The Desulphnrization of Pyritiferous Iron-Ores.*

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(Continued from Page 108.)

Some pieces of Cornwall ore, similar to those used before, were healed beyond their sintering point, and as quickly as possible, to intensify the effect. For comparison the former results, obtained on heating at a low temperature, are added :

No. of Heat.	Temp. ° F.	Duration.	Per Cent. Total Sulphur in Residue.	Sulphur as Sulphide.	Sulphur as Sulphate.	Per Cent. Total Sulphur as Sulphate.
1	1200	2 hrs.	0.346	0.235	0.111	32.18
2	1200	4 hrs.	0.178	0.088	0.090	51.12
3	1500	1 hr.	0.099	0.027	0.072	72.72
4	2400	45 min.	2.125	.....	.....	.....
5	2400	45 min.	2.422	2.337	0.085	3.50

Recalling the fact that the raw ore contained 2.664 per cent. of sulphur, the effect of the sudden fusion can be readily noted in the differences between the results of the first three heats of the last two.

The foltowing are analyses of some clinkers taken from roasters working on Cornwall ore, showing the same effect :

Per Cent. Total Sulphur.	Sulphur as Sulphide.	Sulphur as Sulphate.	Per Cent. Total Sulphur as Sulphate.
1.397	1.224	.173	12.380
1.380	1.245	.135	9.782
1.873	1.777	.096	5.125

These results indicate plainly that the fusion of ores in roasting may prove prejudicial to good results. When it once takes place it is scarcely possible for desulphurization to proceed further. The vicid coating of fused iron oxide, silica and lime, or whatever may, in various cases, go to make up the impervious exterior, is a barrier both to ingress of air and egress of sulphur in any form. If the heat in any roasting process must be carried to so high a point, it should be gradually raised, and sintering should take place only after continued heating at a lower temperature in abundant air. I have frequently found pure sulphur condensed in the cavities of cold clinkers, where it had been vaporized from pyrites, but was unable to escape. Clinkering ore quickly is equivalent to roasting without air, and even more, for the sulphur that heat alone would vaporize is imprisoned in the mass. Furthermore, it prevents any great amount of the sulphur left from being in the form of sulphate.

Ledebur states that desulphurization will be the more complete the smaller the pieces of ore, the more freely air has access, and the higher the temperature or roasting.* It is easy to understand that small pieces means greater surface exposure and less requirement for penetration for heat and air. We have seen that air is absolutely needed for everything like a complete desulphurization. As to temperature, our results do not bear out the asserted necessity of a high heat for thorough roasting in all cases.

The practical application of all these conditions in the roasting of ores is a matter of no little difficulty. A proper roaster must be one in which the heat is under control, the ingress of air ample, and the egress of the products of combustion prompt. A gas-roaster seems to approach most nearly to these conditions. The Gjers kiln in any of its forms seems to be a very deficient apparatus for desulphurization, because it has none of these qualifications. Its effectiveness is about on a par with roasting without air, for little or no air can get at the ore while it is being heated in this style of kiln. Being fired with solid fuel, it is, as a rule, under little control as to temperature, and the greater number of them are chronically "clinkered."

The working of such a kiln can be seen from a few analyses at hand. At the Musconetcong Iron Works, in a modified form of this kiln, the results as given by Mr. J. P. Pardee (*Trans.* xv., 680), were as follows :—

	Per cent. Sulphur.
Raw ore.....	0.883
"	0.68
Roasted ore	0.39
"	0.29

Cornwall ore roasted in Gjers kilns gives the following results :—

	I	II	III	IV
Per cent. sulphur.....	80	1.41	1.05	1.12

As this ore runs from 2½ to 3 per cent. of sulphur, the analyses show only imperfect desulphurization, and are comparable to roasting out of contact with air. As a rule, not more than half the sulphur is removed.

The following conclusions may be drawn from this investigation, in regard to pyrite ores :—

1. Heat alone, without access of air, can remove, at best, only one-half of the sulphur present.
2. Atmospheric oxygen is absolutely necessary for a proper desulphurization.
3. Even at a low heat, ore is properly desulphurized if air can gain access freely to the FeS_2 in it.
4. Sulphate of iron can be decomposed by heat equally well with or without air.
5. In order that the residuum of sulphur in roasted ores may consist, so far as possible, of sulphates, the roasting must be done under free access of air.
6. Fusion or sintering of ore is likely to prevent any further desulphurization.
7. Sintering does not allow much of the remaining sulphur to be in the form of sulphate.
8. Fusion, hence, should never occur in roasting except after continued heating in air at a lower temperature.
9. Ores cannot be properly desulphurized in the upper part of the blast-furnace.
10. An efficient roaster must allow easy control of heat, abundant air access to the hot ore, and rapid removal of the products of combustion.

*Handbuch der Eisenhuttenkunde, p. 188.

The Future of the Port Arthur Silver Region.

"I believe," says Mr. Herbert R. Wood, in a paper read before the Canadian Institute, "this region must ultimately take a foremost place among the silver mining districts of America." My reasons are these :—1st. The universal excellence of the ore, while much is extremely rich, running as high as ten or twelve thousand dollars a ton ; it is all good average mill-work. 2nd. The close proximity of the ten locations in the second group, all within a radius of three or four miles, leads one to believe the belt has plenty of out-crops awaiting the prospectors' pick. 3rd. As the depth of mining increases the value of the ore does not necessarily decrease, as the richest ore is in zones or pockets, liable at any moment to come into view. 4th. It is as yet a new mining region and but awaits the thorough and satisfactory trial of one or two mines to ensure the development of all. 5th. From a geological point of view the veins should all be rich, satisfactory mines. They trend with hardly an exception north-west and south-east, and are true fissures in all probability formed by the one convulsion of nature and similarly filled. The difficulties that have hitherto attended the development of this mineral region seem to have been in several cases the Temerity of the capitalists unacquainted with mining and the expenditure involved in sinking into rich zones of ore. In other cases properties have become mortgaged, mismanaged, till finally abandoned. What is needed is thorough mining men to take hold with lots of capital and push the mines and sink till the mine becomes a settled organiznton, working, yielding and paying.

Notes on Some Coals in Western Canada.*

By Wm. Hamilton Merritt, F.G.S., Toronto.

With the exception of the Vancouver Island coal, all the western coal fields owe their present development to the completion, in the autumn of 1886, of the Canadian Pacific Railroad. While it could not be expected that a very great deal could have been accomplished in three years, enough has been done to pretty thoroughly establish the coal-bearing areas and their correspondence with those which have been developed to the south of the boundary, along the lines of the transatlantic railroads in the United States.

This summer I visited some of the important developments in the coal areas of Washington Territory, largely with the object of being better able to appreciate the corresponding coal-bearing areas in British Columbia to the north.

In Western Canada coal-bearing rocks have been found in three zones :

1. In the plains to the east of the Rocky Mountains, and in the eastern flanking ranges, the coal occurs in the Cretaceous formation (including the Laramie).
2. In the interior plateau of British Columbia the coal is found in the Tertiary formation.
3. On the coast of British Columbia Cretaceous and Tertiary rocks are found carrying coal, and on the Island of Vancouver the well known Nanaimo coal has been worked for years in the first-named formation.

In all of these zones the coals vary from lignites up to higher grades, the factor determining quality being the amount of pressure to which they have been subjected. The intensity of this pressure is generally shown by the disturbance which the coals exhibit, and, in many cases, is almost directly in proportion to the distance of the deposits from mountain ranges. This seems to be also the opinion expressed by Mr. Bailey Willis in connection with his Census Report on the coals of Washington. It has been elsewhere stated that super-imposed strata has been thought to have been an important factor in these changes ; but my observations for several years in all these areas lead me to the conclusion that it is pressure alone from distortion and upheaval that has altered these western coals into the many varying grades in which they are found to exist.

In the first zone an enormous amount of coal occurs in the territory between the western borders of Manitoba and the Rocky Mountains. I shall merely note some of the seams, which are reached by rail, as examples of the character of the coals in the area mentioned. In the plains they are all lignites, changing to a high-grade lignite at the Galt mines (which are reached from the Canadian Pacific Railroad by a branch railroad 110 miles long), into a bituminous coking coal at the Bow River mines (where a 7-foot seam cuts across the main line of the Canadian Pacific Railroad), and finally, the maximum result of the metamorphic influence is reached in the Cascade Valley, where the pressure of the mountains on both sides of the Cretaceous trough, has altered the coal which it contains into an anthracite.

The following analyses, passing from east to west, convey some idea of the types of these coals :—

TABLE A.—EASTERN ZONE.

—	*a.*	*b.*	*c.*	*d.*	*e.*
Water.....	20.54	10.30	6.50	4.41	0.71
Volatile combustible matter.....	33.26	34.40	38.04	40.32	10.79
Fixed Carbon.....	41.15	39.61	47.97	48.27	80.93
Ash.....	5.05	15.64	7.55	7.00	7.57
Total.....	100.00	100.00	100.00	100.00	100.00
Coke.....	None.	None.	None.	Good.	None.
Approximate distance from mountains, miles.....	234	128	36	28	0

a.— Medicine Hat, lignite (Geological Survey) fair coking.
b.—Crowfoot " " " "
c.—Galt " " " "
d.—Bow River mines, bituminous, " "
e.—Cascade Valley, anthracite, " "

In the interior plateau of British Columbia lignite and coal have as yet been found in only a few places. The following are the only occurrences yet discovered worthy of notice :

At Princeton, or Allison's, some 20 feet of alternating lignite and shale seams occur, lying at a gentle dip. The lignite can be obtained of a workable thickness, but the greater part of the bed is too much mixed with shale. The character of the lignite, as indicated by the analysis, is that of an inferior coal.

The lignite found at Marble Canyon, Hat Creek, is of a better description, as shown by the analysis. It is said to be of very considerable thickness. I did not think the quality sufficiently good to justify a visit to the place, which has been described in the Reports of the Geological Survey.

At Kamloops, close to the Canadian Pacific Railroad, coal of a very fair bituminous character has been found ; but as yet seams of only about a foot in thickness have been opened up. The vicinity is being tested by a shaft.

In the Nicola Valley, some 49 miles from the railroad, a seam of bituminous coal, about 5 feet in thickness, has been exposed. This coal has been subjected to a greater amount of metamorphic influence than any yet discovered in this zone. It lies adjacent to a mountain, which is probably a result of the disturbance that has altered it into a good coking bituminous coal.

TABLE B.—INTERIOR ZONE.

—	*a.*	*b.*	*c.*	*d.*
Water	15.75	8.60	6.26	36.065
Volatile Combustible matter..	35.40	35.51	39.97	
Fixed carbon.....	41.45	46.84	48.22	61.290
Ash.....	7.40	9.05	5.55	2.645
Total.....	100.00	100.00	100.00	100.000
Coke.....	None.	None.	Fair.	Very good.

a.—Allison's, lignite.
b.—Hat Creek, lignite (Geological Survey).
c.—Kamloops, bituminous.
d.—Nicola, bituminous, (Geological Survey).

On the Pacific Coast zone, on the main shore, there has as yet been located a very small amount of coal and lignite, in the districts which correspond to the large areas