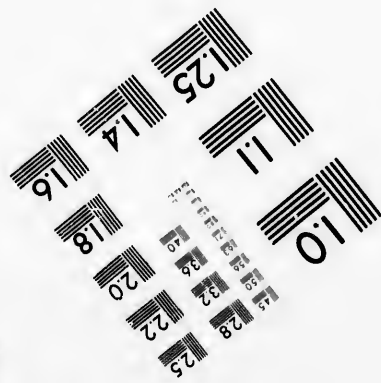
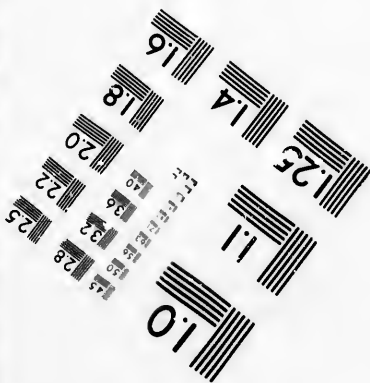
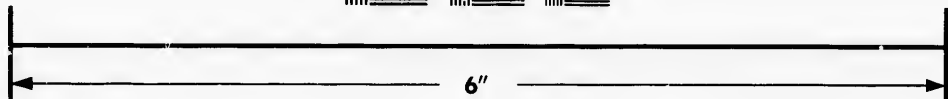
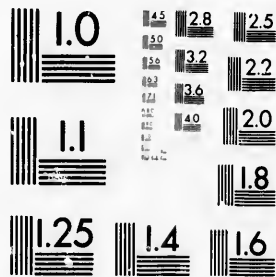


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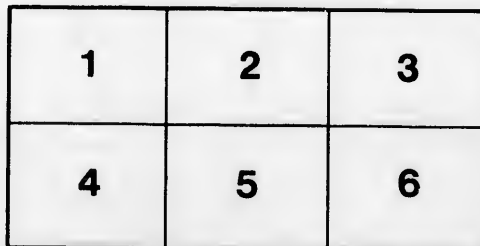
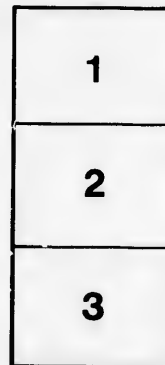
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CHEMICAL CONTRIBUTIONS
TO THE
GEOLOGY OF CANADA,
BY
CHRISTIAN HOFFMANN, F. Inst. Chem.

ON CANADIAN APATITE.

Manner in which the Samples analyzed were selected.

The samples were in all cases good-sized hand specimens; in selecting the same such pieces were taken as were most free from foreign mineral admixture, or, in other words, apparently the purest of that particular variety in the heap (usually a very large one) from which it was taken. As a rule, therefore, the various analyses may be said to represent, in a measure, the composition of these particular varieties in their greatest practically attainable state of purity; such, indeed, as might be secured by careful cobbing,—and not the composition of an average sample of any particular output, and the reader is cautioned against accepting the results in any other light. In some instances the material upon which the analysis was conducted, was said to represent a fair average of the vein; in other cases, by the exercise of a little care it would be quite possible to procure large quantities of the variety almost, if not equally, as pure as the sample examined. The instances in which these remarks hold good will be found specified, together with others of a similar tenor, under the various analyses.

Manner of
selecting the
samples.

Brief allusion to some of the Methods employed in the analysis.

Brief allusion
to methods
employed in
the analysis.

The fluorine was determined in accordance with Wöhler's method, as modified by Fresenius. (Fresenius' Quantitative Chemical Analysis, sixth German edition, Vol. I., p. 431.) The apatite, reduced to an impalpable powder and intimately mixed with finely pulverized quartz, is decomposed in a flask with concentrated sulphuric acid. The fluorine being estimated by collecting and weighing the fluoride of silicon evolved.

The phosphoric acid was estimated by Sonnenschein's process of precipitation with molybdic acid—subsequently precipitating as phosphate of magnesia and ammonia, and weighing as pyrophosphate of magnesia.

Explanatory Remarks.

Explanatory
remarks.

By the term "insoluble residue" is implied that portion of the apatite left undissolved by the action of hydrochloric acid; the mineral having been previously treated with hydrochloric acid, and evaporated to complete dryness.

The term "variety" has not been employed in its strictest sense, inasmuch as all the specimens here examined would, properly speaking, come under the one variety, fluor-apatite; I have, however, permitted myself its use in a wider sense, referring more particularly to texture.

It has been assumed, as is indeed most probable, that the whole of the phosphoric acid is present in combination with lime, and that any excess of this latter beyond that required for the phosphoric and carbonic acids, may possibly—conjointly with the magnesia, alumina, and in some instances a portion of the iron,—pertain to associated foreign mineral matter.

APATITE, var. 1.

Analysis of
apatite from
Storrington.

From the fourteenth lot of the sixth range of the township of Storrington.

The sample was received from W. J. Morris, Esq., who informed me that he was disposed to regard it as representing a fair average of a quantity of some three hundred tons extracted; that about twenty tons of the first two hundred taken out contained some mica derived from the foot-wall, but that this appeared to have since run out. The vein ranged from seven to fourteen inches in width.

Massive, compact. Lustre dull. Colour greyish to reddish-white, with reddish-brown coloured stripes or bands, which impart to the rock a stratified appearance (in some specimens these markings are less distinct). This variety of apatite may not inappropriately be said to resemble, at a first glance, a fine-grained "variegated sandstone." Tough. Fracture uneven. Colour of powder white with a faint reddish tinge. Specific gravity 3.1393.

After drying at 100° C., its composition was found to be as follows:

Phosphoric acid ¹	40.373
Fluorine ²	3.311
Chlorine ³	0.438
Carbonic acid ⁴	0.026
Lime.....	47.828
Calcium.....	3.732
Magnesia.....	0.151
Alumina.....	0.609
Sesquioxide of iron.....	0.151
Alkalies.....	?
Insoluble residue.....	3.890
	100.509

1 Equal to 88.138 tribasic phosphate of lime.

2 Equal to 6.796 fluoride of calcium.

3 Equal to 0.685 chloride of calcium.

4 Equal to 0.059 carbonate of lime.

APATITE, *var.* 2.

From the "Grant Mine," situate on the south-half of the eighteenth lot of the twelfth range of the township of Buckingham. The property of the Buckingham Mining Company. Analysis of apatite from Buckingham.

In the earlier stages of the working about two hundred and fifty tons of this variety were taken out; as the shaft increased in depth, this particular kind was not, nor has it so far, since been met with; it is however inferred, that it will be found again with the other phosphate which lies near the surface, and has yet to be removed.

Massive, vitreous. Brittle. Fracture uneven, angular; in some specimens sub-conchoidal. Lustre sub-vitreous. In thin splinters translucent. Colour pale greenish-grey. Colour of powder pale greenish-white. This variety of apatite closely resembles in its aspect "porcelain jasper." It is not unfrequently penetrated by thin seams of calcite. Hardness 5. Specific gravity 3.1493.

After drying at 100° C., its composition was found to be as follows:

Phosphoric acid ¹	41.080
Fluorine ²	3.474
Chlorine ³	0.260
Carbonic acid ⁴	0.370
Lime.....	49.161
Calcium.....	3.803
Magnesia.....	0.158
Alumina.....	0.705
Sesquioxide of iron.....	0.125
Alkalies.....	?
Insoluble residue.....	0.370
	<hr/>
	99.506

- 1 Equal to 89.682 tribasic phosphate of lime.
- 2 Equal to 7.131 fluoride of calcium.
- 3 Equal to 0.406 chloride of calcium.
- 4 Equal to 0.840 carbonate of lime.

APATITE, *var.* 3.

Analysis of
apatite from
North Burgess.

From the sixteenth lot of the third range of the township of North Burgess.

Massive, confusedly crystalline, weak-defined schistose texture. Fracture uneven. Lustre sub-vitreous, in parts dull. Colour dull red. Colour of powder pale red. Specific gravity 3.1603.

After drying at 100° C., the composition was found to be as follows:

Phosphoric acid ¹	39.046
Fluorine.....	3.791
Chlorine ³	0.476
Carbonic acid ⁴	0.096
Lime.....	46.327
Calcium.....	4.258
Magnesia.....	0.548
Alumina.....	1.190
Sesquioxide of iron.....	1.290
Alkalies.....	?
Insoluble residue.....	3.490
	<hr/>
	100.512

- 1 Equal to 85.241 tribasic phosphate of lime.
- 2 Equal to 7.781 fluoride of calcium.
- 3 Equal to 0.744 chloride of calcium.
- 4 Equal to 0.218 carbonate of lime.

s follows :

APATITE, var. 4.

From the "Ritchie Mine," situate on the seventh lot of the seventh range of the township of Portland.

Analysis of
apatite from
Portland.

This specimen was collected by Dr. B. J. Harrington, who informs me that at the spot whence it was taken, the mass, *as exposed*, measured nearly twenty feet across, and in the whole of this thickness the only apparent foreign mineral admixture consisted of a few crystals of pyroxene and mica, and that, consequently, this specimen might be regarded as representing a large portion of said *exposed mass*.

Massive, lamellar; the laminae varying in thickness from one to eight millimetres, the faces of the same are not unfrequently coated with a more or less delicate film of calcite; the coherence between the individual plates varies; when struck the rock has a tendency to split along the line of lamination rather than across. Brittle. Fracture across the laminae uneven, angular. Lustre of this fracture vitreous, that of the clean surface of the laminae resinous. Colour bright sea-green. Colour of powder white with a faint greenish tinge. Semi-transparent; in thin splinters, transparent. Hardness 5. Specific gravity 3.1884.

of North

texture.
colour dull

follows :

The following interesting fact in connection with this apatite is perhaps, not altogether unworthy of mention; after a short exposure to a low red-heat in a covered crucible it becomes perfectly colourless, its lustre being not at all, and its diaphaneity very slightly affected.

After drying at 100° C., its composition was found to be as follows:

Phosphoric acid ¹	41.139
Fluorine ²	3.863
Chlorine ³	0.229
Carbonic acid ⁴	0.223
Lime.....	49.335
Calcium.....	4.195
Magnesia.....	0.180
Alumina.....	0.566
Sesquioxide of iron.....	0.094
Alkalies.....	?
Insoluble residue.....	0.060

 19.884

1 Equal to 89.810 tribasic phosphate of lime.

2 Equal to 7.929 fluoride of calcium.

3 Equal to 0.358 chloride of calcium.

4 Equal to 0.507 carbonate of lime.

APATITE, *var.* 5.

Analysis of
apatite from
Loughborough.

From the tenth lot of the tenth range of the township of Loughborough. W. J. Morris, Esq., by whom the specimen was presented, stated that the vein from which it was taken—and of which, in his opinion, it might be considered a fair sample,—had a width of about seven feet.

Massive, compact. Lustre dull, in parts sub-resinous. Brittle. Fracture uneven, angular. Colour dull-red. Colour of powder reddish-white. Interpenetrated by delicate films of specular iron. Specific gravity 3.1641.

After drying at 100° C., its composition was found to be as follows:

Phosphoric acid ¹	40.868
Fluorine ²	3.731
Chlorine ³	0.428
Carbonic acid ⁴	0.105
Lime.....	48.475
Calcium.....	4.168
Magnesia.....	0.158
Alumina.....	0.835
Sesquioxide of iron.....	0.905
Alkalies.....	?
Insoluble residue.....	1.150

100.823

1 Equal to 89.219 tribasic phosphate of lime.

2 Equal to 7.658 fluoride of calcium.

3 Equal to 0.669 chloride of calcium.

4 Equal to 0.239 carbonate of lime.

APATITE, *var.* 6.

Analysis of
apatite from
Portland.

From the "Watts Mine," situate on the sixth lot of the first range of the township of Portland. The property of the Buckingham Mining Company.

About seventy per cent. of the phosphate raised from this mine consists of this variety, the balance is similar to that described below, wherein the compact crystalline phosphate preponderates, sometimes to the almost total exclusion of the fine-granular.

Massive, crystalline-granular. Friable. Fracture uneven, granular. Prevailing colour greenish-white. Colour of powder white. Lustre glimmering. Specific gravity 3.1676.

The texture of this variety varies from a very fine-granular crystalline, greenish to greyish-white, homogeneous, somewhat easily friable rock, closely resembling a disintegrating sandstone,—to crystalline granular, with imbedded rounded fragments of semi-transparent sea-

green apatite, constituting what, perhaps, might not inaptly be designated a conglomerate—thence passing on to a condition in which the fragments become more numerous and larger, to the almost total exclusion of the fine-granular matrix.

After drying at 100° C., its composition was found to be as follows:

Phosphoric acid ¹	40.518
Fluorine ²	3.377
Chlorine ³	0.086
Carbonic acid ⁴	0.855
Lime	49.041
Calcium	3.603
Magnesia	0.205
Alumina	0.267
Sesquioxide of iron	0.083
Alkalies	?
Insoluble residue	1.630

99.665

- 1 Equal to 88.455 tribasic phosphate of lime.
- 2 Equal to 6.932 fluoride of calcium
- 3 Equal to 0.134 chloride of calcium.
- 4 Equal to 1.943 carbonate of lime.

APATITE, var. 7.

From the "Grant Mine," situated on the south-half of the eighteenth lot of the twelfth range of the township of Buckingham. The property of the Buckingham Mining Company. Analysis of apatite from Buckingham.

About five hundred tons of this variety have been taken out at this mine; it is still met with, but not in such large quantities.

Massive, crystalline, fine-granular, with occasional imbedded rounded fragments of semi-transparent sea-green apatite. Prevailing colour greyish-green. Lustre glistening, due to the presence of intermixed grains of pyrrhotite. Somewhat tough. Fracture uneven, granular. Colour of powder greenish-grey. Specific gravity 3.2441.

In selecting the material for analysis the aforementioned imbedded rounded fragments were excluded (as also in those specimens upon which the specific gravity was determined), the object being to ascertain the composition of the granular matrix; it need hardly be remarked that their presence would have raised the percentage of tribasic phosphate.

After drying at 100° C., its composition was found to be as follows:

Phosphoric acid ¹	34.032
Fluorine ²	2.855
Chlorine ³	0.101
Carbonic acid ⁴	2.848
Sulphur ⁵	3.507
Lime.....	44.198
Calcium.....	3.062
Magnesia.....	0.422
Alumina.....	1.979
Nickel, cobalt and copper present, but were.....	not det'd
Iron.....	5.370
Sesquioxide of Iron.....	0.120
Alkalies.....	?
Insoluble residue.....	2.050

100.544

- 1 Equal to 74.295 tribasic phosphate of lime.
- 2 Equal to 5.860 fluoride of calcium.
- 3 Equal to 0.158 chloride of calcium.
- 4 Equal to 6.473 carbonate of lime.
- 5 Equal to 8.877 pyrrhotite.

The nickel, cobalt and copper shown to be present, pertain to the associated pyrrhotite. In calculating the amount of the latter (in accordance with the formula Fe_7S_8) corresponding to the sulphur found, their presence has been ignored, as a consequence, the total iron found has been somewhat too largely drawn upon, so that the balance, which was assumed and calculated to be present as peroxide, is somewhat, though possibly very slightly below the actual amount present.

APATITE, var. 8.

Analysis of
apatite from
Templeton,

From the "Doctor Pit," situate on the twelfth lot of the twelfth range of the township of Templeton. The property of the Templeton and North Ottawa Mining Company.

This specimen was collected by Dr. B. J. Harrington, who states that so far as the working had advanced, this particular kind had not been found in any great quantity, but formed a portion of a vein consisting of a crystalline-granular, somewhat friable variety, very similar to that described under Apatite, var. 6, and a compact crystalline variety.

Massive, compact. Fracture uneven. Lustre feeble, waxy. Translucent. Colour pale greenish-white. Colour of powder white with a faint greenish tinge. Specific gravity 3.1750.

After drying at 100° C., the composition was found to be as follows:

Phosphoric acid ¹	40.812
Fluorine ²	3.554
Chlorine ³	0.040
Carbonic acid ⁴	0.518
Lime	49.102
Calcium	3.763
Magnesia	0.620
Alumina	0.565
Sesquioxide of iron	0.125
Alkalies	?
Insoluble residue	0.630
	99.729

1 Equal to 89.098 tribasic phosphate of lime.

2 Equal to 7.295 fluoride of calcium.

3 Equal to 0.062 chloride of calcium.

4 Equal to 1.177 carbonate of lime.

The results of the foregoing analyses have been embodied in Table I. with the object of affording easy reference, and facilitating comparison, not only the one with the other, but alike with those contained in Table II., which embraces analyses of fluor-apatites from some of the principal European localities. In selecting these latter analyses I have only availed myself of those wherein the fluorine has been determined by direct estimation; further, in transcribing them, I have taken the liberty of presenting them in a somewhat different form to that in which they appeared,—that is to say, in analyses A. B. C. where the amount of tribasic phosphate of lime, fluoride and chloride of calcium was given, the amount of phosphoric acid, fluorine, chlorine, lime and calcium thus represented has been calculated and stated separately. In like manner in analysis E. where the amount of fluoride of calcium was given, the amount of fluorine and calcium thus represented has been calculated and stated separately. In the other analyses viz., D. F. G. and H. the total lime found was given and stated as such; in these instances the amount of lime corresponding to the calcium (now stated as such) required for the fluorine or fluorine and chlorine, as the case might be, has been deducted from the total quantity given: as a result of this altered representation, the analyses do not now foot up so high as in the originals.

Explanatory
remarks on
Table II.

TABLE I.—SHOWING THE COMPOSITION OF CERTAIN CANADIAN FLUOR-APATITES.

	1.	2.	3.	4.	5.	6.	7.	8.
Phosphoric acid ¹	40.373	41.080	39.046	41.139	40.868	40.518	34.032	40.812
Fluorine ²	3.311	3.474	3.791	3.863	3.731	3.377	2.855	3.554
Chlorine ³	0.438	0.260	0.476	0.229	0.428	0.086	0.101	0.040
Carbonic acid ⁴	0.026	0.370	0.096	0.273	0.105	0.855	2.848	0.518
Sulphur ⁵.....	.....	.....	.....	.....	.....	.....	3.507	.....
Lime.....	47.828	49.161	46.327	49.335	48.475	49.041	44.198	49.102
Calcium.....	3.732	3.803	4.258	4.185	4.168	3.603	3.962	3.763
Magnesia.....	0.151	0.158	0.548	0.180	0.158	0.205	0.422	0.620
Alumina.....	0.609	0.705	1.190	0.566	0.835	0.267	1.979	0.565
Nickel, cobalt and copper.....	.....	.....	.....	.....	.....	.....	not det'd.	.....
Iron.....	.....	.....	.....	.....	.....	.....	5.370	.....
Sesquioxide of iron.....	0.151	0.125	1.290	0.094	0.905	0.083	0.120	0.125
Alkalies—presence not ascertained—	?	?	?	?	?	?	?	?
Insoluble residue.....	3.890	0.370	3.490	0.060	1.150	1.630	2.050	0.630
	100.509	99.506	100.512	99.884	100.823	99.665	100.544	99.729
Specific gravity.....	3.1393	3.1493	3.1603	3.1884	3.1641	3.1676	3.2441	3.1750
1 Equal to tribasic phosphate of lime.....	88.138	89.682	89.241	89.810	89.219	88.455	74.295	89.098
2 Equal to fluoride of calcium.....	6.796	7.131	7.781	7.929	7.658	6.932	5.860	7.295
3 Equal to chloride of calcium.....	0.685	0.406	0.744	0.338	0.669	0.134	0.158	0.062
4 Equal to carbonate of lime.....	0.059	0.840	0.218	0.507	0.239	1.943	6.473	1.177
5 Equal to pyrrhotite.....	.....	.....	.....	.....	.....	.....	8.877	.....

NOTE.—The numbers heading the columns correspond with those particularizing the variety, and which appear over the respective analyses in the preceding pages.

TABLE II.—SHOWING THE COMPOSITION OF CERTAIN EUROPEAN FLUOR-APATITES.

NOTE.—The numbers heading the columns correspond with those particularizing the variety, and which appear over the respective analyses in the preceding pages.

CANADIAN APATITE.

TABLE II.—SHOWING THE COMPOSITION OF CERTAIN EUROPEAN FLUOR-APATITES.

	A.	B.	C.	D.	E.	F.	G.	H.
Phosphoric acid ¹	42-229	42-172	42-215	40-120	34-630	34-480	41-990	41-980
Fluorine ²	3-415	3-434	3-746	2-160	3-313	3-450	4-200	4-020
Chlorine ³	0-512	0-565	0-096	0-060	.....	.....	0-010	0-110
Carbonic acid ⁴.....	.....	.....	.....	.....	.....	.....	.....	.....
Lime.....	49-960	49-894	49-945	50-269	41-150	40-705	49-752	49-898
Calcium.....	3-884	3-934	3-998	2-308	3-487	3-632	4-427	4-294
Magnesia.....	.....	.....	.....	.....	.....	0-160	.....	.....
Alumina.....	.....	.....	.....	.....	.....	1-680	.....	.....
Sesquioxide of iron.....	.....	.....	.....	0-610	.....	6-420	.....	.....
Alkalies.....	.....	.....	.....	.....	.....	1-000 ^c	.....	.....
Silica.....	.....	.....	.....	3-100 ^a	12-370	4-830	.....	.....
Water.....	.....	.....	.....	.....	1-250	2-450	.....	.....
	100-000	100-000	100-000	98-627	100-000	99-717	100-379	100-302
1 Equal to tribasic phosphate of lime.....	92-189	92-066	92-160	87-586	75-601	75-273	91-668	91-646
2 Equal to fluoride of calcium.....	7-010	7-049	7-690	4-434	6-800	7-092	8-621	8-252
3 Equal to chloride of calcium.....	0-801	0-885	0-150	0-094	.....	.....	0-016	0-172
4 Equal to carbonate of lime.....	.....	.....	.....	.....	.....	3-432	.....	.....

A. From Arendal, Norway, by G. Rose.
 B. From Murcia, Spain, by G. Rose.
 C. From Greiner, Tyrol, by G. Rose.

D. From Estramadura, Spain, by Garzo and Penuelas.

a. With alumina.—b. With some alumina, magnesia, iodine (traces) and carbonic acid (by difference).—c. Consisting of potash 0-58 and soda 0-42.

E. From Estramadura, Spain, by P. Thilbault.
 F. From Staffel, Nassau, Germany, by Foster.
 G. From Tokovaia, Ural, Russia, by Pusirevski.
 H. From Sludianka, Russia, by Pusirevski.

Iodine and Bromine in Apatite.

Iodine and
bromine in
apatite.

Iodine has been shown to be present in certain varieties of apatite from the departments of Lot and Tarn-et-Garonne: P. Thibault has found it in Nassau phosphate, in Spanish phosphorite from the vicinity of Cogues (Estramadura) and has also established its presence in coprolites found in the Valley of the Rhone, near Bellegarde (Ain) close to the Swiss frontier: Petersen also found it in apatite from Diez, Nassau, and that from Amberg, Bavaria, afforded H. Reinsch in addition to iodine a trace of bromine.

Analysis of
apatite from
the department
of Lot.

According to an analysis by P. Thibault, a sample of apatite from the department of Lot, contained:—

Phosphoric acid ¹	33.05
Lime.....	47.09
Silica	2.71
Alumina, oxide of iron, magnesia, chlorine, fluorine, iodine ¹⁵ (_{1,000,000}), }	12.86
carbonic acid (by difference).	
Water.....	4.29
	100.00

¹ Equal to 72.151 tribasic phosphate of lime.

It has been suggested that the apatite from the departments of Lot and of Tarn-et-Garonne might possibly be utilized as a commercial source of iodine, and efforts have been made in this direction by M. P. Thibault at the Super-phosphate Works of MM. Maxime Michelet et Paul Thibault, (à la Villette-Paris). The phosphates employed at these works consist of apatite from the department of Lot, coprolites from the Ardennes and Spanish phosphorite.

The plant at this factory may be briefly described as follows:—

Brief descrip-
tion of the
superphosphate
works of MM.
Michelet and
Thibault.

Two endless belts, the one of leather with wooden scoops or cups for raising the powdered phosphate, the other of gutta-percha with scoops or cups of the same material for raising the acid. On motion being communicated to these belts, the powder and acid are raised simultaneously and dropped into an horizontal, cylindrical, cast-iron mixer where the powder and liquid are thoroughly intermixed by the revolving spindle of the mixer and its blades, after which the mass passes down through a shoot into brick chambers where it solidifies and whence it is afterwards withdrawn. The acid vapours generated in the mixer and chambers are withdrawn from these vessels by means of a powerful aspirator and made to traverse a sheet-iron cylinder lined with lead and filled with fragments of coke, upon which a constant stream of water is kept trickling from above, and pass finally into the factory chimney. By this arrangement the acid vapours generated on mixing the powdered phosphate with the acid and which

Removal of the
noxious gases
generated in
the process of
superphos-
phating.

are at all times discomforting and often (especially when fluor-apatites are being worked) positively injurious to those exposed to their influence, are carried off and completely absorbed. When phosphates containing iodine are employed, the iodine disengaged during their conversion into superphosphate and carried away in the state of vapour or as hydriodic acid, is completely absorbed and by allowing the same liquid to retrace the coke, the solution may contain as much as eight grammes of iodine to the litre. It will be thus seen that it is quite possible to collect all the iodine which is disengaged in the gaseous condition; the amount thus disengaged however is very far from representing the total amount originally contained in the apatite, the greater part unfortunately remaining in the superphosphate; and, so far as I am aware, a method has yet to be discovered whereby that portion of the iodine may be profitably extracted.

Collection of the iodine.

If, however, the method devised by M. P. Thibault does not so far permit of the recovery of all the iodine it nevertheless possesses other important advantages, such as a continuous process of manufacture, considerable saving of manual labour, and complete absence of noxious vapours.

Advantages of P. Thibault's method.

From its usually high content of phosphate of lime Canadian apatite may be regarded as a most eligible material for the manufacture of a concentrated superphosphate. Generally speaking it contains (as will be seen on reference to Table I.) only small quantities of oxide of iron, and not unfrequently the amount is altogether quite insignificant: it is to be remembered that No. 7 is a very exceptionally occurring variety, has only been met with at this mine, and there only, as stated, in small quantity.

Canadian apatite as a material for the manufacture of superphosphate.

All the Canadian apatite hitherto met with belongs to the variety fluor-apatite, and is very similar in composition to that derived from many European localities, as will be seen on comparing Table I. with II. A great deal of the phosphatic material at present extensively employed in the manufacture of superphosphate, contains more or less fluoride of calcium, this may be said of Spanish phosphorite, German or Nassau phosphato and most coprolites: when such material are treated with sulphuric acid in the process of superphosphating, hydro-fluoric acid is evolved, which not only causes discomfort, but is injurious to the workmen. For this reason, at works where no special precautions are taken to effect the removal of the noxious gases evolved in the mixing process, any phosphatic material containing much fluorine is apt to be looked upon with some disfavour: its presence, however, can be a matter of very little moment when the very simple and effective device, for drawing off and absorbing these gases, as ear-

On the presence of fluoride of calcium in phosphatic material employed in the manufacture of superphosphate.

ried out at the works of MM. Michelet and Thibault (afore briefly described) is adopted.

Concluding
remarks.

It was originally contemplated to make some practical and comparative experiments with European and Canadian phosphate in order to ascertain the relative facility with which they admitted of being reduced to a fine powder; sufficient time could not be found to carry out this intention. There is, however, no reason for supposing that in this respect they compare at all unfavourably with foreign apatites.

In the manufacture of superphosphate from mineral phosphates it is almost impossible in practice to render the whole of the phosphate of lime soluble, more or less (according to the skill and care bestowed in the manufacture) of the latter remaining in its original unchanged state. In order to employ the mineral phosphates to the best advantage, it is requisite that they should be reduced to an almost impalpable powder, and that the mixing of this latter with the acid should be most thorough.

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