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Illustration of the concentration and Flintshire furnace treatment of lead ores at the Desloge Mines, Missouri

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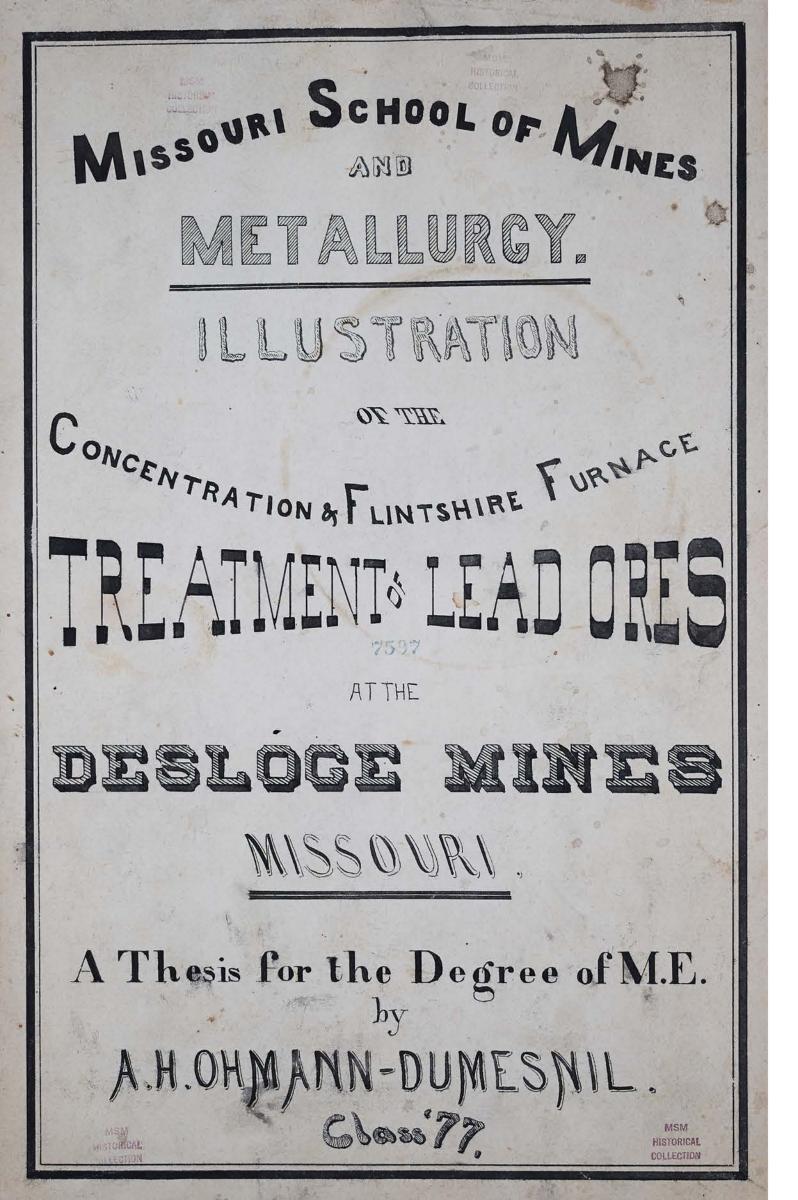
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THESIS

T. 7 3.

LEAD ORES AT DESLOGE MINES OHMANN-DUMESNIL 1877



MISSOURI SCHOOL OF MINES AND METALLURGY.

ILLUSTRATION OF THE **CONCENTRATION & FLINTSHIRE** TREATMENT OF LEAD ORES AT THE **DESOLGE MINES** MISSOURI.

A Thesis for the Degree of M.E. by A.H. Ohmann-Dumesnil.

Class '77.



The Dasloga Mines, the subject of the present thesis, are situated in Township 37 North and Range 4 East Or. Français Co. Mo. and are directly north of the Dr. To mines . They are 10 miles distant, in a Douth -Casterly direction, from Cadet, a station on the At. Fouris, Iron Mountain and Southern Rail-Road 5-7 miles from It. Fouris. Though Cadet is insignificant in point of population ; still as a shipping point, it ranks high among those in Douch East Missouri; since it is the depot and entrapol- for the Disloge, At. Jos and Old Miner. The country about here is of an undulating character and will covered with timber, chiefly of the varieties of white, pass and perule oak. Amerous streams intersecting each other and chiefly anising from springs, form a metwork giving the country a reticulated appearance On Flats I is given a small portion of the gurrounding country,

The Desloge Mines, the subject of the present thesis, are situated in **Township 37 North and Range 4 East** St. Francois Co. Mo. and are directly North of the St. Joe mines. They are 10 miles distant, in a South-Easterly direction, from Cadet, a station on the St. Louis, Iron Mountain and Southern Rail-Road, 57 miles from St. Louis. Though Cadet is insignificant in point of population; still as a shipping point, it ranks high among those in South East Missouri; since it is the depôt and entrepôt for the Desloge, St. Joe and Old Mines. The country about here is of an undulating character and well covered with timber, chiefly of the varieties of white, post and scrub oak. Numerous streams intersecting each other, and chiefly arising from springs, form a network giving the country a reticulated appearance. On Plate I is given a small portion of the surrounding country,

(the topographical features bring omitted) and is intended to convey a correct impression of the relative positions of the stines and supply point. Plate II. is a plat containing all the principal buildings and the shafts. The blocks have been laid out as represented and the limits on the North , East and West extend much farther but sufficient is given for the needs at present. transportation to and from Cadet are very limited, consisting as they do of six-mule teams, which under the most favorable circumstances can make but two round trips per day and are often compelled, on accounts of the inclemency of the wrather, bad roads or other causes, to make but one trip and return. They have the products of the Ames i.s. lead ; and , on their peturn trip, the supplies for the Company's store. The subject of leas treatment at the Desloge Thines will be taken up in three separate parts vig.:

(the topographical features being omitted) and is intended to convey a correct impression of the relative positions of the Mines and supply point. Plate II. is a plat containing all the principal buildings and the shafts. The blocks have been laid out as represented and the limits on the North, East and West extend much farther but sufficient is given for the needs at present. At present the means of transportation to and from Cadet are, very limited, consisting as they do of six-mule teams, which under the most favorable circumstances can make but two round trips per day and are often compelled, on account of the inclemency of the weather, bad roads or other causes, to make but one trip and return. They haul the products of the Mines i.e. lead; and, on their return trip, the supplies for the

Company's store.

The subject of lead treatment at the Desloge Mines, will be taken up in three separate parts viz.:

the Mining; Concentrating and Omeeting of rav. Mining. The ore occurs as an impregnated dolomitic lines tone of the Phird Magnesian Armiestore series. The galeniferous timerock occurs in stratified bids ranging in thickness, from a few contrinstos to three metres as a maximum. There are found Amall seams of calcite and galena. The general dip is 2° East and bids of mineral are met with at varying depths. There are also found pockets of Chalcopyrite * Called by the miners "sulphus" and regarded by them as an indication of "rich rock" to follow. The following may be taken as the composition of the average ore taken out :-* Inalysis of the nearly pure Chalcopynte thows 1.612 % of Tickel and Coball.

the Mining; Concentrating and Smelting of ores.

Mining.

The ore occurs as an impregnated dolomitic limestone of the Third Magnesian Limestone series. The galeniferous limerock occurs in stratified beds varying in thickness, from a few centimetres to three metres as a maximum. There are found small seams of calcite and galena. The general dip is 2^o East and beds of mineral are met with at varying depths. There are also found pockets of Chalcopyrite* called by the miners "sulphur" and regarded by them as an indication of "rich rock" to follow.

The following may be taken as the composition of the average ore taken out: --

*Analysis of the nearly pure Chalcopyrite shows 0.612% of Nickel and Cobalt.

Specific Gravity 4.011 Rational

Empirical

Calmite 49.625 26 42.981 Sphalerite 1.921 Cu trace Chalcopynte trace TE 0.966 Milleritz 0.226 Zn 1.287 Jynita 2.070 Ait Co 0.146 Gangue 46158 5 8.462 Eangue 46.158 100,000 At present there are three shafts worked, viz.: the Clara, Middle and Jophie. Their relative positions may be ascertained from Plate IE. The Clara shaft has been sink 37.195 metrus (1221), but there is only one gallery 9,146 metres (301) from the surface, that is worked. It general height is about 2 metres (6.5*), this bring the thickness of the bid. This is a dry shaft and the material is haisted by a ten-horse-power engine, in buckets (Killbles) whence it is transported to the skips (of which Figs, 1 8 21 Flats 115 are a year and side elevation, in which it will be seen that they are dumped

Specific Gravity 4.011

Empirical

Pb	42.981
Cu	trace
Fe	0.966
Zn	1.287
Ni+CO	0.146
S	8.462
Gangue	<u>46.158</u>

100.000

At present there are three shafts worked, viz.: the Clara, Middle and Sophie. Their relative positions may be ascertained from Plate II.

The Clara shaft has been sunk 37.195 metres (122'), but there is only one gallery 9.146 metres (30') from the surface that is worked. It general height is about 2 metres (6.5'), this being the thickness of the bed. This is a dry shaft and the material is hoisted by a ten-horse-power engine, in buckets (Kibbles) whence it is transported to the skips (of which Figs. 1 & 2 Plate III are a rear and side elevation, in which it will be seen that they are dumped

Rational

Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue chiefly MgO, Co₂ CaOCo₂

49.625 1.921 trace 0.226 2.070 <u>46.158</u>

100.000

ty opening a hinged door forming the end of which are drawn to the concentrating house by a mule, on a slightly inclined tranway , 508 metres (20") wide. The return of the caro to the month of the thaft is antomatic, this bring effected by the grade. The middle shaft has been simple to a depth of 18.29 metris (60') and is not yet worked, there bring no galleries opmened as yet. It was full of water which had been due to its remaining incovered and bring fieled by rains and Anow, The Sophie shaft is by for the most important, although only Annot to a depth of 50.48 metrus (1651), There are two levels the first bring at 30. 48 metrus (100' blow the surface and the fecond at 50,48 (1651). It is a wit shaft and consequently pumps are employed to paise the water which is utilized in the concentrating house.

by opening a hinged door forming the end) which are drawn to the concentrating house by a mule, on a slightly inclined tramway .508 metres (20") wide. The return of the cars to the mouth of the shaft is automatic, this being effected by the grade.

The middle shaft has been sunk to a depth of 18.29 metres (60') and is not yet worked, there being no galleries opened as yet. It was full of water which had been due to its remaining uncovered and being filled by rains and snow.

The Sophie shaft is by far the most important, although only sunk to a depth of 50.48 metres (165'). There are two levels, the first being at 30.48 metres (100') below the surface and the second at 50.48 (165'). It is a wet shaft and consequently pumps are employed to raise the water which is utilized in the concentrating house.

These pumps consist of a Cameron pump from the bostom to the first level and a Cornish plunger from the first level to the surface. The hoisting engine, which is of twenty horse-power, operates these pumps busides its regular work of raising the ora. The same means of transportation to the concentrating house are here employed, as in the case of the Clara shaft; the Tramway bring about 91.47 metres (300') long. The shifts in the shafts consist of eight hours each. The material is obtained by blasting, hand drilling thing employed. The total amount broken per diem has not tren estimated, although it for exceeds the amount quelted or Concentrated -

These pumps consist of a Cameron pump from the bottom to the first level and a Cornish plunger from the first level to the surface. The hoisting engine, which is of twenty horse-power, operates these pumps besides its regular works of raising the ore. The same means of transportation to the concentrating house are here employed, as in the case of the Clara shaft; the

tramway being about 91.47 metres (300') long.

The shifts in the shafts consist of eight hours each. The material is obtained by blasting, hand drilling being employed. The total amount broken per diem has not been estimated, although it far exceeds the amount smelted or concentrated —

Concentration. This consists essentially in oushing the ore, sieving it and passing them to the jigs and classificator which completely peparate the galena from the limestone. The ora is hauled from the shafts and dumped on an elevated platform built by the side of the concentrating house and show at P Plate IV. Dis a track on which a dumping car runs and S is a green to protect the workmen. From this platform the ore is phovelled into a Blake cusher c. (of which more anow) and it falls then between two sets of Cornish rolls RX + to be ground still finer. It finally falls in the pit Q whence it is elevated by means of the elevator "h' whose diametric length is 12.8 netres (42%. The people ss, s's' dump the onshed material into the hopper It, whence it is distributed to the sieves S'. These size the ora and drop it in a trough

Concentration.

This consists essentially in crushing the ore, sieving it and passing then to the jigs and classificator which completely separate the galena from the limestone The ore is hauled from the shafts and dumped on an elevated platform built by the side of the concentrating house and shown at P Plate IV. D is a track on which a dumping car runs and S is a screen to protect the workmen. From this platform the ore is shovelled into a Blake crusher c. (of which more anon) and it falls then between two sets of Cornish rolls R & r to be ground still finer. It finally falls in the pit Q whence it is elevated by means of the elevator h h' whose diametric length is 12.8 metres (42'). The scoops ss, s^1s^2 dump the crushed material into the hopper H, whence it is distributed to the sieves S¹. These size the ore and drop it in a trough

I Plate V., whence it is distributed to the jigs J', J2 40 by side canals not thown in the drawings. The classificator or Rittinger table completes the peries of concentrating apparatus which will now by taken upin detail. The concentrating house is a building 12.19 by 30.48 metre (40'x 1001), exclusive of the boiler thed which is about 9.146 by 12.19 metres (30'x 40'). The machinery is operated by an engine of one hundred nominal horse- power, having glinders 1.066 by. 406 metris (16" x 42"). There are two boilers 711 metros (28") in drameter and 3. 05 metres (10') long with 9 fluer 152 metrus (6") in diameter and carrying on an average 34. 59 Kilogrammes (75-tts) of Team, The consumption of full is about 35.985 cubic metras (10 cords) per day of ten hours. The Blake crusher is of the size known as No. 5 of which a section is given in Tig. & Plate III.

T Plate V., whence it is distributed to the jigs J^1 , J^2 &c by side canals not shown in the drawings. The classificator or Rittinger table completes the series of concentrating apparatus which will now be taken up in detail.

The concentrating house is a building 12.19 by 30.48 metres $(40' \times 100')$, exclusive of the boiler shed which is about 9.146 by 12.19 metres (30' x 40'). The machinery is operated by an engine of one hundred nominal horse-power, having cylinders 1.066 by .406 metres (16" x 42"). There are two boilers .711 metres (28") in diameter and 3.05 metres (10') long with 9 flues .152 metres (6") in diameter, and carrying on an average 34.59 kilogrammmes (75 lbs) of steam. The consumption of fuel is about 35.985 cub metres (10 cords) per day of ten hours --The Blake crusher is of the size known as No. 5 of which a section is given in Fig. 3 Plate III.

of which the following gives the different parts : D - section of fly-wheel shaft. E. - section of crank. E - connecting rod. E - lever. II - fulcum of lever. I & J.J - toggle joint. K- fixed jaw. I. - cheeks holding back the fixed jaw. NL - movable jaw. N- hivot. 0 - india rubber spring. I - screw-nut to raise and lower wroge. Q- widge. R - toggle-block. The action of the machine is readily inderstood from the drawing. The space between the jaws is about 1039 metres (1.5"). The next machines for crushing consist of two pairs of Cornish rolls, whose construc. tion is easily inderstood, and which crush the ore still finer and make it ready to To governed. The elevator needs no description .

of which the following gives the different parts:

- D section of fly-wheel shaft.
- E section of crank.
- F connecting rod.
- G lever.
- H fulcrum of lever.
- I & J, J toggle joint.
- K fixed jaw.
- M movable jaw.
- N pivot.
- O india rubber spring.
- Q wedge.
- R-toggle-block.

The action of the machine is readily understood from the drawing. The space between the jaws is about .039 metres (1.5").

The next machines for crushing consist of two pairs of Cornish rolls, whose construction is easily understood, and which crush the ore still finer and make it ready to be screened.

The elevator needs no description.

L – cheeks holding back, the fixed jaw.

P – screw-nut to raise and lower wedge.

The goreens are four in num-For and are placed as shown in Plates IV &V, making fifteen to twenty revolutions per minute. Saking them in the order of the size of the holes we find that the first sieve is of perforated iron having holes 15 mill instras in diameter, The second is also of iron and consists of three divisions 52, 53 x 54 (Plate V.) 52 x 5 having holes 7 mm in diameter and st holes 10 mm in diameter. The third sieve, of iron, has three divisions also 5, 5' × 5', sigs having holes 3.25 mm and st holes similar in diameter. The fourth and last sieve is made of perforated copper plates and has three divisions 5°, 5°K 5° 58 x 59 having holds 1mm and s' holes 2 min in diameter. By this means the ora is effectively screened, all the aparticles not passing through the first fiers bring returned to the rolls, The stuff from the firsttwo screens is also sent to the rolls after bring washed; also the middlings from the jegs,

The screens are four in number and are placed as shown in Plates IV & V, making fifteen to twenty revolutions per minute. Taking them in the order of the size of the holes we find that the first sieve is of perforated iron having holes 15 millimetres in diameter. The second is also of iron and consists of three divisions s^2 , $s^3 \& s^4$ (Plate V.) $s^2 \& s^3$ having holes 7 mm in diameter and s⁴ holes 10 mm in diameter. The third sieve, of iron, has three divisions also s⁵, s⁶, & s⁷, s⁵ & s⁶ having holes 3.25 mm and s⁷ holes 5 mm in diameter. The fourth and last sieve is made of perforated copper plates and has three divisions s⁸, s⁹ & s¹⁰, s⁸ and s⁹ having holds 1 mm and s¹⁰ holes 2 mm in diameter. By this means the ore is effectively screened, all the particles not passing through the first sieve being returned to the rolls. The stuff from the first two screens is also sent to the rolls after

being washed; also the middlings from the jigs.

The material that has been properly sized is then sent on to the jigs to the concentrated. The stuff is Sent by a means already indicated. The jigs are of the self. discharging pattern and yield as products; washed ore, middlings, Alimes, coasse and fine chats. The vashed on is taken off to be Amelted, the middlings of nearly all the flgs and the coarse and fine chats are send to the rolls, whilst the middlings of one set of jigs and all the Alimes are sent to the classificator for breatment. There are four sets of jigs, two in each set. The first chree sets are plunger and the fourth set eccentric jigs. The jigs are 1.72 × 1.22 × 1.83 metro (4'×4'×6') and require no particular des cription here as they are will Known, tring Rittinger's seef discharging jigs. The first set J'(Ilater) has two jigs which size to 15 mm, the firsts having a stroke of 5.08 centimetres (2") and the second

The material that has been properly sized is then sent on to the jigs to be concentrated. The stuff is sent by a means already indicated. The jigs are of the selfdischarging pattern and yield as products; washed ore, middlings, slimes, coarse and fine chats. The washed ore is taken off to be smelted, the middlings of nearly all the jigs and the coarse and fine chats are sent to the rolls, whilst the middlings of one set of jigs and all the slimes are sent to the classificator for treatment.

There are four sets of jigs, two in each set. The first three sets are plunger and the fourth set eccentric jigs. The jigs are 1.22 x 1.22 x 1.83 metres (4' x' 4' x 6') and require no particular description here as they are well known; being Rittinger's selfdischarging jigs.

The first set J¹ (Plate V) has two jigs which size to 15 mm, the first having a stroke of 5.08 cemtimetres (2") and the second

one of 3.81 continetos (12"). The washed and discharged have the following compositions respectively. Nº 1. Empirical Rational Sp. Gr. 6.149 51, 549 Galenite 59. 517 0.383 Sphalerite 0.490 Ph Cu 0.383 Tra 1:855 - Chalcopyrite 1.108 Zn 0.328 Millesite 0.300 Ai+Co 0.194 Pyrite 3.143 S 10.249 Gangue 35.442 teanguer 35.442 100.000 1119.000 Nº 2. Sp. Er. 6.579 Pil Galenite 61.074 52.897 Cu 0.942 Sphalerik 0.251 I's 0.910 Chalcopynt 2.725 Zm 0.168 Millerite 0,480 Zynto 0.178 Ait 6 1.316 5 9.475-Ctanque 35,292 Ganque 35.292 100.000 . 100,000 The second set of jigs (J=Plate V) size respectively to y and 5 mm, the stroke bring 3.81 cm (12") for the first

one of 3.81 centimetres (1 1/2"). The washed ores discharged have the following compositions respectively.

No. 1.

Empirical		
	Sp. Gr. 6.149	
51.549	The second second second second second	G
0.383		S
1.855	(С
0.328		V
0.194	1	P
10.249	(G
<u>35.442</u>		
100.000		
	Sp. Gr. 6.579	
52.897		G
0.942	5	S
0.910	(С
0.168	1	V
1.316	l	P
9.475	(G
<u>35.292</u>		
100.000		
	$\begin{array}{c} 0.383\\ 1.855\\ 0.328\\ 0.194\\ 10.249\\ \underline{35.442}\\ 100.000\\\\ \end{array}$	Sp. Gr. 6.149 51.549 0.383 1.855 0.328 0.194 10.249 <u>35.442</u> 100.000 No. 2. Sp. Gr. 6.579 52.897 0.942 0.942 0.910 0.168 1.316 9.475 <u>35.292</u>

The second set of jigs (J² Plate V) size respectively to 7 and 5 mm, the stroke being 3.81 cm $(1 \frac{1}{2})$ for the first

Rational

Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue

59.517 0.490 1.108 0.300 3.143 35.442 100.000

Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue

61.074 0.251 2.725 0.480 0.178 35.292 100.000

and 3.18 cm (1/4") for the second; the stuff bring finer than that of the first set is consequently pover as may of the washed are from each jig. Nº 3. Empirical Rational Sp. Gr. 6.760 53.851 Galenite 62.175 Ple Cu 0.805- Sphalerite 0.301 I'c 0.896 Chalcopyrite 2.517 Zn 0.202 Millerite 0.484 Ni+Co 0.316 Pyik 0.274 S 9.681 Gangue 34.249 C 34 219 100.000 Ganque 34.249 Nº 4
 \$p. Gr. 6.856

 Ph
 55.974

 Galenith
 64.627

 Cu
 0.077

 Scholerith
 0.243

 Th
 0.931

 Chalcopyith
 0.224
 Zn 0.163 Millerik 0.101 Nit Co 0.065 Pyrite 0.918 S 8,903 Ganque 33,887 Eanque 33.887 100.000 The third set of jigs (J's Plater.) Nizes to 3.5 and 2 in with strokes that are more ctively 3. 18 - ----1/4") and 1.91 " ("14"), The

and 3.18 cm (1 ¼") for the second; the stuff being finer than that of the first set is consequently purer as may be seen from the annexed compositions of the washed ore from each jig.

No. 3.

Empirical

		Sp. Gr. 6.760
Pb	53.851	G
Cu	0.805	S
Fe	0.896	С
Zn	0.202	N
Ni+CO	0.316	P
S	9.681	G
Gangue	<u>34.249</u>	
	100.000	

	No. 4
	Sp. Gr. 6.856
55.974	G
0.077	Sp
0.931	Cl
0.163	N
0.065	Py
8.903	G
33.887	
100.000	
	0.077 0.931 0.163 0.065 8.903 <u>33.887</u>

The third set of jigs (J^3 Plate V.) sizes to 3.5 and 2 mm with strokes that are respectively 3.18 cm (1 ¼") and 1.91 cm (3/4"), the

Rational

Galenite Sphalerite Chalcopyrite Villerite Pyrite Gangue 62.175 0.301 2.517 0.484 0.274 <u>34.249</u> 100.000

Galenite Sphalerite Chalcopyrite Villerite Pyrite Gangue 64.627 0.243 0.224 0.101 0.918 <u>33.887</u> 100.000

washed one bring fine and having a good appearance as may bi in-ferred from the annexed compositions Compirical Rational Sp. Gr. 7.116
 Ph
 63.568
 Galenite
 73.298

 Cu
 0.025
 Sphalenite
 0.100

 Fe
 0.217
 Chalcopynte
 0.071

 Zn
 0.071
 Atillenite
 0.019
 Ph Zn Ln 0.011 Pyritz 0.202 Ait Co 0.011 Pyritz 0.202 S 9.804 Canque 26.304 11.2014 T00.000 100.000 Aº 6. Sp ler. 7. 536 Galenite 69.277 Salaberite 0.144 26 60.001 Ca 0.028 The 0.616 Chalcopynts 0.080 In 0.096 Thillerite 0.018 Nit Co 0.011 Ignite 0.653 5 9.440 Gaugue 29.808 29.808 te angue 29.808 100.000 100.000 The fourth set (I' Hater) consists of two eccentric jigs which wash the fine stuff and have respectively stroker of 42 c.m. ("") and .32 c.m

washed ore being fine and having a good appearance as may be inferred from the annexed compositions. No. 5

Empirical Sp. Gr. 7.116 Pb 63.568 Cu 0.025 Fe 0.217 0.071 Zn Ni+CO 0.011 S 9.804 26.304 Gangue 100.000

		No. 6.
		Sp. Gr. 7.536
Pb	60.001	G
Cu	0.028	S
Fe	0.616	C
Zn	0.096	Ν
Ni+CO	0.011	P
S	9.440	G
Gangue	<u>29.808</u>	
	100.000	

The fourth set (J^4 Plate V) consists of two eccentric jigs which wash the fine stuff and have respectively strokes of .42 c.m. (1/6'') and .32 cm (1/8'').

Rational

- Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue
- 73.298 0.106 0.071 0.019 0.202 <u>26.304</u> 100.000

Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue 69.277 0.144 0.080 0.018 0.653 <u>29.808</u> 100.000

The following are the compositions of the washes my from these. Nº 7. Empirical A. Gr. 6.974 Actional 5.334 Galenita 63.888 Plu 0.027 Sphalerik 0.203 Cu Ze 0.175 Chalcopyrite 0.068 Zn 0.136 Millerik 0.025 Nit Co 0.016 2 pite 0.334 5 8.830 Comput 35.482 Conque 35.482 100.000 100.000 Nº 8. Ap. Gr. 6.979 63 54.805 Galenite 63.277 26 0.050 Aphalents 0.181 Cn I'a 0.854 Chalcopyik 0.145 Zn 0.121 Millerik 0.024 Ni+Co 0.016 Pyik 1.736 S 9.517 Kangua 34.637 Gangue 34.637 100.000 The fine and caarse "chats" (the average composition of each of which is given further on J when sufficiently fine and sub to the classificator and when too coarse to the rolls.

The following are the compositions of the washed ores from these.

No. 7.

		No. 7.
En	npirical	
		Sp. Gr. 6.974
Pb	55.334	G
Cu	0.027	S
Fe	0.175	C
Zn	0.136	N
Ni+CO	0.016	Р
S	8.830	G
Gangue	<u>35.482</u>	
	100.000	
		No. 8.
		Sp. Gr. 6.979
Pb	54.805	G
Cu	0.050	S
Fe	0.854	С
14 2450	2010/07/Me08124e8 - 17	970

Zn	0.121	Ν
Ni+CO	0.016	Р
S	9.517	e
Gangue	34.637	
	100.000	
Th	e fine and coarse "cha	ats" (the

The fine and coarse "chats" (the average composition of each of which is given further on) when sufficiently fine are sent to the classificator and when too coarse to the rolls.

Rational

- Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue
- 63.888 0.203 0.068 0.025 0.334 <u>35.482</u> 100.000

Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue 63.277 0.181 0.145 0.024 1.736 <u>34.637</u> 100.000

They are very poor in galena, but still, some is sand by this treat. ment. Coarse chats. Sp. Er. 2.969. Rational Empirical Ph. 0.961 Galenite 1.109 In 0.125- Sphalerite 0.307 72 4.879 Chalcopyite 0.359 Zn 0.205 Millerite 0.011 Nit Co 0.007' Zyitz 10.221 5.830 Ganque 87.993 5 100.000 Ganque 87.993 100,000 Fine chato. Sp. Gr. 3. 053 1.789 Galenik 2.065-0.392 Sphälerik 0.322 26 Cu In 6.496 Chalcopyrik 1.134 Zn 0.216 Millerik 0.117 Nitlo 0.076 Pyrite 13.028 7.767 Aangue 83.334 5 Gangue 83.334 100.000 100,000 The classificator, (o, Plater) or as it is better Known, the Rittin. ger table is the next machine in the concentration that deserves our attention as will on account

They are very poor in galena, but still, some is saved by this treatment.

	Coarse chats.			
	Sp. C	Gr. 2.969		
Empirical				
Pb	0.961	G		
Cu	0.125	S		
Fe	4.879	C		
Zn	0.205	N		
Ni+CO	0.007	P		
S	5.830	G		
Gangue	<u>87.993</u>			
	100.000			
		Fine chats		
		Sp. Gr. 3		
Pb	1.789	G		
Cu	0.392	S		
Fe	6.426	C		
Zn	0.216	N		
Ni+CO	0.076	P		
S	7.767	G		
Gangue	<u>83.334</u>			
	100.000			

The classificator, (c, Plate V) or as it is better known, the Rittinger table is the next machine in the concentration that deserves our attention, as well on account Galenite Sphalerite Chalcopyrite Villerite Pyrite Gangue

ts. 3.053 Galenite Sphalerite Chalcopyrite Millerite Pyrite Gangue Rational 1.109 0.307 0.359 0.011 10.221 <u>87.993</u> 100.000

> 2.065 0.322 1.134 0.117 13.028 <u>83.334</u> 100.000

of its simplicity and the through ness with which it does its work, as of its but result introduction in concentrating machinery. On Plate VI is given an end elevation and a plan, in which it will to seen that the double cam c. (Fig. 1) acting on the hoorgontal bar B causes the whole table to recillate from side to side, the stroke tring 6.35 c.m. (22"), and the return tring ensured by means of the subbr spring R. The framework is necessarily compact on account of the number of shocks it has to endure , rasying as they do from 50 to 80 per summente, according to the coardeness or fineness of the stuff-Fig. 2 is a plan of the table , in which o' is the trough delivering the stuff which is distributed by the riffles at D; m, m bring the riffles to distribute the streams of water flowing down over the table , it having an inclination of about 2°. The dotted lines ss', mm'xIt' show the courses

of its simplicity and the thoroughness with which it does its work, as of its but recent introduction in concentrating machinery. In Plate VI is given an end elevation and a plan, in which it will be seen that the double cam c. (Fig. 1) acting on the horizontal bar B causes the whole table to oscillate from side to side, the stroke being 6.35 cm. (2 ½"), and the return being ensured by means of the rubber spring R. The framework is necessarily compact on account of the number of shocks it has to endure, varying as they do from 50 to 80 per minute, according to the coarseness or fineness of the stuff. Fig. 2. is a plan of the table, in which 0' is the trough delivering the stuff which is distributed by the riffles at D; w, w being the riffles to distribute the streams of water flowing down over

the table, it having an inclination of about 2^o. The dotted lines s s', m m' & T t' show the courses

taken by the washed ora, middlings and tailings respectively. The ora no it comes off of the table is the purest of all the washed ones, as may to seen from the following analysis : Comprisal Rational Sp. Gr. 7.616 Ph 72.442 Galenik 83.640 0.013 Sphaleritz 0.040 Cu For 0.133 Chalcopyith 0.037 In 0.027 Miller its trace Ait Co trace 2 yrite 0.261 5 11.363 Georgene 16.022 Eauque 16.022 100.000 100,000 The middlings are sufficiently nich to warrant treat mentthe table whiles the tailings are thrown away. The following are the compositions of the misthings and tailings :-

taken by the washed ore, middlings and tailings respectively.

The ore as it comes off of the table is the purest of all the washed ores, as may be seen from the following analysis:

Empirical

		Sp. Gr. 7.616
Pb	72.442	
Cu	0.013	
Fe	0.133	â
Zn	0.027	
Ni+CO	trace	
S	11.363	
Gangue	<u>16.022</u>	
	100.000	

The middlings are sufficiently rich to warrant a second treatment on the table whilst the tailings are thrown away.

The following are the compositions of the middlings and tailings: --

Rational

Galenite83.640Sphalerite0.040Chalcopyrite0.037MilleritetracePyrite0.261Gangue16.022100.000

Empirical Rational Sp. Gr. 3.450 20.633 Galenite PL 23,822 0,395 Sphalerite Cu 1.253 5.614 Chalcopynt 1.144 Ir Zn 0,840 Millerit 0.135-Ari+Co 0.088 Pyrik 11.281 10.065 Gangue 5 62:365le angue 67.365-100.000 100.000 Pailings . Sp. Gr. 3. 085. 5.834 Galenita 6.735 Zh 0.516 Sphalerite 1.415-Cu TE 5.894 Chalcopynk 1.492 Millerik 0.047 Zn 0.948 0.030 Lyntz 11.654 Nit Co Ganque 78.657 8.121 100.000 trangue 78.657 100,000 The water, for all the dressing, is supplied by The pumps of the Dophie shaft, its month bring on a level with the top of the concentrating house. An iron pipe connecting with the discharge of

		Middlings	
	Empirical		
		Sp. Gr. 3.450	
Pb	20.663		Ga
Cu	0.395		Sp
Fe	5.614		Cł
Zn	0.840		Μ
Ni+CO	0.088		Ру
S	10.065		Ga
Gangue	<u>62.365</u>		
	100.000		
		Tailings.	
		Sp. Gr. 3.085	•
Pb	5.834	-	Ga

0.516

5.894

0.948

0.030

8.121

78.657

100.000

Cu

Fe

Zn

S

Ni+CO

Gangue

The water, for all the dressing, is supplied by the pumps of the Sophie shaft, its mouth being on a level with the top of the concentrating house. An iron pipe connecting with the discharge of

Rational

- alenite phalerite halcopyrite **1illerite** vrite angue
- 23.822 1.253 1.144 0.135 11.281 62.365 100.000

alenite Sphalerite Chalcopyrite Millerite Pyrite Gangue

6.735 1.415 1.492 0.047 11.654 <u>78.657</u> 100.000

the pumps leads to a tank in the upper part of the con-Centrating house and a steady stream, sufficient for the washing of all the ore, is Kept flowing. 4535 Klogrammes (10,000 thes) of me are dressed yer day of 10 hours there bring no night shifts) and this exceeds the melting powers of the furnaca. Then an employed in the Concentrating house ten men distributed as follows: Ansman and Engineer !! Feeder for the crusher 2 To attend to the jigs se. 4 To carry off chats . F Potal 10 Note. In the following page is a table containing the compositions (Empirical and rational) of the raw and washed ores, as also their specific fravities to show at a glance how the was tring concentrates the ore, the purity and specific gravity increasing alle from step to stop -

the pumps leads to a tank in the upper part of the concentrating house and a steady stream, sufficient for the washing of all the ore, is kept flowing. 4535 kilogrammes (10,000 lbs) of ore are dressed per day of 10 hours (there being no night shifts) and this exceeds the smelting powers of the furnace.

There are employed in the concentrating house ten men distributed as follows: Foreman and Engineer Feeder for the crusher To attend to the jigs &c. To carry off chats Total

<u>Note</u>. On the following page is a table containing the compositions (Empirical and rational) of the raw and washed ores, as also their Specific Gravities to show at a glance how the washing concentrated the ore, the purity and specific gravity increasing alike from step to step --

- - 1 2 4 <u>3</u> 10

Washed Ores.

				0.10			\wedge		×-		
		Raw ore.	Jr= 1	Nº 2	Nº- 3	Nº 4	Nº 5	Jre 6	Nº 7	Jre 8	From the Rittinger table
-	FB	42.981	57.549	52.897	53.851	55. 974	63.568	60,001	15.334	54.805	72.442
K	Cu	tracr	0.383	0.942	0.805	0.077	0.025	0.028	0.027	0.050	0.013
10	FE	0.966	1.855-	0.910	0.896	0.931	0.217	0.616	0.175	0.854	0,133
A	Zn	1.287	0.328	0.168	0,202	0.163	0.071	0.096	0.136	0.121	0.027
9	Nitco	0.146	0.194	0.316	0. 316	0.065	0.011	0.011	0.016	0.016	trace
5	S Thy calculation	8.462	10.249	9.475	9.681	8,903	9.804	9.440	8.830	9.57	11. 363
M	(Rangur [by diff]	46.158	35.442	35.292	34.249	33. 887	26.304	29.808	35.482	34.637	16.022
	< lasta), 111	100,000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100,000	100.000
J.	(Galenita	49.625	59.517	61.074	62.175	64.627	73.298	69.277	63.888	63.277	8-3.640
*	Sphalerit	1.92-1	0.490	0.251	0.301	0.243	0,106	0.144	0.203	0.181	0.040
2	Chalcopyrite	trace	1.108	2.725	2.517	0.224	0.071	0.080	0.068	0,145	0.037
711	Millerite	0.226		0.480	0.484	0,101	0.019	0.018	0.025	0.024	trace
X	I yrite	2.070		0,178	0.274	0.918	0.202	0.653	0.334	1.736	0.261
R	Grangue	46.15-8	2 12 14 14	35.292	34.249	33.887	26,304	19.808	35:482	. 34.637	16.022
	Carangue .	100.000		100.000	100.000	100.000	100.000	100.000	100.000	100. 000	100.000
y.											
à	Specific Gravity	4.011	6.149	6.579	6.760	6.856	7.116	7.536	6.974	6.979	7.616
										-	
					F						
				No. of Contraction of Contraction			Received in American				11, 5

Washed Ores

Empirical	Raw Ore	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	From the Rittinger table
Pb	42.981	51.549	52.897	53.851	55.974	63.568	60.001	55.334	54.805	72.442
Cu	trace	0.383	0.942	0.805	0.077	0.025	0.028	0.027	0.050	0.013
Fe	0.966	1.855	0.910	0.896	0.931	0.217	0.616	0.175	0.854	0.133
Zn	1.287	0.328	0.168	0.202	0.163	0.071	0.096	0.136	0.121	0.027
Ni+CO	0.146	0.194	0.316	0.316	0.065	0.011	0.011	0.0106	0.016	trace
S [by calculation]	8.462	10.249	9.475	9.681	8.903	9.804	9.440	8.830	9.517	11.363
Gangue [by diff]	46.158	35.442	35.292	34.249	33.887	26.304	29.808	35.482	34.637	16.022
	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000

Rational										
Galenite	49.625	59.517	61.074	62.175	64.627	73.298	69.277	63.888	63.277	83.640
Sphalerite	1.921	0.490	0.251	0.301	0.243	0.106	0.144	0.203	0.181	0.040
Chalcopyrite	trace	1.108	2.725	2.517	0.224	0.071	0.080	0.068	0.145	0.037
Millerite	0.226	0.300	0.480	0.484	0.101	0.019	0.018	0.025	0.024	trace
Pyrite	2.070	3.143	0.178	0.274	0.918	0.202	0.653	0.334	1.736	0.261
Gangue	46.158	35.442	35.292	34.249	33.887	26.304	29.808	35.482	34.637	16.022
	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000

	0			e						2
Specific Gravity	4.011	6.149	6.579	6.760	6.856	7.116	7.536	6.974	6.979	7.161

Smelting. The one after having passed the treatment described , in the foragoing pages, is next quel-ted to extract the lead. For this purpose there are two fornaces , a calcining or roasting and a reducing furnace; both situated in the formace hause, a building 12, 19 by 30,48 metres (40'x 1001). The calcining formace has a hearth of a rectangular form, four working doors on each side and a flat- gole with a discharging hole near the firs- bridge as shown in Figs. 182 Platevit., which are respectively a longitudinal section and plan. The following are the explanations :-A - arch . B - fire-box. B'- brioge) - work doors. D' - fire- box door E - grate bars. H - hearth. 0 - discharging hole. f - flue.

Smelting.

The ore after having passed the treatment described, in the foregoing pages, is next smelted to extract the lead. For this purpose there are two furnaces, a calcining or roasting and a reducing furnace; both situated in the furnace house, a building 12.19 by 30.48 metres (40' x 100').

The calcining furnace has a hearth of a rectangular form, four working doors on each side and a flat sole with a discharging hole near the fire-bridge as shown in Figs. 1 & 2 Plate VII., which are respectively a longitudinal section and plan. The following are the explanations: --

- A -- arch.
- B -- fire-box.
- B' bridge.
- D -- work doors.
- D' fire-box door.
- G grate-bars.
- H hearth.
- O discharging hole.
- f -- flue.

The consted or is charged by means of the work doors and is sugaised, the object bring to render it the more easily reducible. The time of elaboration is 10 hours two men bring smployed, the yet, the roasting is far from perfect, but better results are to be expected no the workmen trame more skilled. The following are analyses of the washed ore charged and of the roasted on as with drawn from the furnace. Washed or -Rational Empirical 54,485 Galenits 62.907 PL 0.048 Sphaleriti Cn 0.176 FE 0.091 Chalcopyrite 0.144 Ln 0.119 Killerite 0.104 Nit Co 0.067 Zynk S 8.622 Ganque Ganque 36.568 0.101 36.568 100,000 100.000

The crushed ore is charged by means of the work doors and is oxydised, the object being to render it the more easily reducible. The time of elaboration is 10 hours, two men being employed. As yet, the roasting is far from perfect, but better results are to be expected as the workmen become more skilled. The following are analyses of the washed ore charged and of the roasted ore as withdrawn from the furnace.

	Wash	ed ore
	Empirical	
Pb	54.485	
Cu	0.048	
Fe	0.091	
Zn	0.119	
Ni+CO	0.067	
S	8.622	
Gangue	36.568	
	100.000	

Rational Galenite Sphalerite Chalcopyrite

Chalcopyrite Millerite Pyrite Gangue 62.907 0.176 0.144 0.104 0.101 <u>36.568</u> 100.000

Roasted Mr.

Empiric	al	Rat	tional
(503	2.0434	Ca 0. 503	3.4738
Cao	1.4304	Zn0.503	trace
Zno	trace	260.503	2.7183
760.503	2.7183	260	57.9649
[26	76.6607	265	26.3898
Cu	0.8486	Cu, S	1.0630
Fr	1.4299	Te S2	3.0640
Zn	0.8659	Lns	1.2873
A:	0.7089	This	1.0927
Cal .	0.5696	Cal. CO,	
MgO	0.8463	Mgg. Cu	idad
5	6.1889		99.8381
Con	1.3784		
0	4.2589		
-	99.8381		

The next and final operation is the smelting proper. This is done. in a Flintshire reverberatory. The roasted as is charged by the doors; the fire is atfirst Kept low, it is then gradually raised and the doors closed. When reduction commences fluor span is added to make the stag that is formed, more fusible.

Roasted ore.

Em	pirical	
{SO₃	2.0434	
{CaO	1.4304	
{ZnO	trace	
PbO.SO₃	2.7183	
{Pb	76.6607	
{Cu	0.8486	
{Fe	1.4299	
{Zn	0.8659	
{Ni	0.7089	
{CaO	0.5696	
{MgO	0.8463	
{S	6.1889	
{CO2	1.3784	
(0	4.2589	
	99.8381	

The next and final operation is the smelting proper. This is done in a Flintshire reverberatory. The roasted ore is charged by the doors; the fire is at first kept low, it is then gradually raised and the doors closed. When reduction commences fluor spar is added to make the slag chat is formed, more fusible.

Rational

CaO.SO $_3$ ZnO.SO $_3$ PbO.SO $_3$ PbO PbS Cu $_2$ S FeS $_2$ ZnS NiS CaO.CO $_2$ MgO.CO $_2$

3.4738 trace 2.7183 57.9649 26.3898 1.0630 3.0640 1.2873 1.0927 1.0171 <u>1.7772</u> 99.8381

Finally the lead, having all collected in the "pond" (Imp), is purified by collecting the slag , which is done by throwing in some time. The lead is tapped, run into a pot there purified with your duck, Atimmed and fun into molds in the form of "pigs" Dach is the general tratment and the results obtained with the Flinkhin and claimed to be much more patisfactory than those obtainable with the common or I. furnaces. The hearth area is to the grate area as le to 1. Plates VIIE, IX- & X- are respectively the plan, longitudinal and cross section of the Flintshirs of which the following are the explanations :-A - arch. B - friz-box. B'- bridge. D - Work-door. J' - firs-box door. I' - flues-ff - flues-

Finally the lead, having all collected in the "pond" (sump), is purified by collecting the slag, which is done by throwing in some lime. The lead is tapped, run into a pot, there purified with saw dust, skimmed and run into molds in the form of "pigs." Such is the general treatment and the results obtained with the Flintshire are claimed to be much more satisfactory than those obtainable with the common or I furnaces. The hearth area is to the grate area as 6 to 1. Plates VIII, IX & X are respectively the plan, longitudinal and cross section of the Flintshire of which the following are the explanations: --A -- arch. B – fire-box. B' – bridge. D -- fire-box door. E }

ff} -- flues.

I' - passage under the furnace for air to exculate. & - grate bars. H - hearth. H'- hopper. K (figz. I late X) - tapping holes. I - furnace pot. As may be seen from the drawings there are three work- doors on each side and the hearth slopes down towards the pot. The following are some of the details of the opera-tions with a few of the amounts of the materials used. The heating is done by means of wood (chiefly oak) which is delivered at the rate of 62.5 cents for cubic metre (\$ 2.25 - per cord). The consumption is 3.589 cubic metros (one cord / per 453.5 Kilogrammes (1000 tos) of raw or and proportion ately less for calcined ora

F' – passage under the furnace for air to circulate.
G -- grate bars.
H -- hearth.
H' – hopper.
K}
T} (fig 2 Plate X) – tapping holes.
P -- furnace pot.

As may be seen from the drawings there are three work-doors on each side and the hearth slopes down towards the pot.

The following are some of the details of the operations with a few of the amounts of the materials used.

The heating is done by means of wood (chiefly oak) which is delivered at the rate of 62.5 cents per cubic metre (\$2.25 per cord). The consumption is 3.589 cubic metres (one cord) per 453.5 Kilogrammes (1000 lbs) of raw ore and proportionately less for calcined ore.

The furnace is not allowed to cool, but immediately after ladling out the lead, and ecaping out the plag, a charge is introduced. If goasted ora, 1360.5 Kilogrammer 3000 thes) are put in by throwing in by the work doors. If, on the other hand, raw ore is introduced, it is put in by the hopper, 1133.75 - Kilogrammes (2500ths) constituting a charge. I slow fire is now put on for four hours, to drive off the sulphur; then the heat is increased till the lead mus, when as much heat is put on , as possible . It-This Stage 12 to 16 Kilogrames (25 to 40 thes) of fluor spiar are added and afterwards about 10 Kilogrammes (20 ths) of time to collect the flag. The furnace is then tapped, the day plugs in K & I (Fig 2. Plate X bring remond and the pot- filled with the molton lead. This is then purified (as stated abor)

The furnace is not allowed to cool, but immediately after ladling out the lead, and scraping out the slag, a charge is introduced. If roasted ore, 1360.5 Kilogrammes (3000 lbs) are put in by throwing in by the work doors. If, on the other hand, raw ore is introduced, it is put in by the hopper, 1133.75 Kilogrammes (2500 lbs) constituting a charge. A slow fire is now put on for four hours, to drive off the sulphur; then the heat is increased till the lead runs, when as much heat is put on, as possible. At this stage 12 to 16 Kilogrammes (25 to 40 lbs) of fluor spar are added and afterwards about 10 Kilogrammes (20 lbs) of lime, to collect the slag. The furnace is then tapped, the clay plugs in K & T (Fig 2. Plate X) being removed and the pot filled with the molten lead. This is then

purified (as stated above)

with sawdust, stimmed of the dross that collects on the surface and cast into Jugs. The lead is very Juna and has the following average composition: Sp. Gr. 11.359* St. .0001933 As trace I'E .0065-849 Cu .0468218 Z.n. .0003276 Ai .0005941 Ag (by cupellation) .00366666 26 (Ty difference/99.9418117 The time of elaboration is 12 hours with raw and 8 with roasted ora, About 2731 Kilogrammes (6000 ths) of ore war worked off in 24 hours and 52% of this is pig lead; or, in other words, the general product averages 20 pigs, of from 35, 4 to 36.3 Kilogrammer (78 to 80 ths), * Convected for 4° Cantigrade.

with sawdust, skimmed of the dross that collects on the surface and cast into pigs. The lead is very pure and has the following average composition:

Sp. Gr. 11.359* Sb As Fe Cu Zn Ni Ag (by cupellation) Pb (by difference)

The time of elaboration is 12 hours with raw and 8 with roasted ore. About 2731 Kilogrammes (6000 lbs) of ore are worked off in 24 hours and 52% of this is pig lead; or, in other words, the general product averages 20 pigs, of from 35.4 to 36.3 Kilogrammes (78 to 80 lbs),

*Corrected for 4^o Centigrade

.0001933 trace .0065849 .0468218 .0003276 .0005941 .0036666 99.9418117 100.0000000

per run. The slag, which is peroped out and hauled off, is about 25% of the weight of the or and has the following composition : Sp. Gr. 4.039* Empirical Rational P60.50, 20.231 Phil. So, 20.231 4 21.127 Z60 20.188 ZL Zn 10.503 26.5 2.756 0.715 5604) trace trace Too3) Cu 56) trace toly To) trace toly To) To Trace toly To To To 5.673 FE 7.405 FEO 9.521 Ait Co 0.895 1.259 (Ait Co)0 1.041 Alson 9.129 Al, 03 1.259 4.048 Cao 9.129 0.375 Cail 0.375 14.618 Mg0 4.048 Cao Mgo Cath Sila 5.539 Sila 14.618 S 99.734 1 3.966 99.734 * Water af 4° Centigrade.

per run.

The slag, which is scraped out and hauled off, is about 25% of the weight of the ore and has the following composition:

Sp. Gr. 4.039*

Empi	rical
PbO.SO₃	20.231
Pb	21.127
Zn	10.503
Cu	0.715
Sb}	
As}	trace
e	7.405
Vi+CO	0.819
Al ₂ O ₃	1.259
CaO	9.129
MgO	4.048
CaFl	0.375
SiO2	14.618
5	5.539
C	3.966
	99.734

*Water at 4^o Centigrade.

Rational PbO.SO $_3$ PbO PbS SbO $_4$ } AsO $_3$ } ZnS FeO CuO (Ni+CO)O Al $_2O_3$ CaO CaFl MgO SiO $_2$

20.231 20.188 2.756 trace 15.673 9.521 0.895 1.041 1.259 9.129 0.375 4.048 <u>14.618</u> 99.734

The skinnings or dross of the furnace-pot avrage about 70 Kilogrammers (100ths) per charge, and are pe-Amelted with the ore. The . composition varies exceedingly but the following analysis is from a fair sample. Rational Impirical Zh 19.821 ZhS 7.435 Cu 1.305 Zh 13.382 Z6 79.821 765 Zn 0.050 Asl trace Shel trace Sby 1.305 As Cn 1.305 Nit Co 0:083 Zn 0.000 Fr 0.065 MitCo 0.083 MgO 0.764 Fr 0.065 Cao 3.144 MgO 0.764 M2 0.815 Cao 3.144 Sila 12.771 Alz 3 0-815-0.996 S. 42 99.814 5 12.771 99.814 The flees of the Flintshin connect with a canal 914 by 1.52 metrico (3'x5-") in section

The skimmings or dross of the furnace-pot average about 70 Kilogrammes (150 lbs) per charge, and are re-smelted with the ore. The composition varies exceedingly but the following analysis is from a fair sample.

Empirical

Pb	79.821
Cu	1.305
Zn	0.050
Sb}	trace
As}	
Ni+CO	0.083
Fe	0.065
MgO	0.764
CaO	3.144
Al ₂ O ₃	0.815
SiO ₂	12.771
S	0.996
	99.814

The flues of the Flintshire connect with a canal .914 by 1.52 metres (3' x 5') in section

Rational

PbS Pb As} Sb} Cu Zn Ni+CO Fe MgO CaO Al₂O₃ SiO₂

7.435
73.382
trace
1.305
0.050
0.083
0.065
0.764
3.144
0.815
<u>12.771</u>
99.814

and 91.47 metris (2001) long. This has been built to promote the draught of the furnace and it connects with a high stack. The draught is regulated by a couple of firs - bick dampers placed in the flues f, f Matritu The canal has been found to & coated with fime, which although 5- to 8 centimetres (""to 3") thick is shel of so little wright that it has not him taken out to emelt. The following is its Composition. Rational Impirical 503 53.5070 9.1493 Zho. 503 Zno 0.9027 260 21.4917 A:0 0.1719 The 0.503 1.7942 Cao 4.8979 Stio. 503 0.36 56 Mgo 0.7856 Cuo .0.3224 260.503 Fro 53.5070 0.4578 0.3224 Zno 0.4872 Cul FEO Ca0. 503 0.4578 11.2918 Zno Cal.Co, Trace 0,4872 260 Cao 21.4917 4.9592 Mg0. 503 Cao 4.9592 2.3568 digo 0.9372 Mgo.coz Trace chgo S.Oz trace 0.9372 Coz 5:02 2.3859 2.3859 100.3568 100.3568

and 91.47 metres (300') long. This has been built to promote the draught of the furnace and it connects with a high stack. The draught is regulated by a couple of fire-brick dampers placed in the flues f, f Plate VIII.

The canal has been found to be coated with fume, which although 5 to 8 centimetres (2" to 3") thick, is still of so little weight that it has not been taken out to smelt. The following is its composition.

Empiri	cal
{SO₃	9.1493
{ZnO	0.9027
{NiO	0.1719
{CaO	4.8979
{MgO	0.7856
PbO.SO₃	53.5070
{CuO	0.3224
{FeO	0.4578
{ZnO	0.4872
{PbO	21.4917
{CaO	4.9592
{MgO	0.9372
{CO ₂	trace
{SiO2	<u>2.3859</u>
	100.3568

Rational PbO.SO $_3$ PbO ZnO.SO $_3$ NiO.SO $_3$ CuO FeO ZnO CaOSO $_3$ CaOCO $_2$ CaO MgO.SO $_3$ MgO.CO $_2$ MgO SiO $_2$

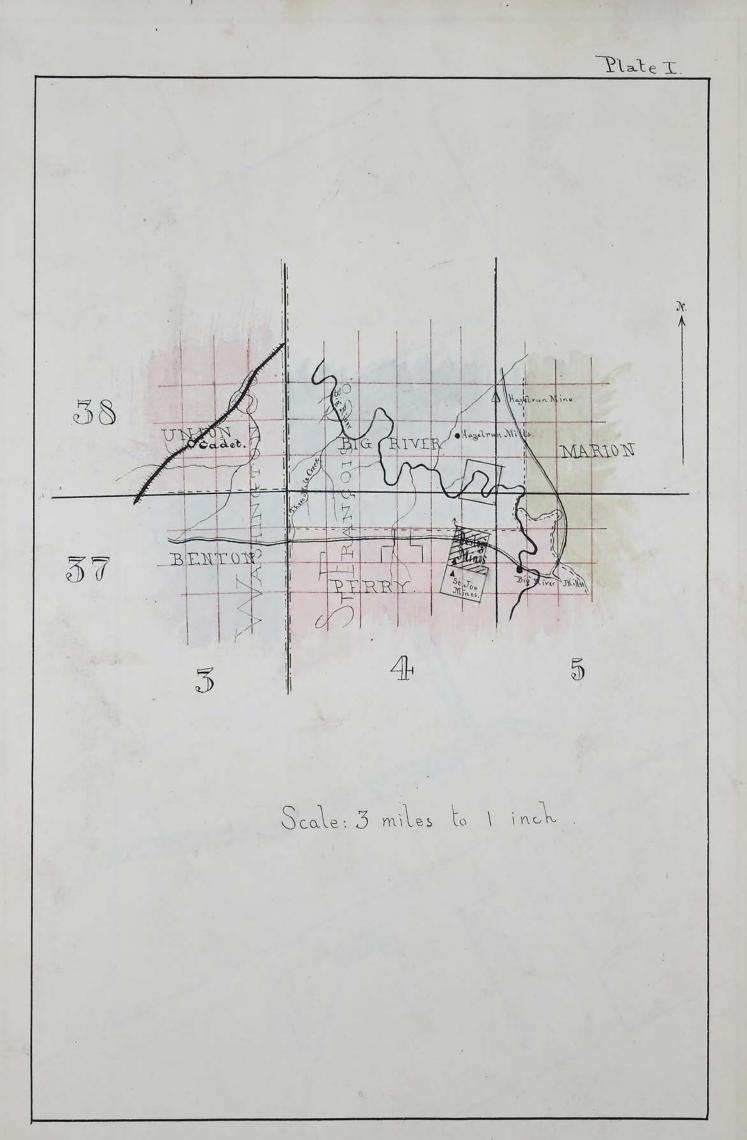
53.5070 21.4917 1.7942 0.3656 0.3224 0.4578 0.4872 11.2918 trace 4.9592 2.3568 trace 0.9372 <u>2.3859</u> 100.3568

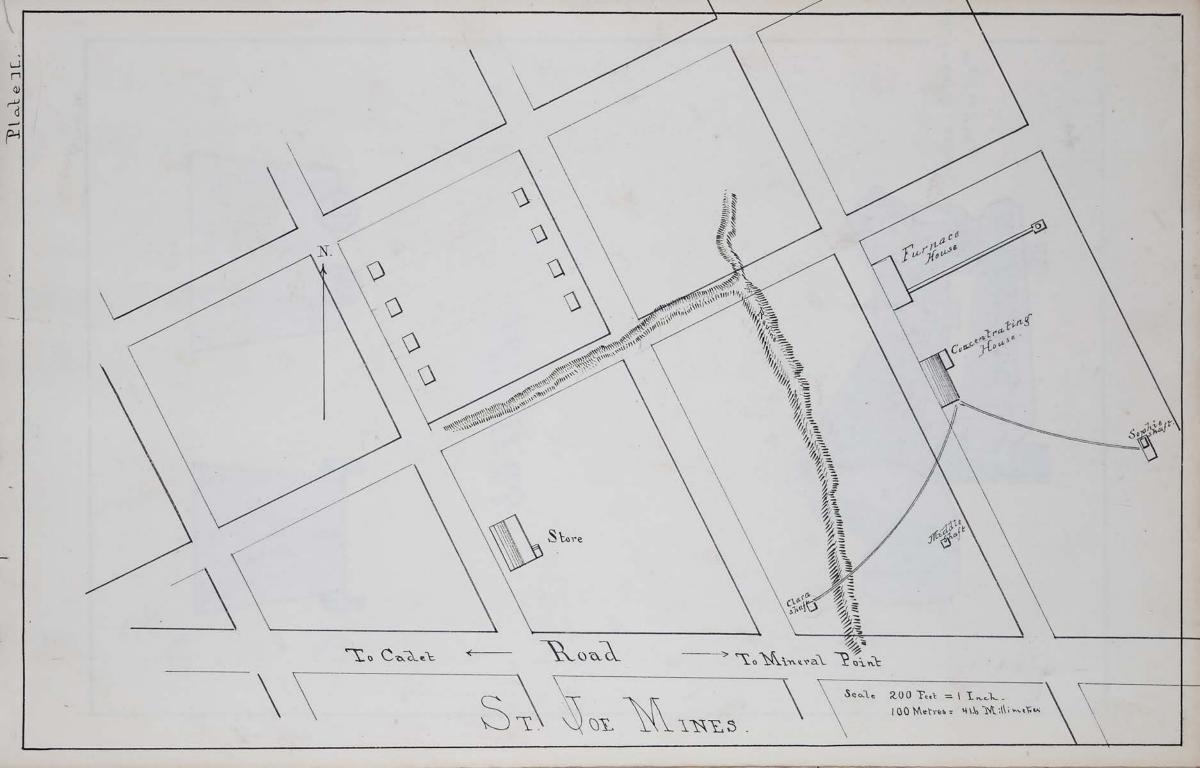
Two men are employed to work the Flintshirs and the shifts, throughout the furnace house, are two in 24 hours. place here to observe that the lead produced of which an analysis is given else-where) compares very favorably both with Thissowii and other leads, as one which can "h used chomically, It is what is technically called a "soft" or "chomical" lead and with refining would, perhaps, rouk as one of the best in the state. A. H. Ohmann - Dimesmily.

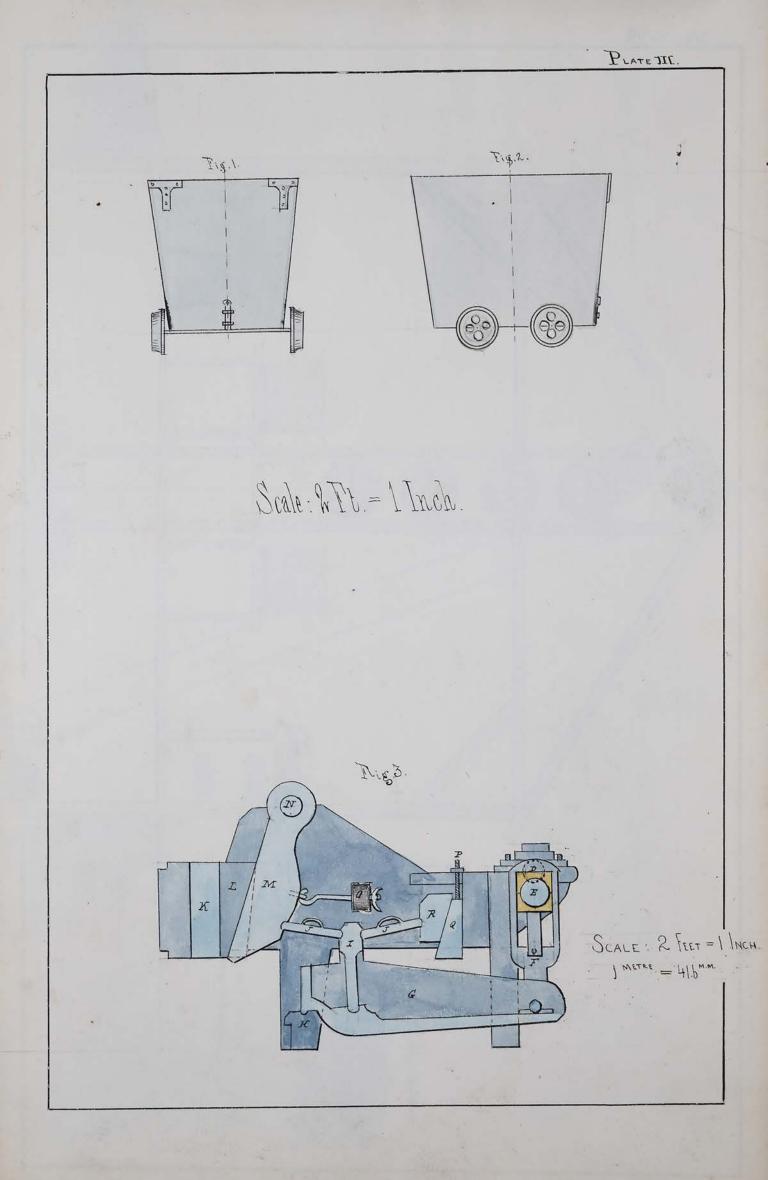
Two men are employed to work the Flintshire and the shifts, throughout the furnace house, are two in 24 hours.

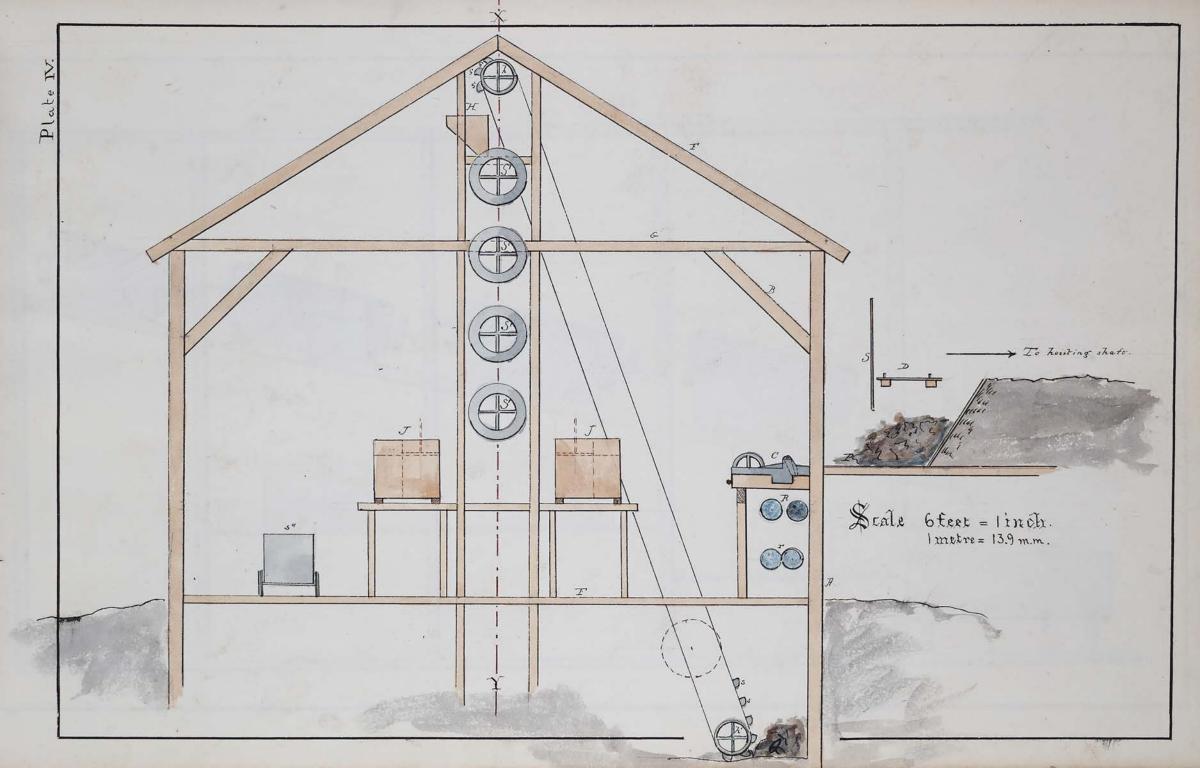
It may not be out of place here to observe that the lead produced (of which an analysis is given elsewhere) compares very favorably both with Missouri and other leads, as one which can be used chemically. It is what is technically called a "soft" or "chemical" lead and with refining would, perhaps, rank as one of the best in the state.

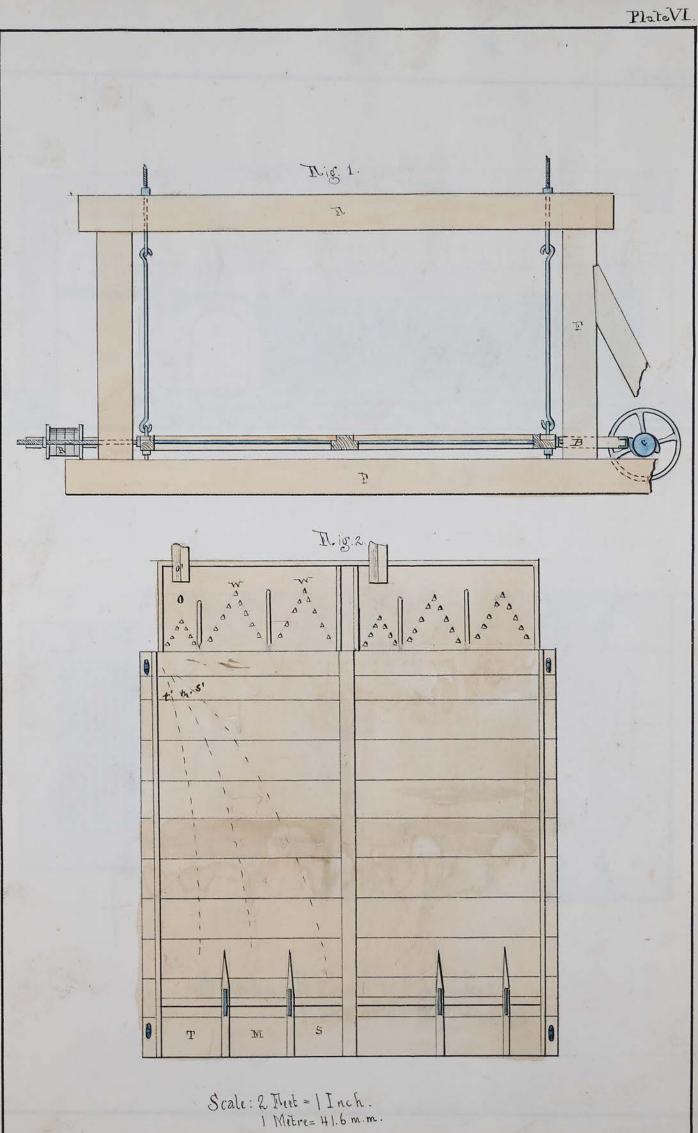
A.H. Ohmann-Dumesnil.



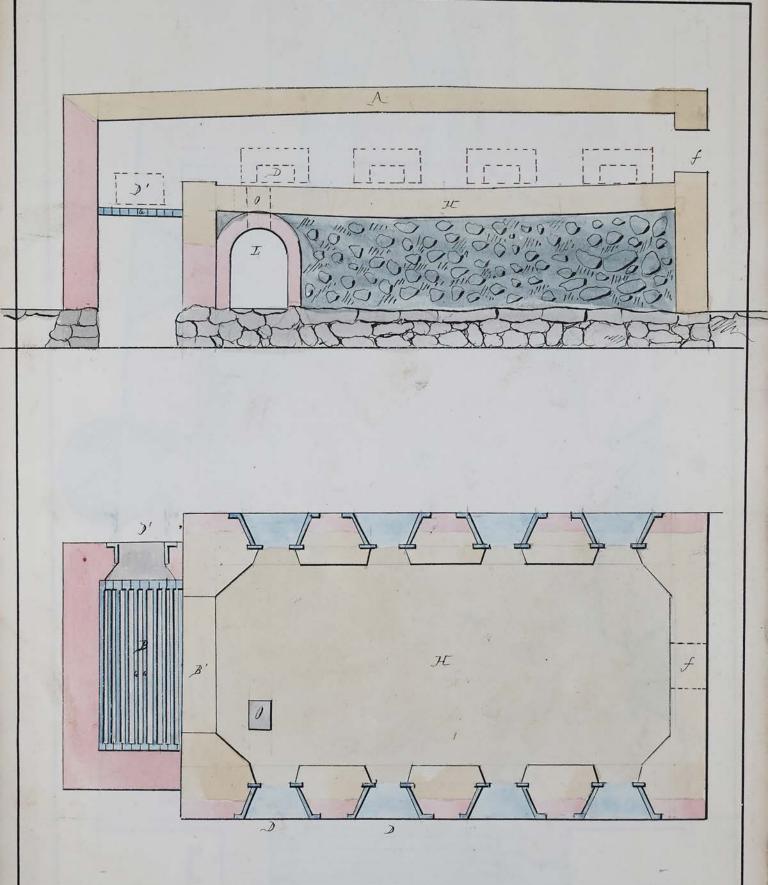








PlateVII.



Scale: 3 8003 = 1 Inch. 1 Mobres 27.7 m.m.

