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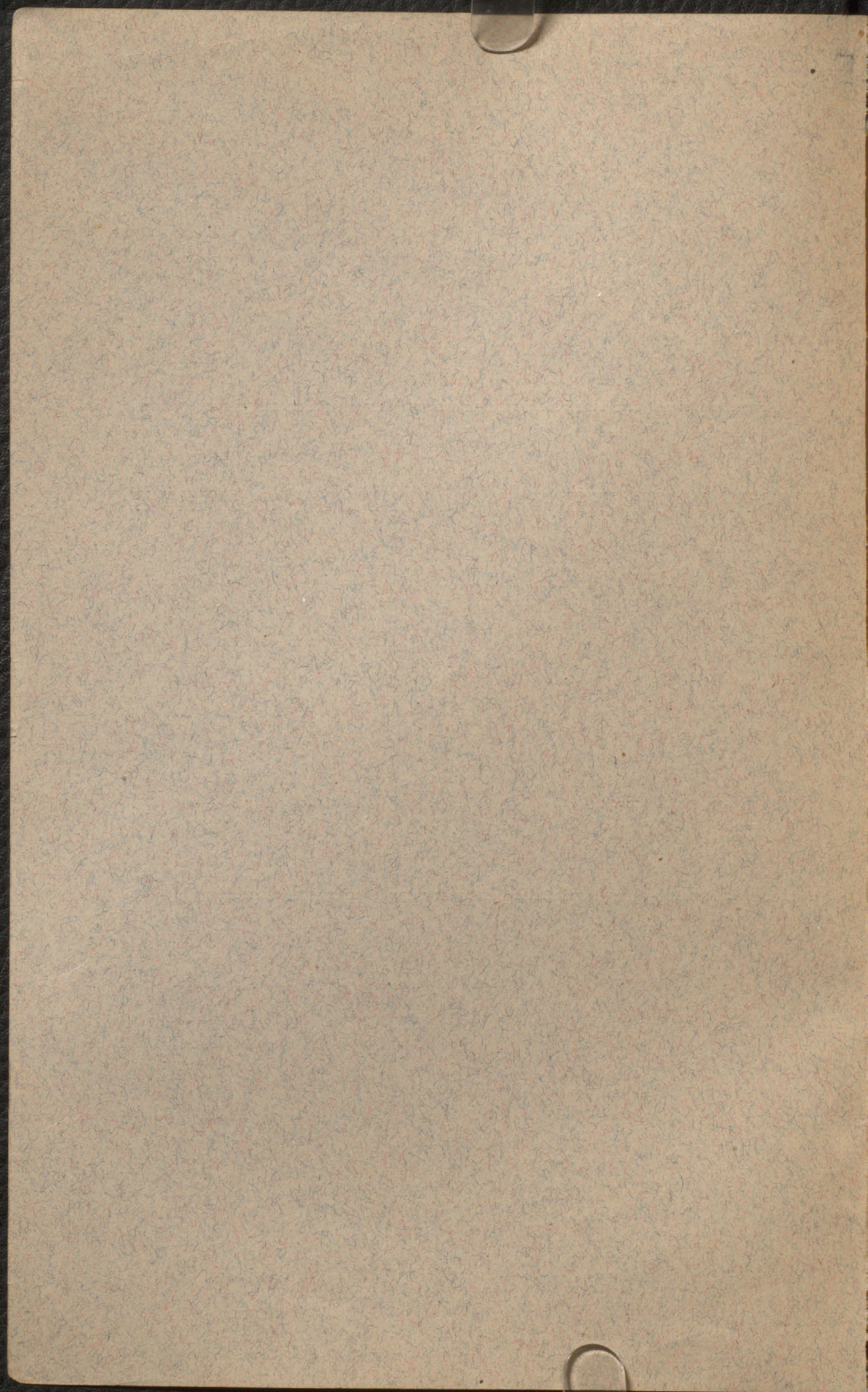
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NOTES ON CHROME GARNET, PYRRHOTITE  
AND TITANIFEROUS IRON ORE.

BY

B. J. HARRINGTON, B.A., PH.D.

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Garnet affords us an excellent example of the wide variation in composition exhibited by many mineral species. The variation is due to what is known as isomorphous replacement, or the replacement of one or more substances in a chemical compound by analogous substances without any essential change of form resulting therefrom.

If we take  $R_3 R_2 Si_3 O_{12}$  as the general formula for garnet, the numerous analyses of the mineral which have been made tell us that R may be represented by calcium, magnesium, iron (in the ferrous state), manganese, &c., while R may be aluminium, iron (in the ferric state), or chromium. With all these differences in composition, the crystals of the mineral are always closely related or identical in form; but, as might be expected, the variations in specific gravity and colour are considerable.

In a paper on "Apatite and its associated Minerals," which I had the pleasure of reading before this Society about a year and a half ago, garnet was mentioned as one of the rarer constituents of the apatite-bearing veins; and its occurrence was again noticed in a report published by the Geological Survey last year. Of the varieties which have been observed the most common is probably a lime-alumina garnet; but the most interesting is a beautiful emerald-green variety which was discovered some time ago in the township of Wakefield, Quebec, and which has proved on analysis to be chromiferous. So far as I am aware there is no instance recorded in which the element chromium has hitherto been detected in any of the Laurentian minerals of Canada, although it is well known to be a constituent of serpentines and other minerals in succeeding formations. In order to ascertain whether the Wakefield garnet resembled the original ouvarovite or chrome-garnet, from Bissersk, in the Urals, a quantitative analysis has recently been made, and the results are given under

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	I. *	II.	III.
Silica .....	37.50	36.65	36.93
Alumina .....	18.65	17.50	5.68
Ferric oxide.....	1.07	.....	1.96
Ferrous oxide.....	.....	4.97	.....
Chromium sesquioxide.	4.95	6.20	21.84
Lime.....	36.13	33.20	31.63
Magnesia .....	0.52	0.81	1.54
Cupric oxide.....	.....	.....	trace.
Loss on ignition.....	0.48	0.30	.....
	99.30	99.63	99.58

On comparing these analyses we see that while in the true ouvarovite, the predominant sesquioxide obtained on analysis is that of chromium, it is alumina in the garnet of Wakefield and Orford. Strictly speaking, therefore, the two last should be classed as lime-alumina rather than lime-chrome garnets.

The hardness of the Wakefield mineral is a little above 7 and the specific gravity 3.542. Before the blow-pipe it fuses between 4 and 5. Notwithstanding that it contains less chromium, the green in the specimens which I have seen is deeper than that of the Orford mineral and quite as deep as that of ouvarovite. The crystals are rhombic dodecahedrons with the faces often striated in the direction of the longer diagonal. In my specimens the well-defined crystals are mostly one-eighth of an inch or a little more in diameter; but one—unfortunately not entire—is nearly half an inch. On weathering, the crystals lose their glassy lustre, becoming dull and paler in colour. Among the minerals associated with the garnet are a green pyroxene, which is probably chromiferous, apatite, calcite, orthoclase, tourmaline and idocrase.

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## II. PYRRHOTITE OR MAGNETIC IRON PYRITES.

In 1875 a vein containing considerable quantities of copper pyrites was discovered near Polson's Lake, in Antigonish County, Nova Scotia. Loose masses of the ore had long before been found scattered over the surface, and although it was evident that they had not travelled far, a number of attempts to discover their source proved failures.

Among the minerals associated with the copper pyrites are spathic iron ore, iron pyrites, pyrrhotite and more rarely native copper. Pyrrhotite, as is well known, frequently contains nickel, or both nickel and cobalt, replacing a portion of the iron, and much of the nickel of commerce has been derived from this source. On account of this fact it was deemed worth while to analyse the mineral from Polson's Lake. The specimen examined—for which I am indebted to Dr. Dawson—was paler in colour than ordinary pyrrhotite and had a very high lustre. It contained a good deal of spathic iron ore (or ankerite) which was difficult to separate completely from the pyrrhotite. An analysis gave the following results :

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Copper.....	0.181
Manganese.....	traces.
<b>Nickel</b> .....	0.773
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Sulphur.....	38.580
Calcium Carbonate.....	0.786
Magnesium Carbonate.....	0.216
	99.512

The carbonates must be due to a small quantity of intermixed gangue, and a little of the iron was no doubt also present as carbonate. The mineral was strongly attracted by the magnet.

It should be stated here that the late Professor Howe, of Windsor, Nova Scotia, detected nickel and cobalt several years ago in specimens of pyrrhotite from both Nova Scotia and New Brunswick.\* Specimens from Cape Breton Island gave 0.50 per cent. of oxides of nickel and cobalt, the amount of metallic nickel being "at least 0.36 per cent." A specimen from Nictaux in Annapolis County, gave "nickel, with a little cobalt, 0.10 p.c.

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I am told that some years ago a pyrrhotite containing 2.5 per cent. of nickel was profitably treated in Pennsylvania at a time when nickel was worth \$1.50 per lb. Subsequently the price rose to \$3.00 per lb., and in Litchfield County, Connecticut, an attempt was made to work a pyrrhotite containing, according to some authorities, about 0.75 p. c., but the results did not prove satisfactory. During the past few years the price of nickel has greatly declined, owing partly to the discovery of important deposits of nickel ores in New Caledonia. Exactly what the metal is worth in the United States at present I am not aware, but in England the price is only three shillings sterling per lb. A year ago it was four shillings to four and sixpence, while in 1874 it was eleven shillings.

The New Caledonia ores are said to be hydrated silicates of nickel, and to occur in serpentines associated with euphotides, diorites, amphibolites, &c. They are in fact found in rocks resembling the so-called metamorphic rocks of the Eastern Townships, many of which were long ago shown by Dr. Hunt to contain nickel.

That pyrrhotite is a common mineral in our Laurentian rocks is well known, and it is not unlikely that, as in Norway so here, deposits of both pyrrhotite and pyrite may yet be found, containing sufficient nickel for profitable extraction. A short time ago it was estimated that Norway annually supplied as much nickel as one-third of the yield of the whole world.\*

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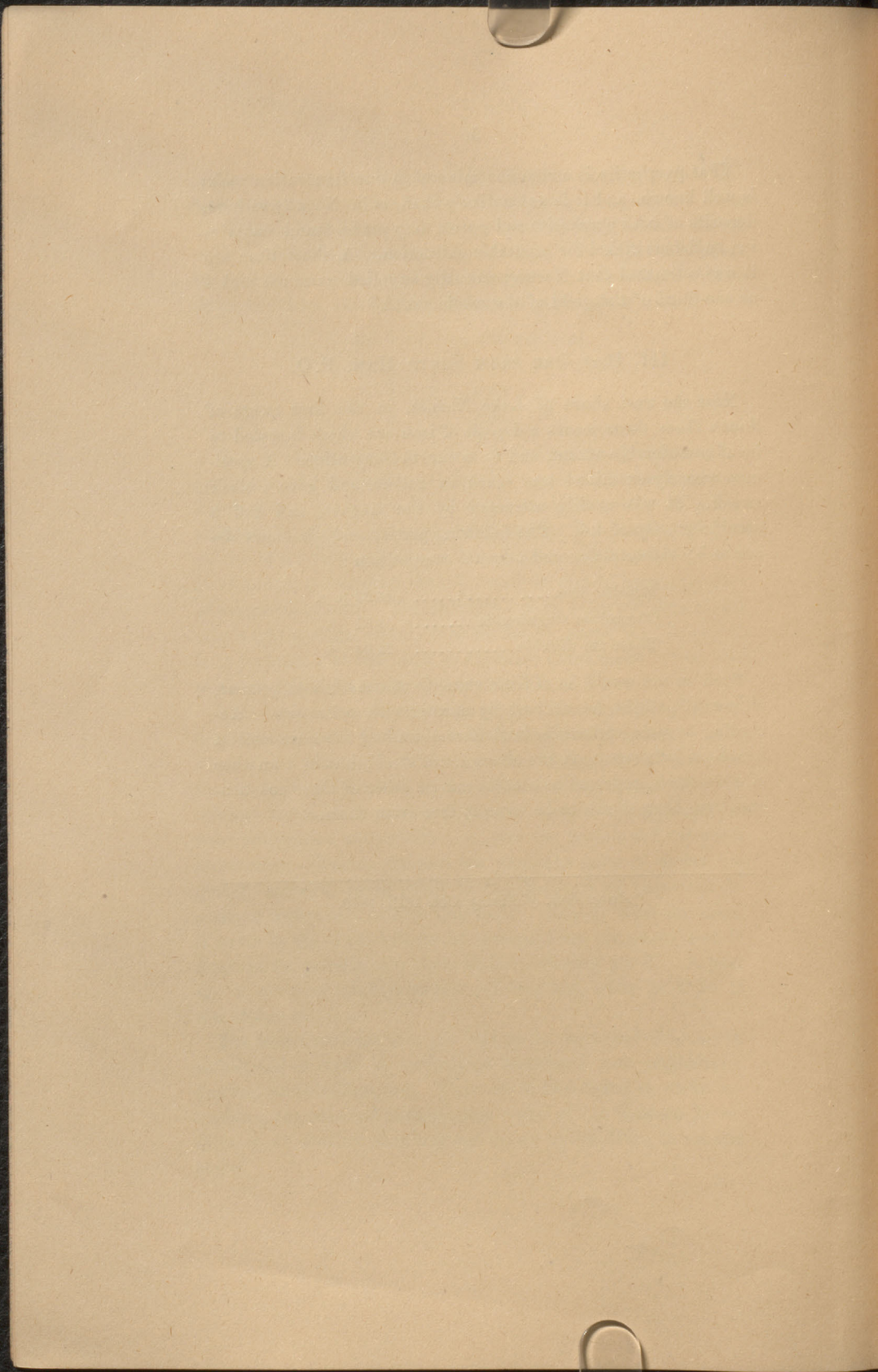
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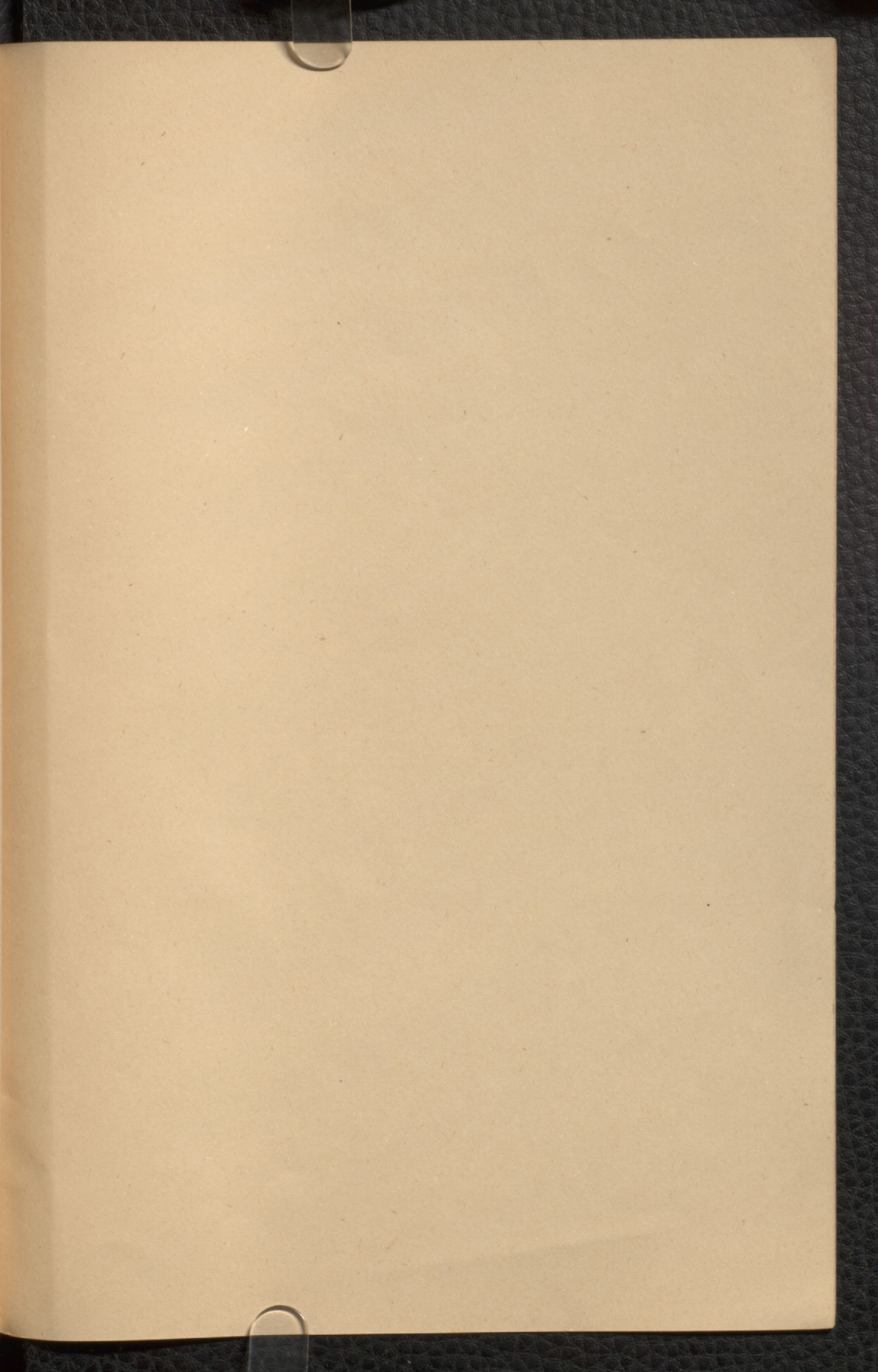
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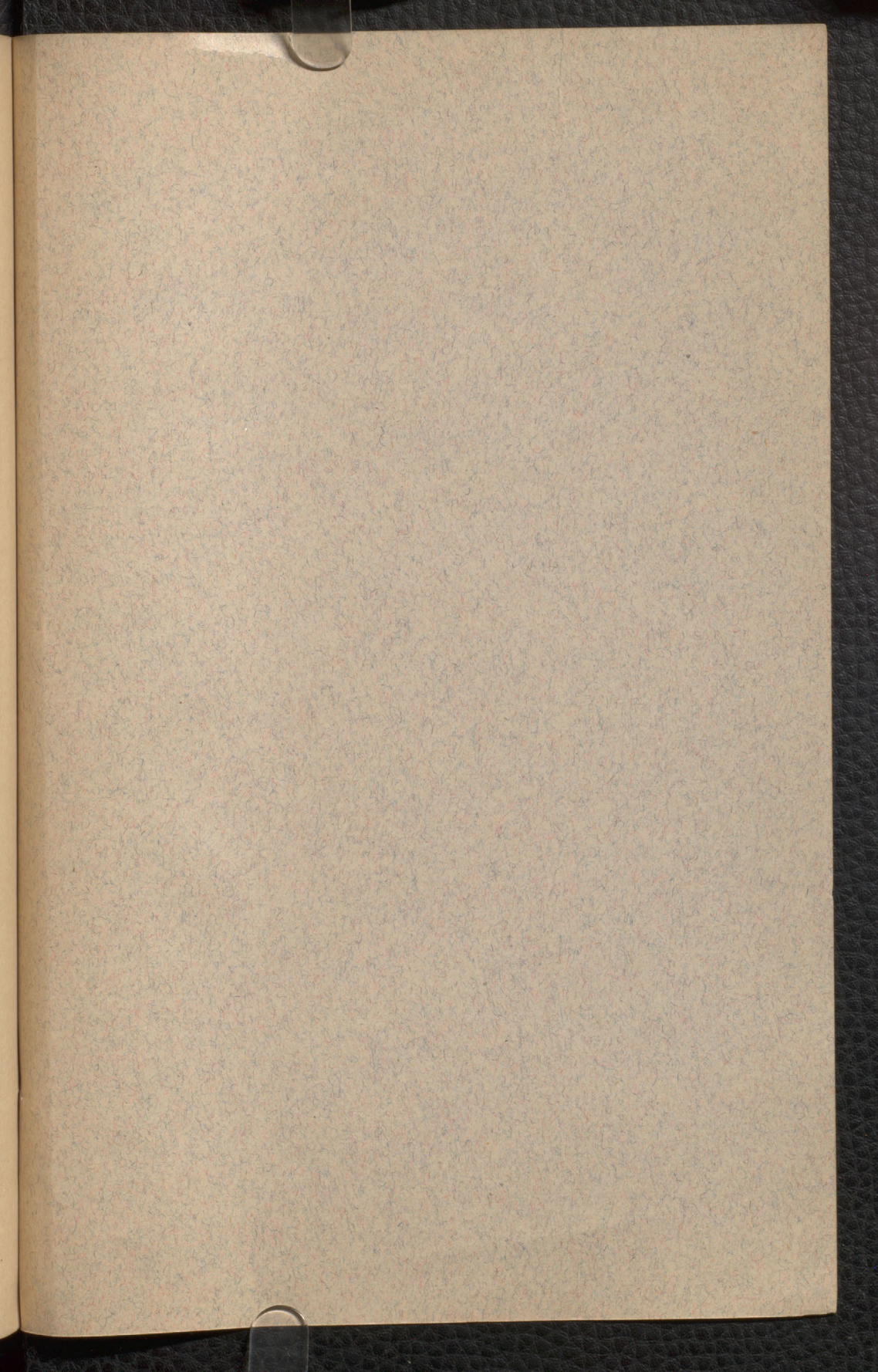
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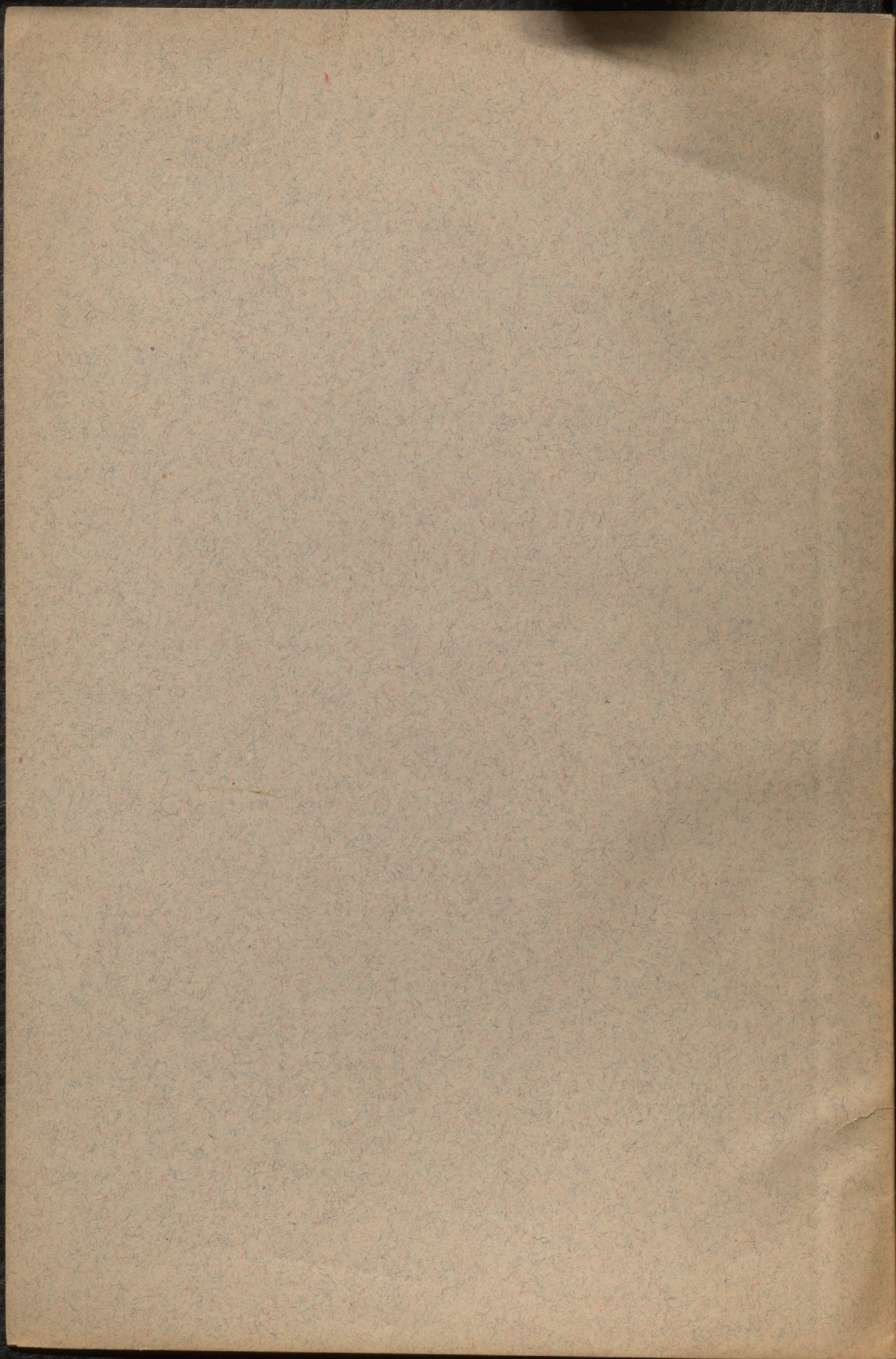












*Canadiana - Mineralogy* (K36)

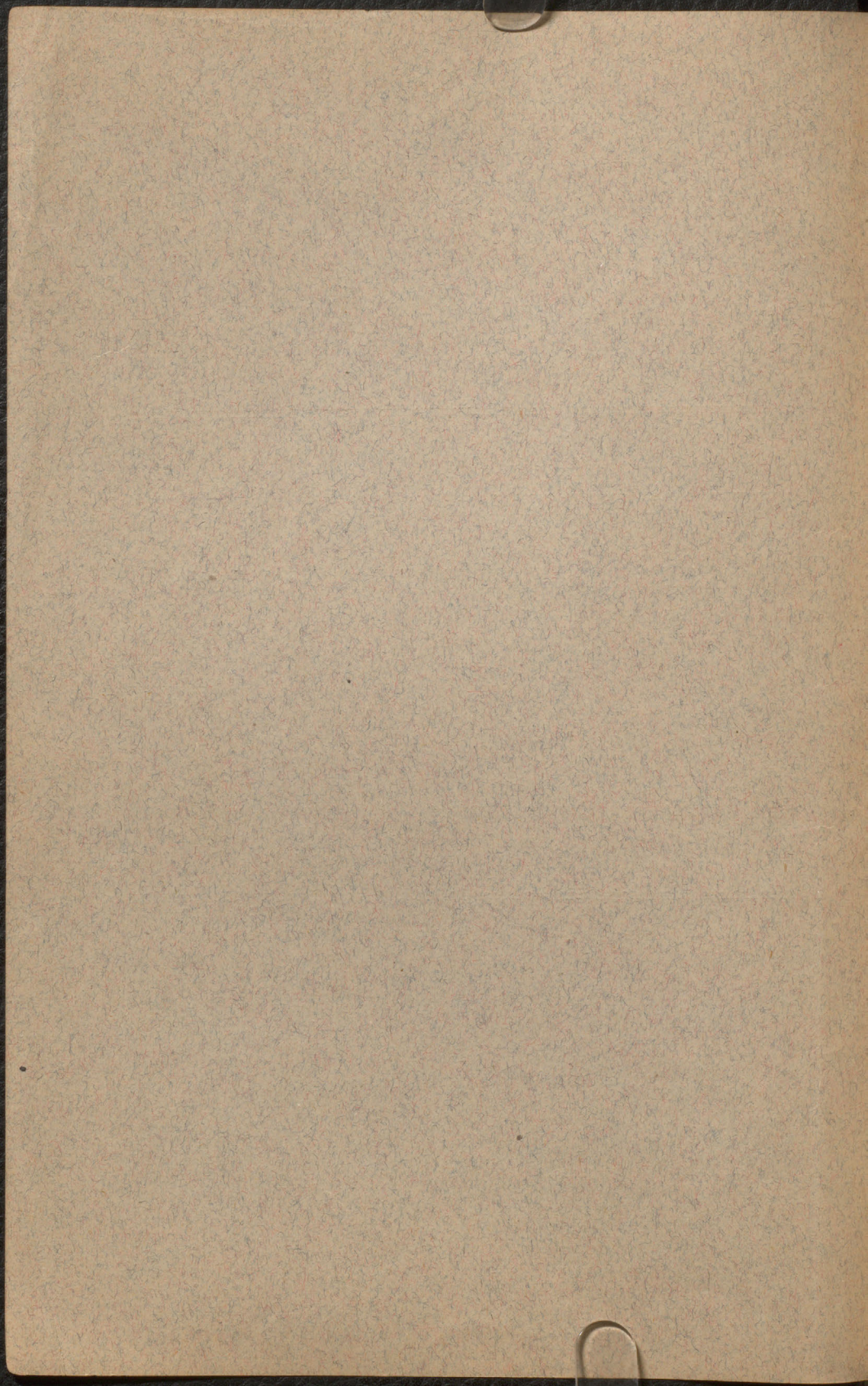
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