9. PHOSPHATE OCCURRENCES IN THE SOUTH ISLAND.

(By P. G. Morgan, Director.)

During the past season visits were paid to several localities in the South Island where phosphatic substances occur, but no material discovery was made. A sample from the upper surface of the Amuri limestone at Weka Pass was found to contain 1·21 per cent. of phosphoric anhydride, equivalent to 2·61 per cent. of calcium phosphate, thus showing that some phosphatization of the limestone had taken place. Hard limestone from Hutchinson's quarry, Oamaru, portions of which resemble the phosphate rock occurring at Clarendon, on being tested gave disappointing results, the heighest percentage of phosphoric anhydride obtained from several samples being 1·26 per cent., equivalent to 2·75 per cent. of calcium phosphate. A sample of soft limestone from Mr. J. K. McCulloch's property, west of Ngapara, yielded 3·63 per cent. of phosphoric anhydride, equivalent to 7·92 per cent. of calcium phosphate. Such material, if it occurs in quantity, will make a useful dressing for agricultural purposes, either in the form of pulverized rock or applied after calcination. Small phosphatic concretions were collected from a greensand overlying the Burnside marl near Dunedin, but cannot be considered as of much economic importance. The greensand itself contains 3·35 per cent. of phosphoric anhydride, and 4·12 per cent. of potash, so that it is of some value as a fertilizer.

A visit to the rock-phosphate quarries at Clarendon was made, and various features of interest noted; but since the deposits have been well described by Professor Park and Dr. Andrew, it is not necessary at the present time to embody the observations made in a report, much of which would traverse old ground.

The following list of phosphate occurrences in the South Island is here given for general information:—

Calcium Phosphate.

(1.) *Wangapeka, Nelson.*—A specimen of highly phosphatic limestone forwarded to the Colonial (now Dominion) Laboratory about thirty years ago contained 20·78 per cent. of phosphoric anhydride, equivalent to about 45 per cent. of tribasic phosphate of lime. See Col. Lab. Rep. No. 20, 1886, p. 57.

(2.) *Cheviot District.*—In 1906 a sample of phosphatic rock forwarded from Port Robinson was found by B. C. Aston to contain 35 per cent. of tricalcic phosphate. (See the *Journal of Agriculture*, No. 6, vol. x, June 1915, p. 501.

(3.) *Amberley, North Canterbury.*—A sample forwarded to the Dominion Laboratory in 1908 contained 29·94 per cent. of P_2O_5, equivalent to 65·38 per cent. of $Ca_3P_2O_8$. See Dom. Lab. Rep. No. 42, 1909, p. 22.

(4.) *Weka Pass, North Canterbury.*—Phosphatic nodules occur here in greensand between the Weka Pass and Amuri limestones. See Col. Lab. Rep. No. 22, 1887, p. 46, and Rep. Geol. Expl. during 1886–87, No. 18, 1887, p. 84. An analysis is quoted on an earlier page (No. 12, p. 92).

(5.) *Waimate District, South Canterbury.*—In 17th Ann. Rep. Dep. Agri., Chemistry Division, 1909, B. C. Aston states that he had received a sample of high-grade phosphate rock from the Waimate district. Limestone containing 8 per cent. of calcium phosphate is also reported to occur in this district.

(6.) *Oamaru District, North Otago.*—B. C. Aston reports the occurrence of phosphatic nodules in the Oamaru district. See "Phosphate in New Zealand," Bull. No. 1, Chemistry Division, Dep. Agri., 1906, p. 5. The nodules are probably associated with one of the greensands found in the district both above and below the limestone. The results of tests made on phosphatic limestones from Hutchinson's Quarry and Ngapara are noted above.

(7.) *Kaikorai Valley, Dunedin.*—The existence of phosphatic nodules or concretions (so-called coprolites) in the Kaikorai Valley and neighbouring localities has long been known.

(8.) *Burnside, Green Island District, Otago.*—In the greensand overlying the marl at the Milburn Lime and Cement Company's pit small poorly phosphatic concretions are common. The greensand also contains an appreciable quantity of phosphoric anhydride, as noted above.

(9.) *Clarendon, Otago.*—The well-known and important deposits of phosphate of lime at Clarendon have been described by Professor James Park and Dr. A. R. Andrew. See Trans. N.Z. Inst., vol. 35, 1903, pp. 391–402, and vol. 38, 1905, pp. 447–82.

Aluminium Phosphate.

Flaxbourne, Marlborough.—A hydrous phosphate of aluminium with a little ammonium phosphate occurs in a cave near Flaxbourne. See Col. Lab. Rep. No. 27, 1893, pp. 26–27.

Greymouth District.—A specimen of stibnite from Langdon's lode, near Greymouth, in the Canterbury Museum is labelled as having a coating of wavellite.

Green Island, Otago.—B. C. Aston has identified aluminium phosphate as occurring on this island. See "Phosphate in New Zealand," Bull. No. 1, Chemistry Division, Dep. Agri., 1906, p. 5.

Iron Phosphate.

The numerous recorded occurrences of vivianite, the hydrous phosphate of iron, include: Awatere valley, in moa-bones (Hector, in Rep. Geol. Expl. during 1890–91, No. 21, 1892, p. 119); Six-mile Creek, three miles above its junction with the Matakitaki (C. S. Beilby); saddle between Glenhope and Tadmor valleys (C. S. Beilby); Hope Saddle, in large boulders (W. F. Worley); Waiuta, south of Reefton, in a quartz lode (J. McPadden and J. Henderson); Springfield (specimen in Canterbury Museum); Waimate Gorge (specimen in Canterbury Museum): Timaru (James Park, in "The Geology of New Zealand," 1910, p. 402); Waitati, in moa-bones (specimen in Canterbury Museum); Port Chalmers (Park, *op. cit.*, p. 402); Dunedin, at Museum-site (specimen in Museum); North-east Valley,