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## The Phosphate Trade of Canada.

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There are probably very few persons beyond those interested in the trade who know what Apatite is, or to what uses it is applied, and when they are told that the shipments of crude rock in 1886 reached the large amount of 24,876 tons, and that they are annually increasing, they will naturally seek some information respecting it. Apatite is the crystalline form of phosphate of lime, used largely for the manufacture of superphosphates when treated with sulphuric acid. It is only within the last few years that attention has been given to its existence in Canada, although the late Sir William Logan cites its existence in certain localities. Specimens of it, and very pretty they look in a cabinet, might have been seen in museums or in private collections, but the great wealth it would bring to the country was little thought of, and mining it on any large scale would, till quite recently, have been looked upon as a waste of money. To day, however, it is taking its place as one of the foremost industries in Canadian mining, and with the exercise of care and judgment apatite mining affords a handsome return to those who engage in it. This industry, moreover, adds to the general wealth of the country, by the circulation of money in the purchase of agricultural products to feed the miners, for boats and railways transporting it to the seaboard for shipment, to the vessels which carry it across the Atlantic, and to the brokers and commission merchants who handle it before it reaches its British purchasers.

Prof. Boyd Dawkins, an eminent geologist, who, when in America with the British Association, visited the Ottawa County mines, stated, in a paper read by him at Manchester, on his return, that in his opinion phosphate was "one of the most important resources of Canada."

When Liebig, in the year 1840, compelled the agricultural community to accept his views of exhaustion and restoration of the soil, and that the constant removal therefrom in the harvest of the inorganic elements of plant food, notwithstanding the rotation of crops and the old system of manuring, was a robbery of the soil, which enriched the present at the expense of the future, he may be said to have been the founder of an industry which has assumed constantly increasing proportions ever since. That industry is the manufacture of fertilizers or superphosphates, and the demand for materials from which these can be manufactured led to a search for and consequent working of natural deposits in which phosphate of lime preponderated. It is not our intention to

go into the question of fertilizers further than to state *en passant* that in supplying the nutritive elements of plants in the form most favourable for absorption and assimilation, the whole art of manuring consists, and that as ordinary manure does not always contain the two most important inorganic elements of plant food, phosphoric acid and potash sufficient for plant use, the needs of mankind demand the employment of artificial fertilizers along with or as a substitute for farm-yard manure.

Dr. Dawson, the assistant director of the Geological Survey of Canada, in a paper read by him before the Ottawa Field Naturalists' Club, in 1884, reviewed very concisely how phosphorous was essential to all living tissues whether vegetable or animal, and in following the transmission of that substance from the soil to the plant, from the plant to the animal, and from the animal again to the soil, he further pointed out that this cycle of nature is interfered with and broken by the massing of population in large towns where the phosphates and other substances valuable to agriculture are lost. He also cited statistics of the amount of phosphorous actually contained in the grain annually shipped from the port of Montreal, estimating it for this purpose in the form of phosphoric acid. Wheat contains eight-tenths per cent. of this, or about sixteen pounds to the ton, and a very little calculation will show annually the enormous amount carried away, and a still further calculation, based on the average quantity (about two-tenths per cent.) contained in ordinary soils, gives the amount of phosphate of lime required to restore and maintain the fertility of the fields. With these statistics the necessity is evident of having sources of supply of phosphates, the most available of which are concentrated natural deposits. The questions that follow are: what is the nature of them? Where do they occur? How have they been formed?

To the first of these questions let us take Dr. Dawson's own words: "The concentration of phosphates in nature is generally found to have been brought about by organic agency," and he then cites as the first example guanos, composed essentially of the excrements of seabirds. These are divided into two classes, nitrogenous and phosphatic. In the former, which belong exceptionally to dry climates, the organic matter converted by decomposition into ammonia salts, remains as part of the mass, but in the latter the rain has removed the soluble ammonia, leaving the phosphatic matter. This is the case with the West Indian guano, and the coral rock, penetrated with hollows and fissures has become so permeated with phosphatic accumulations that it is known as phosphate rock. The deposits in the South of France, known as Bordeaux phosphates, are looked upon as of a similar origin, the higher parts, the plateaus of Jurassic limestone in which it is found appearing to have formed at one time an archipelago in a tertiary sea, like the West Indian Islands of our own time. This phosphate rock, however, is of very modern origin geologically

speaking. Coprolite beds, such as the phosphate rock of South Carolina, have their origin in a different source, and are traceable to the accumulations in shallow tidal estuaries of ancient seas, of molluscs, bones and other marine organisms massed together by concretionary action, and forming layers similar to the well-known mussel beds on many parts of our sea coasts to-day. But the expression coprolite, applied as it is to Carolina phosphate, is erroneous. It should only be applied to the fossil excrements of various animals, notably the saurian monsters of the antediluvian shores, and which are so abundant in the eastern counties of England that coprolite pits have been worked there for many years. Crystalline phosphate or apatite is new, different in appearance from the preceding, and Dr. Dawson remarks, speaking of it, that in the Laurentian rocks of Canada are sediments deposited in the earliest seas of which we have any trace, but which originally resembling those of later seas, have been so completely altered that their materials have entered into new combinations, and have by igneous action become entirely crystalline, resembling now the original deposits as little as do the crude ingredients of glass the finished product. In substantiation of this theory limestones thus acted on would assume the crystalline character of marble, beds of a peaty or coaly nature would pass into graphite or plumbago (crystalline carbon), and phosphatic layers would appear as crystalline calcic phosphate or apatite. All these substances are found in contiguous zones or belts in the Laurentian rocks near Ottawa, an evidence pointing directly to the correctness of this theory. The greatly disturbed character of these rocks explains the irregularity of their deposits, as layers which, before the great folding and kneading together caused by igneous and volcanic disturbance may have possessed regularity and uniformity have been so dislocated and upset as to lead to the production of large pockets and irregular masses connected only by narrow and twisted seams, so narrow sometimes as to appear as isolated portions.

The principle sources of supply may be stated as follows:—the West Indies and other islands of the Caribbean Sea, supplying what is known to the trade as Sombrero phosphate, or rock guano as it is sometimes called, of high quality; Navassa, from its impurities can only be used for a lower grade of superphosphate; Maracaibo or Mark's Island, is of very high quality; St. Martin's Island, of good quality; Araba Island yields a variable quality, and Pedro Keys and other small islands yield an uncertain supply. In the Pacific Ocean, Baker, Jarvis, Howland, Malden and Starbuck islands afford a high class rock guano. In the South of France the Ardennes region affords what is known as Bordeaux phosphate, so called from the port from whence it is chiefly shipped. The valley of Lahn, in Nassau, yields what is known as German phosphate. The eastern counties of