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ON THE SO-CALLED AMBER OF CEDAR LAKE, NORTH SASKATCHEWAN, CANADA.

By B. J. Harrington.

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ART. XXXII.—*On the so-called Amber of Cedar Lake, North Saskatchewan, Canada;* by B. J. HARRINGTON, McGill College, Montreal.

THE occurrence of mineral resins in some of the coals and lignites of the Northwest and British Columbia has been known for many years, and the results of a partial examination of specimens from three localities were published by the writer in the report of the Geological Survey for 1876–77, p. 471. The conclusion then arrived at was that none of the specimens could be referred to amber or succinite, though in some respects closely resembling that substance. Attention was also called to the statement of Goeppert that he knew of no instance of true amber being found in the brown coals of northern Germany, the substance occurring in those beds being "retinite."

During the summer of 1890, Mr. J. B. Tyrrell, M.A., of the Geological Survey of Canada, visited a locality on the west shore of Cedar Lake, near the mouth of the North Saskatchewan, where a mineral resin resembling amber in appearance has been found in large quantity. With regard to it Mr. Tyrrell says: "It occurs mixed with sand and many fragments of partly decayed wood, on a low beach behind a gradually shelving shore and along the face of a deep, wet, spruce swamp. The pieces were, for the most part, smaller than a pea, but could be readily seen glittering among the sand and vegetable debris. Some pieces were found as large as a robin's egg, and Mr. King [of the Hudson's Bay Company] informed me that he had collected pieces very much larger. It has evidently been washed up on the shore by the waves, but its exact age has not been positively determined.

"The first place at which it was seen was in a small bay behind a limestone point projecting towards the north, but the most extensive deposit is more than a mile south of this point, where a rounded beach stretches across the margin of a low swamp. This beach is about a mile in length and from eighty to one hundred and twenty feet in breadth. The amber is found most plentifully along its ridge, where it constitutes between five and ten per cent by volume of the sand and vegetable debris, and holes dug to a depth of two feet show no diminution in its quantity. Towards the edge of the lake, however, the sand is freer, both from fragments of wood and amber. It is difficult to make an accurate estimate of the quantity of amber on this mile of beach, but it may confidently be said to be found throughout the distance in a band thirty feet wide, with a minimum depth of two feet."*

* Summary report of the Geological Survey Department for 1890, p. 22.

The writer is indebted to Mr. Tyrrell for specimens of this so-called amber from Cedar Lake, and the results of their examination, as far as completed, will now be given. The substance was in pieces, for the most part very irregular in shape, some being more or less angular, others approximately spherical, and others flattened, discoid or lenticular. Some of the pieces were smaller than a pea, but they ranged from this up to the size of an ordinary bean (about 2 centimeters long). In color they varied from pale yellow to dark brown, and many, when examined by transmitted light, appeared clouded or banded from the presence of black carbonaceous matter. Superficially they were generally dull, owing, perhaps, to chemical change, but on fresh surfaces the luster was resinous. The fracture was conchoidal. Though electric on friction, they appeared to be less strongly so than ordinary amber.

Light-colored fragments, free from black carbonaceous matter, were selected for examination, and any superficial crust carefully removed by scraping. The hardness of these selected pieces was fully $2\frac{1}{2}$. The specific gravity, as obtained with a quantity of material in the specific gravity bottle, was 1·055 (at 20° C.), and a single fragment gave by suspension with a hair 1·0543 (20° C). The material for analysis was finely powdered and dried over sulphuric acid *in vacuo*. The combustions were made with lead chromate in the usual way, and the ash determined with a separate portion in a platinum crucible. The following are the results obtained:

	I.	II.	Mean.
Carbon	80·01	79·91	79·96
Hydrogen	10·37	10·55	10·46
Oxygen	9·53	9·45	9·49
Ash	0·09	0·09	0·09
	100·00	100·00	100·00

Excluding the ash the results become:

	I.	II.	Mean.
Carbon	80·08	79·98	80·03
Hydrogen	10·38	10·56	10·47
Oxygen	9·54	9·46	9·50
	100·00	100·00	100·00

The ash was brick-red in color and found to contain silica, alumina, iron, lime, and magnesia.

The only solvents whose action upon the resin has been tried as yet are absolute alcohol and absolute ether, and the effect of these was ascertained as follows: One gram of the finely pow-

dered resin was mixed with ten grams of pure quartz sand in a cylinder of filter paper and extracted in Soxhlet's apparatus, in the case of the alcohol for three and a half hours (24 siphonings) and in the case of the ether for two hours (24 siphonings). In each case the sand and filter paper were previously extracted by the special solvent for several hours. The extract from the resin was evaporated in a weighed platinum dish and the residue dried at 100° C. The results obtained were as follows:

Dissolved by absolute alcohol ..... 21·01 per cent.
" " " ether ..... 24·84 "

The effect of more prolonged action of the solvents has not as yet been ascertained. The alcoholic extract after drying was brownish in color, while that obtained with ether was only faintly yellow.

When small fragments of the resin were heated in closed tubes it was found that they began to soften at about 150° C., the point of softening being roughly ascertained by pressure with a platinum rod. At 180–190° C. the fragments were sufficiently yielding to be pressed into one mass by the platinum rod. Heated up to 300° C. the resin did not melt into a flowing liquid, but became soft and elastic, and had darkened a good deal from partial decomposition.

Fragments of genuine amber behaved in a similar manner, but began to soften at about 140° C. At 180° they could be readily pressed into one mass, and in the one experiment tried they seemed to darken more readily than the Cedar Lake resin when heated up to 280°–300° C. The ordinary statement that amber fuses at 287° C. is certainly misleading, the fact being that it begins to soften at a very much lower temperature, gradually getting softer and softer as the temperature rises, but not becoming a flowing liquid until decomposition takes place.

On heating the Cedar Lake resin in a test tube or retort no crystals of succinic acid were obtained, although they were readily obtained from true amber by similar treatment.

It is customary to assign to amber the formula $C_{40}H_{64}O_4$, which gives: carbon 78·94, hydrogen 10·53, oxygen 10·53; but this is apparently based upon very insufficient data—so far as the writer is aware, upon the single analysis of Schrötter (carbon 78·82, hydrogen 10·23, oxygen 10·95), which really corresponds much more closely to $C_{39}H_{60}O_4$. Such a substance as amber, too, coming from a variety of localities and originally derived from very different plants can scarcely be expected to agree closely in composition with one definite formula.

The Cedar Lake resin contains more carbon than the amber analyzed by Schrötter and less oxygen, and in this respect comes nearer to Walchowite and to some of the recent copals from India. The relations of some of these bodies will be made plain by the following tables:

	Carbon.	Hydrogen.	Oxygen.	Ratio of C, H, and O atoms.	Ratio of C, H, and O atoms, taking C = 40.
I. Amber	78·82	10·23	10·95	9·60 : 14·95 : 1	40 : 62·29 : 4·16
II. Krantzite	79·25	10·41	10·34	10·22 : 16·11 : 1	40 : 63·05 : 3·91
III. Cedar Lake Resin	80·03	10·47	9·50	11·23 : 17·63 : 1	40 : 62·79 : 3·56
IV. Copal (Bombay)	79·70	10·40	9·90	10·75 : 16·83 : 1	40 : 62·62 : 3·72
V. Copal (Calcutta)	80·34	10·32	9·34?	11·46 : 17·67 : 1	40 : 61·67 : 3.49

I. Phillips' Mineralogy (1852), p. 630. Anal. by Schrötter. II. Dana's Mineralogy (1869), p. 741. Anal. by Landolt. IV. Watts's Dictionary of Chemistry (ed. i.), vol. ii, p. 19. Anal. by Filhol. V. Watts's Dictionary of Chemistry (ed. i), vol. ii, p. 19. Anal. by Filhol.*

Though resembling amber in some of its characters, the Cedar Lake resin may here be classed provisionally as "retinite," on account of its differing from amber in its deportment with solvents,† in not yielding crystals of succinic acid on distillation, and in having a somewhat different ultimate composition. The name retinite as used by some mineralogists is a convenient general term to include such substances as Walchowite, Krantzite, Jaulingite, Rosthornite and the Cedar Lake resin, which last, by way of distinguishing it from other retinites, may be called Chemawinite (from Chemahawin or Chemayin, the Indian name of a Hudson Bay post, not far from where the resin occurs).

Though the origin of this substance is not certainly known, there can be little doubt that it has been derived from one of the Tertiary or Cretaceous lignites occurring on the Saskatchewan. Some of these are known to contain resins, one of which, examined by the writer, was not essentially very different from the Cedar Lake material. It behaved similarly on heating, had a hardness of over 2, a specific gravity of 1·066, and dissolved in absolute alcohol to the extent of 29·30 per cent.

Some of the larger pieces of the Cedar Lake resin might, perhaps, be employed for ornamental purposes (beads, etc.), and possibly the material might be utilized by the varnish-maker. This question will be discussed when the examination of the resin is completed.

* In the last analysis, as given by Watts, there is an error. The total is given as 100, whereas it is really only 99·80. It is here assumed that the error is on the oxygen—the constituent determined by difference. A similar error occurs in Schrötter's analysis of amber, as given by Dana.

† The statements in works on mineralogy with regard to fossil resins are often vague and sometimes conflicting. Thus, in speaking of the action of such solvents as alcohol or ether, we are told nothing as to the strength of the solvent, the duration of its action, etc., and the results given are, therefore, often of little value.