to know if possible the correspond-  
ing anode analyses.

Very truly yours,

*Crew*

February 1, 1935

Lead Refinery.

Mr. H. Kingsmill, General Manager,  
Cerro de Pasco Copper Corporation,  
Lima, Peru.

Dear Sir:

Under date of December 12 you sent us the following analysis of the anodes from which refined lead, lots 14, 15, 16, were produced:

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If the information is available we should like to have our metallurgical staff answer as fully as they can the following questions:

- 1) Can antimony in the anodes be varied over considerable limits
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- 4) What are slimes treatment costs
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  - (a) when using high antimony anodes
  - (b) " " " bismuth anodes

Any information that you can send us on these questions will be very useful to us in possible negotiations with respect to patent rights.

Yours truly,

*Acty CVD*

# *Cerro de Pasco Copper Corporation*

*44 Wall Street,*

*New York,*

April 3, 1930

*Office of C. V. Drew,  
45th floor.*

*Telephone Beekman 3900-4*

*Cable Address:  
"Cerrocop, New York,"  
"Cerrocop, Lima."*

Mr. L. Addicks,  
Bel Air, Md.

Dear Sir:

The attached copy of letter dated March 31 from Arthur E. Hall of Perth Amboy with respect to a cheap, effective method of eliminating bismuth from lead is very interesting especially as it came the day after I had a talk with Mr. Roger Straus relative to the possibility of their handling lead bullion running over two-tenths of one percent in bismuth. In the course of that conversation Mr. Straus said that he thought they could take care of such bullion as under stress of necessity their organization had developed a process for eliminating bismuth without Betts refining and that patents for the process had been applied for. He added that it was largely due to Cerro's high bismuth bullion that they had been forced to develop this process because after making a contract with us the source of low bismuth lead which they had expected to use to dilute Cerro bullion had been shut off. I asked Straus if they could take care of high bismuth bullion right away and he said they would prefer to have a few months' time to make provision for any considerable tonnage but that they had no doubt they could take care of it in time. I was unable to get out of him what the cost of such treatment would be. I asked him if it was a process that would enable them to recover the bismuth and he said "yes at a certain cost". I then asked him if they would be willing to treat high bismuth bullion for us and return the bismuth to us. He hesitated and then said that the whole bismuth situation was so unsettled he would have to think the matter over. This attitude on his part gives me an opportunity to unburden my mind to you on this subject. My opinion is that the whole question of high bismuth lead bullion should be settled before we enter into any contract with the bismuth Syndicate. I am apprehensive that if the AS&R should get us in a position where we either had to build a Betts plant or pay them such refining rates as they might demand they would be very difficult to deal with.

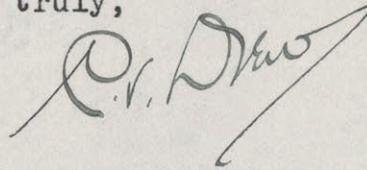
I am enclosing herewith copy of Oroya Research Department letter for February in which you will notice that the statement is made that practically no ores are free from bismuth.

In the case of San Cristobal mine on which we have an option and which we expect to acquire, the bismuth content of the ore itself runs as high as .12 and .15. Concentrates from such ore when smelted would of course produce a very high bismuth bullion. We must face this situation squarely. It looks as if we are going to have plenty of high bismuth bullion, not only from flue dust but also from ores, to dispose of and so we may

have to consider a Betts plant in Peru or elsewhere or make some arrangement with AS&R or some other refiners.

Mr. Colley is sailing from Peru April 16 and should arrive the last of this month. While he is here we should hear all of his arguments for a Betts plant in Peru and then decide on a policy with respect to treatment of high bismuth lead bullion so that we will know definitely where our supply of bismuth is to come from before we sign any contract with the Syndicate.

Yours truly,

A handwritten signature in dark ink, appearing to read "R. V. Drew". The signature is written in a cursive style with a long, sweeping underline that extends to the right.

enc.

March 31, 1930

Mr. C. V. Drew, Vice Pres.,  
Cerro de Pasco Copper Corp.,  
44 Wall St.,  
New York City.

Dear Sir:

Something less than a year ago you granted me an interview relative to a possible engagement for me by your company.

Since that time, amongst other things, I have developed a cheap, effective method for eliminating bismuth from lead, or at least producing lead 0.02% bismuth on the one hand and lead up to 40.0% bismuth on the other.

It is applicable to lead either before or after the ordinary softening, desilverizing etc., but is in no sense a substitute therefore except in very special cases.

I have built a small scale apparatus for demonstration of the principles of process at this address.

I have applied for U.S., Peru and Mexican patents.

If you are interested in this I would be glad to explain the principle of the process and make a demonstration to anyone you might designate.

Sincerely yours,

ARTHUR E. HALL

COPY

A-311

December 1, 1931

Mr. C. V. Drew, Vice-Pres.,  
Cerro de Pasco Copper Corp.,  
44 Wall Street, New York City.

Dear Mr. Drew:

LEAD REFINING CONTRACT

Confirming yesterday's conversation I think that the proposal from Mr. Straus should be preserved if possible as a basis for future negotiations but declined at present on the ground of unprofitable metal markets. In the meantime we should investigate the various possibilities of placing the present output in a field where its refining would not be necessary. The possibility of using it for burial caskets is worth looking into.

As refining would cost \$17 a ton there is quite a margin. If it has to be refined we should wait for a considerable appreciation in the lead market.

Very truly yours,

*Ray*

WALTER C. SMITH  
METALLURGIST

Moylan, Pa.

May 4 30

Mr Lawrence Addicks -

My dear Mr Addicks -

Worked all last week with Mr. Hall on high burn with refined lead. Had some trouble with the apparatus, more than with the high antimony bullions of the week before. A very heavy cross loss was present with refined lead, which was not noted with bullion. Mr Hall claims that larger apparatus would reduce the cross loss and give better temperature control.

Samples have been sent to Walker-White for assay, and when reported I will send in report.

The apparatus is very small, crude and too small to give any reliable data, but if assays are promising, should warrant a large scale test.

P.S. Leaving for  
Wash. D.C. tonight.

Yours very truly  
W.C. Smith

May 21, 1930.

Mr. C. V. Drew, Vice-Pres.,  
Cerro de Pasco Copper Corp.,  
44 Wall Street, New York City.

Dear Mr. Drew:

LEAD METALLURGY

I have Mr. Smith's memorandum of May 17th regarding the tests made at Perth Amboy on the Hall process.

The Hall process is merely Pattisonizing which in turn is systematic liquation analogous to freezing fresh ice out of salt water. The novel step is that in previous mechanical systems the enriched <sup>leaves</sup> been drained away from the purified crystals while Hall removes the crystals from the bath as formed by means of a screw conveyor, just as they were ladled out by hand in the early days.

When a number of metals are present at once the crystals become small and the separation faulty so that in the past bullion has always been softened before Pattisonizing when more than 1% of impurities were present. This is confirmed by the Hall experiments on regular Cerro bullion and I think we shall have to confine the possible application to reducing bismuth in fine lead.

Published data (pre-war) on the plant built at Omaha indicates an investment of \$85,000 for treating 150-200 tons a day of bullion running 0.33% bismuth, producing 80% fine lead running 0.05% bismuth and 20% anode lead running 1% bismuth which was sent to the Betts plant. The cost was about \$5.00 a ton of entering bullion using 11 kettles.

The metallurgical limitations have been well established. We are interested in two points: (1) has Mr. Hall improved and cheapened the process? and (2) would its application be useful to us?

Our lead flow-sheet at Oroya has been based on two assumptions: (1) rich bismuth lead should not be mixed with leaner--- that is segregation not aggregation of bismuth, and (2) refining plants should not be built in Peru unless absolutely necessary. I have always admitted this may require us to produce two or more grades of work-lead but I hope we can avoid this and keep the present simple combination of one average grade of lead sent to Perth Amboy. Our trouble is that the present contract limit of 0.2% bismuth is too high for the A S & R and too low for us.

At present by carefully watching the ore charges to the blast furnaces and holding the reverberatory bullion down to 10% bismuth we are able to keep the lead sent to Perth Amboy down to the limit imposed by the contract. But we have been warned by Peru that ore charges running up to 0.25% may be unavoidable later on and we know that the reverberatory process would be cheapened if we could make a correspondingly richer bullion.

We can therefore say at once that a process or a contract to take a bullion running up to say 0.3% is attractive.

If Mr. Hall can do what he claims, that is, equal Omaha Pattison metallurgy for \$1.75 a ton plus \$0.25 royalty there is plenty of profit available. To use it at Oroya we should have to install softening furnaces and a Parke's plant either ahead of or to follow it and to dispose of a small quantity of enriched bismuth lead. We are much more interested in extending the limits of bismuth in the existing contract, however, and avoiding the whole question. In other words it is the A S & R and not ourselves who should use the process or its equivalent but the knowledge that we could use it is a good card in our hand.

I should say, therefore, that we were interested in demonstrating the process, while admitting that if the result is only to extend the present contract we have done well. We cannot hope to run a Parkes plant ourselves for the base costs in the present contract and I think even to extend the present bismuth penalty to 0.3% would justify us in going on as we are.

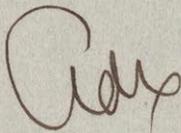
Now as to the Perth Amboy experiments on desilverized bullion. The bismuth elimination was way below standard. The Omaha schedule compares as follows:

Kettle#	Bismuth	Hall
--	0.050	
1	0.063	
2	0.081	
3	0.104	0.183
4	0.130	0.193
5	0.164	0.202
6	0.206	0.207
7	0.260	0.221
8	0.330	0.230
9	0.440	
10	0.580	
11	0.770	
--	1.000	

This is a weak showing but may be due to poor temperature control.

It seems to me that we should ~~at~~ first sound out what sort of a contract can be worked out with Mr. Straus. If these conversations are encouraging we can drop the experiments, if not, we should look into the cost of constructing a full size kettle of Hall's and the probable operating costs if successful. Perhaps it could be tried out at one of the refineries, but in any case it can best be done here rather than in Peru. While I am not over-hopeful in the face of the experiments already made I should examine the possibilities patiently because it might mean much to us either practically or pschycologically.

Very truly yours.

A handwritten signature in cursive script, appearing to read "C. D. P.", is centered below the typed text.

May 17, 1930

MR. ADDICKS:

The attached pencil sketches show the results obtained with Hall Test Equipment, both on CdeP bullion and on refined lead containing .203% bismuth.

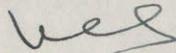
Several inconsistencies appear in each test. I do not know whether these are due to errors in analytical work or possibly we are expecting too much of bismuth determination since .01% difference would be very noticeable.

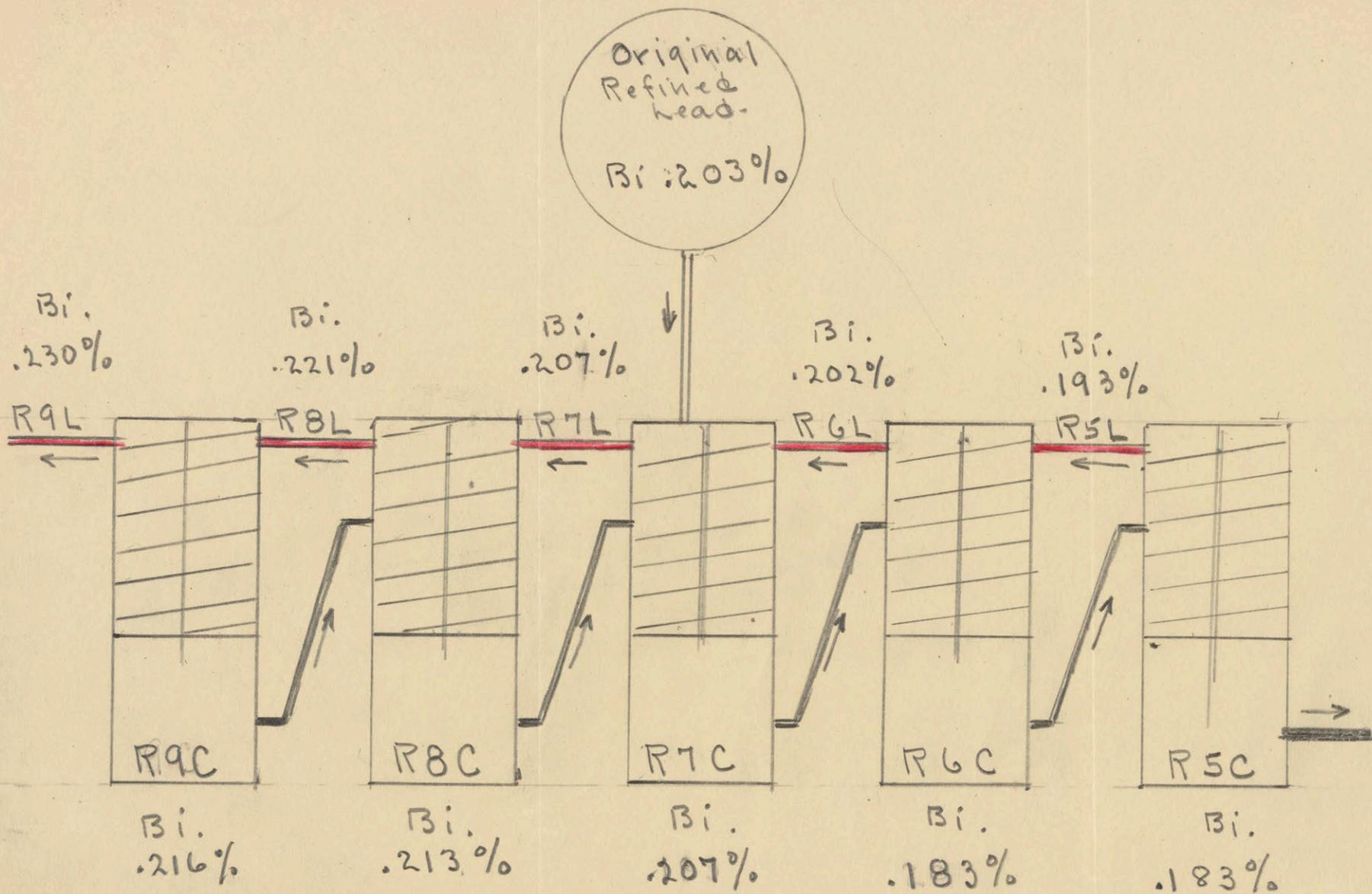
Just received the assays to-day and have not talked with Mr.Hall. I will not do so until I hear from you as to your opinion.

When working with bullion, only a small amount of dross was formed but with the refined lead a very large amount of dross was formed at each step - in some cases as much as 15%. Mr.Hall claims this was due to small scale operation and inability to properly regulate temperature with the test apparatus, but this could be controlled with larger and properly designed apparatus.

Sm/G

W. C. SMITH





Hall Process.

Refined head. Containing 203% Bismuth.

WCS 5/17/30

# Hall Process

Cerro de Pasco Bullion

Apr. 21-26 1930

378 Market St.

Perth Amboy.

N.J.

Original  
Bullion

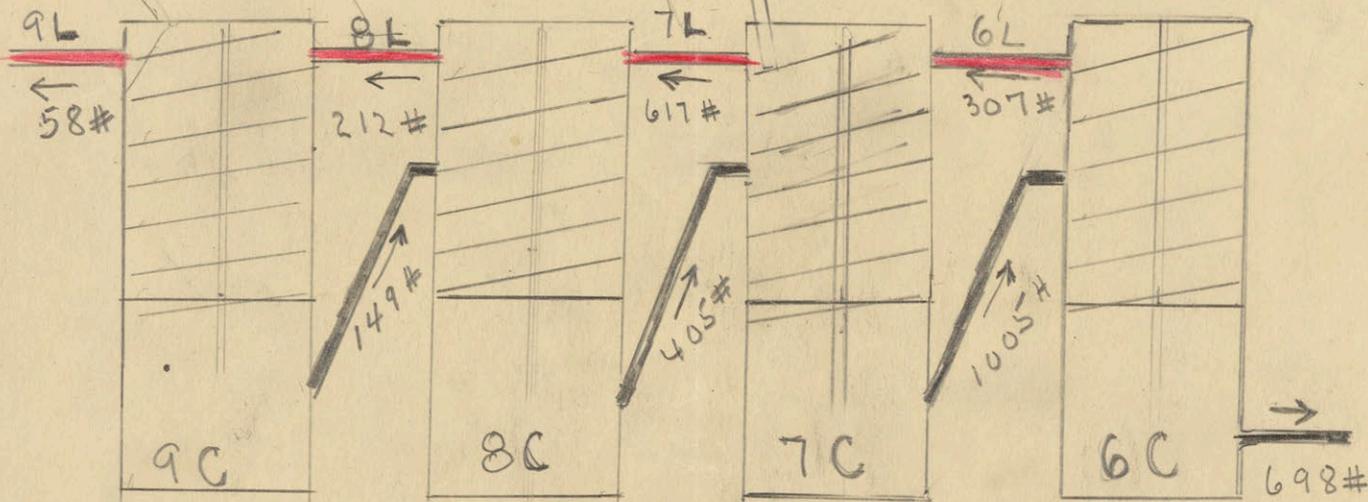
Ag	220.5 oz.
Sb	3.86%
As	.337%
Cu	.07%
Bi	.178%

1622 #.

Ag 243.7  
Sb 4.16  
As .358  
Cu .042  
Bi .177

Ag 238.5 oz  
Sb 4.11%  
As .346%  
Cu .041%  
Bi .178%

Ag 224.6  
Sb. 3.98%  
As .325%  
Cu .055%  
Bi .169%



Ag 235.3 oz  
Sb 4.02%  
As .329  
Cu .056%  
Bi .171%

Ag 217.2  
Sb 3.85%  
As .325%  
Cu .064%  
Bi .174%

Ag 213.8 oz.  
Sb. 3.77%  
As .329%  
Cu .063%  
Bi .166%

Ag 211.4 oz.  
Sb 3.68%  
As .296%  
Cu .059%  
Bi .166%

1025 #

W.C.S.  
5-13-30

*Cerro de Pasco Copper Corporation*

*Office of C.V. Drew,  
15th floor.  
Telephone Beekman 3900-4*

*44 Wall Street,  
New York,*

*Cable Address:  
"Cerrocop, New York,"  
"Cerrocop, Lima."*

May 25, 1930

Mr. L. Addicks,  
Bel Air,  
Maryland.

Dear Sir:

Herewith is copy of letter of May 25 from Mr. Hall.  
Acting on Mr. Smith's suggestion I have written Mr. Hall of our  
approval of a further demonstration of his process as he re-  
quests.

Yours truly,

*C. V. Drew*

May 25, 1930

Mr. W. C. Smith,  
Cerro de Pasco Copper Corp.,  
New York City.

Dear Mr. Smith:

Your thoughtfulness in sending me copies of Walker & Whyte analyses has been greatly appreciated. Unfortunately they show that my demonstration to date was a flivver. However, inasmuch as I have and can again make a separation, as I have indicated, with refined lead, I still am not discouraged in the case of high anti-mony bullion. My past week's experience and thought have indicated that after getting results with refined lead (which I did) I allowed myself to drift into different manipulation. This difference was the application of water so high in the inclined trough and applied to such a small volume of lead that the whole portion of lead to which water was applied was converted to crystal and removed by screw, hence no separation.

I shall promptly substantiate this theory, and ask for the privilege, after having done so, of giving another demonstration.

I shall send some samples to Walker & Whyte on my own account and will ask them to furnish you with results of same as well as myself.

Yours very truly,

ARTHUR E. HALL

Advise if this meets with your approval.

AEH

COPY

May 19, 1930

HALL PROCESS.

MR. DREW:

Mr. Arthur E. Hall of Perth Amboy, N.J., has offered the Cerro de Pasco Copper Corporation certain rights to a modified Pattinson process for refining lead containing bismuth. Arrangements were made to test the process at Perth Amboy under Mr. Hall's direction on two classes of lead-bismuth material:

- A. Regular Cerro de Pasco lead bullion as received at the refinery.
- B. Refined lead which contains only bismuth as an impurity.

The apparatus available was Mr. Hall's original laboratory equipment and consisted of

- 2 small kettles of 35 lbs. capacity each
- 1 crystallizer with screw conveyor and drive, with gasoline burners, molds, etc.

With this equipment only a single crystallization could be conducted at a time, the apparatus then had to be cleaned and the next crystallization carried on. The products of each crystallization had to be stored until they could be handled.

Mr. Hall proposes to install sufficient crystallizers in series in the full sized plant to yield only three products:

1. Lead sufficiently low in bismuth to be classed as corroding lead, i.e., less than .07%
2. Lead with a very high bismuth content, which must be treated by some other method
3. Some dross will be produced at each stage and this material will have to be reduced to lead and retreated.

With the single stage apparatus it was necessary to discard the liquid proportions on the bismuth decreasing side and the crystals on the bismuth increasing side and as a minimum of 90 lbs. was required only a limited number of crystallizations could be made before the metal was tied up as intermediate products.

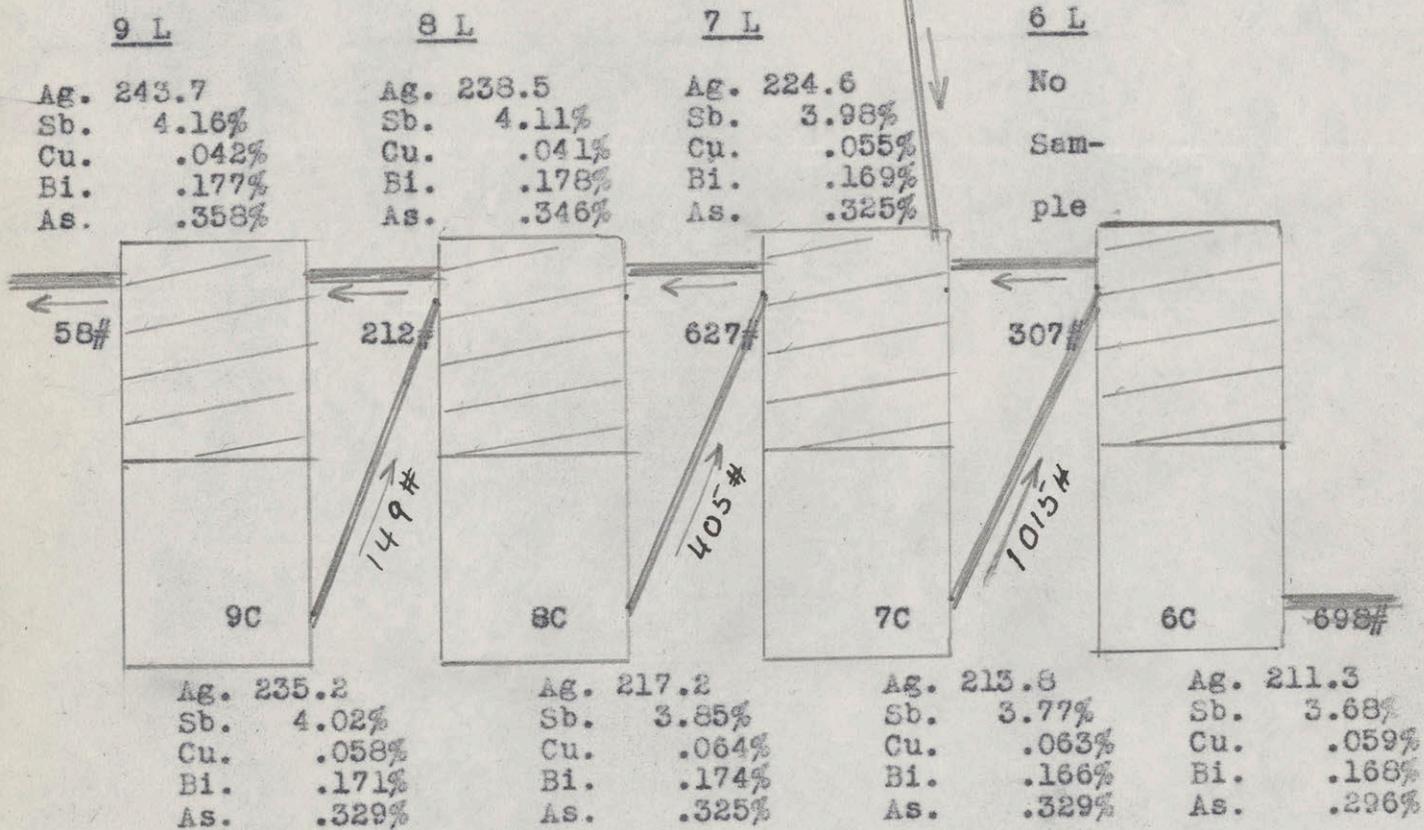
The experimental apparatus was so small that it was impossible to properly regulate the temperatures and to govern the flow of lead to the crystallizer correctly. Hence the results obtained are not as good as could be expected with larger apparatus.

The data can best be shown by the following schematic diagrams. The weights do not check out correctly as there were samples taken at each stage, and drosses formed on each melting, which can not be shown on the diagrams:

1700 lb.

Original  
Bullion

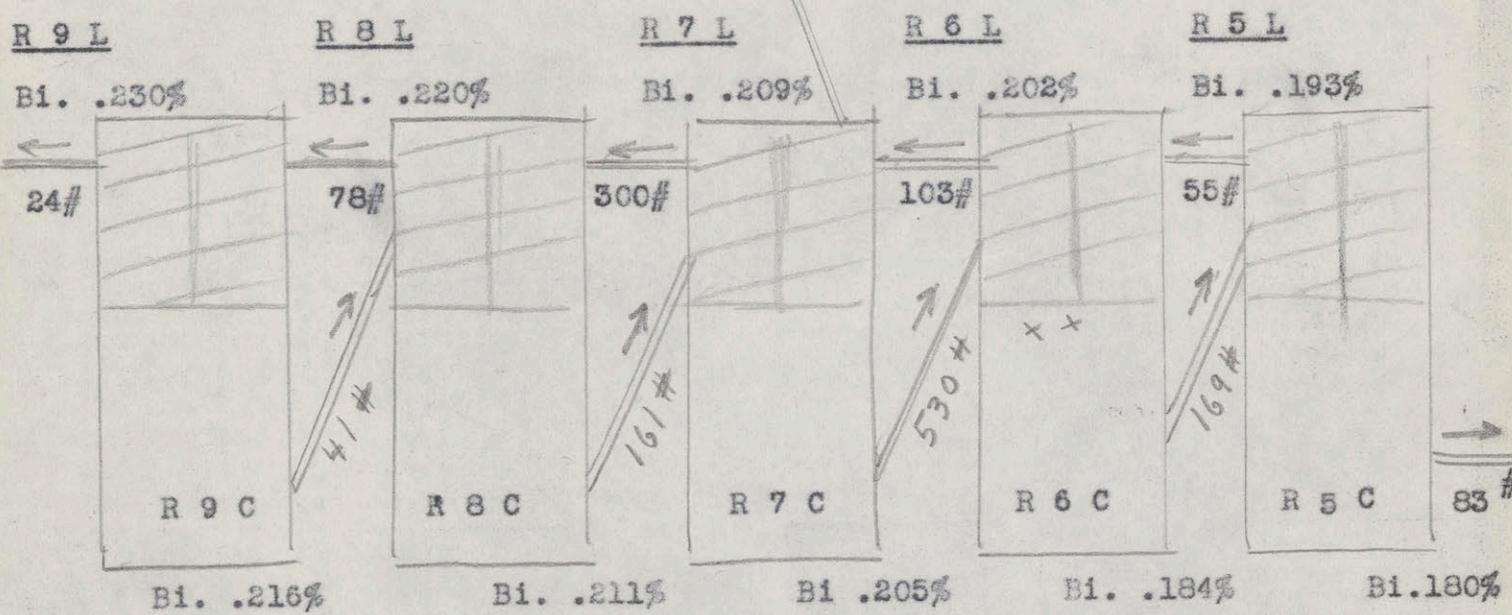
Ag. 220.5 oz.  
Sb. 3.86%  
Cu. .07%  
Bi. .178%  
As. .337%



CERRO DE PASCO BULLION

Dross averaged about 1% per crystallization

1000 lb.  
Original  
Refined  
Lead  
Bi. .203%



Refined Lead with .203% Bismuth

\*\* Only about 1/2 of R 7 C used for #6.  
Dross formation erratic but averages about 5% per stage,  
temperature too high.

The results obtained in the tests on C de P bullion show little or no concentration of bismuth. They do indicate some concentration of silver and antimony. The concentration of the silver and antimony would be expected to stop at or about the eutectic points of lead/silver and lead/antimony composition, i.e., about 700 oz. per ton silver and 10 to 11% antimony.

In the case of the refined lead there is a decided concentration of bismuth but it is considerably less per stage than the concentrations shown in Mr. Hall's patent application. Test results indicate a concentration of approximately .007% Bi. per stage, hence to reduce .20% bismuth/lead to .07% would require  $\frac{.13}{.007} = 19$  stages on the low side and probably as many more on the high side to give good separations into corroding lead and high bismuth lead.

It is an open question whether several units of larger size will give better results than those obtained in the small scale tests. If better results can not be obtained the process does not look very inviting.

Mr. Hall estimates the cost of the first full sized unit at approximately \$10,000. but the additional units will only cost a fractional part of the cost of the first unit. In other words, it will cost between \$20,000. and \$30,000. to prove that large scale operations will give better concentration ratios and less dross than was indicated by the laboratory apparatus. If much better concentration can not be obtained the operating costs will be very much higher than estimated by Mr. Hall and Betts refining of the lead would be cheaper.

I do not believe that C de P would be justified in spending \$20,000. - \$30,000. to prove this point.

Sm/G

W. C. SMITH

*Mr. Addicks*

BISMUTH ASSAYS  
LEAD BULLION TO PERH AMBOY  
-----

<u>Shipment</u>	<u>Walker &amp; Whyte</u>	<u>Refinery</u>	<u>Umpire</u>	<u>Settlement</u>
12	.15	.13		.14
13	.13	.15		.14
13-A	.14	.14		.14
14	.12	.15	.16	.15
15	.15	.165		.157
16	.163	.166		.165
17	.16	.17		.165
18	.145	.14		.143
19	.14	.147		.144
20	.166	.166		.166
21	.167	.155		.161
22	.148	.16		.154
23	.148	.16		.154
24	.145	.156		.151
25	.144	.152		.148
26	.153	.17		.162
27	.147	.157		.152
28	.156	.16		.157
29	.14	.162		.151
30	.15	.162		.156
31	.15	.155		.152
32	.14	.157		.148
33	.14	.16		.15
34	.117	.14		.128
35	.105	.125		.115
36	.122	.122		.122
37	.116	.126		.122
38	.11	.13		.12
38-A	.10	.12		.11
38-B	.10	.12		.11
39	.10	.11		.105
40	.097	.12		.108
41	.098	.115		.107
42	.106	.12		.113
43	.124	.132		.128
44	.123	.145		.134
45	.13	.14		.135

A-55

March 12, 1929

Mr. C. V. Drew, vice-pres.,  
Cerro de Pasco Copper Corp.,  
44 Wall Street, New York City.

Dear Mr. Drew:

I have your letter of yesterday. I shall plan  
to come up next week, probably Monday.

Very truly yours,

*C. V. Drew*

*Cerro de Pasco Copper Corporation*

*44 Wall Street,*

*New York,* March 11, 1929

*Office of C. V. Drew,  
15<sup>th</sup> floor.  
Telephone Beekman 3900-4*

*Cable Address:  
"Cerrocop, New York,"  
"Cerrocop, Lima."*

Mr. Addicks,  
Bel Air,  
Maryland.

Dear Mr. Addicks:

This is merely to inquire when you expect to be in New York again. Mr. G. P. Hulst of 511 Academy Street, South Orange, would like to talk with us about bismuth lead.

Yours truly,

*C. V. Drew*

*Kingsmill due  
tomorrow -*

*No hurry  
about coming  
up - He will  
be busy for several  
days before we  
can take up  
lead & bismuth -*

March 29, 1929

Mr. C. V. Drew, vice-pres.,  
Cerro de Pasco Copper Corp.,  
44 Wall Street, N. Y. C.

Dear Mr. Drew:

If we have not already the information in the monthly metallurgical reports, I suggest that we ask Perú to let us know the lead-bismuth ratio in the leady copper matte being produced at the lead plant.

The estimates have indicated that 10% of the lead entering the blast furnace is sent to the converter flues and our conferences of last week lead to the conclusion that the true figure may be 20%. Should it happen that this lead is truly bismuth-free its separate collection and return direct to the lead furnace becomes very important as it would go far toward the reduction of our current lead bullion to the 0.1% Bi figure desired by the A. S. & R. to avoid mixing complications in marketing our projected increase in tonnage.

On the other hand should there be some intermediate quantity of bismuth present it might turn out that there is little to be gained by separate collection.

Very truly yours,

*C. V. Drew*

Ad4

Can you come to  
up on Monday to  
discuss this situation  
with me - z.

How 3/27

TRANSLATION OF CABLE NO.33 - LIMA, MARCH 26, 1929

Received New York

- March 27, 1929

CERROCOP NEW YORK:

Second lead furnace estimated to begin operation  
September 1.

Present furnace will require one month for repairs.  
This may become necessary at any time.

Excluding current production Casapalca concentrates  
present furnace will clean up Casapalca concentrates in stock pile  
by September 1 producing 1700 tons bullion per month, or total  
of 8500 tons of following analysis:

Lead 95%

Silver 250 ozs.

Antimony 3.20%

Bismuth .15%

During September/October /November two furnaces should treat balance  
of stock pile and all current receipts, producing 11,500 tons of  
bullion of following analysis:

Lead 97.8%

Silver 140 ozs.

Antimony 1.20%

Bismuth .12%

This gives from April to November inclusive a total bullion production  
of 20,000 tons of the following average analysis:

Lead 96.6%

Antimony 2.05%

Silver 186 ozs.

Bismuth .13%

Even if Casapalca concentrates are not exported the stock pile  
and all current receipts could be cleaned up by end of February 1930.

Colley/Spilsbury

Our cable eighth - item 1 should read 1158 tons  
item 2 " 572 "