INTRODUCTION.

Minerals and their decomposition products are the basic substances from which soils are formed.

In this paper it is proposed to discuss the importance of the mineral composition of soils, with particular reference to tropical soils, and suggest methods of studying it.

Owing to the great variation in size of soil particles, different methods have to be employed for examining the different fractions. Common petrographic methods are only applicable to the examination of the larger particles and therefore, in this paper, the mineralogical constitution of the sand fraction only, will be considered.

Petrographic methods have had very limited use in soil science up till the present time. According to Russell (1932), effective methods for mineralogical analysis of soils were first devised by Delage and Legatu (1904) but after this time petrographic methods were used in soil studies in British Guiana by Harrison.

A Bulletin of the United States Department of Agriculture by McCaughey and Fry (1913), on the microscopic determination of soil forming minerals, was published in 1913. This publication gave a detailed account of the various methods for determining the mineral composition of soils, with a description of the various minerals and the mineral composition of some United States soils. Plummer (1915) gave an account of the mineral composition of some North Caroline soils. In this work he used the petrographic methods suggested by McCaughey and Fry and found, that in the soils examined, there is a very low content of minerals other than quartz. The low mineral content corresponded with a low content of the three more important plant nutrients, nitrogen, phosphorus and potash. Plummer was of the opinion that petrographic methods give a good estimate of the amount of each nutritive element present and the manner of combination. He suggests that useful information might be obtained from an investigation on the availability of the

nutritive

nutritive elements in the various minerals. Merril (1921) gives the mineral and chemical analysis of the various fractions of a soil and states that the chemical constitution could have been foretold from the mineral analysis. The methods of McCaughey and Fry necessitate some training in Petrology but a method was described by Hendrick and Newlands (1923), which with a little practice can be used by the average soil worker. These methods were first devised in order to investigate the mineral constitution of some Scottish drift soils from the Experimental Farm of Craibstone near Aberdeen. Hendrick and Ogg (1916) made a detailed chemical analysis of this soil and compared it with soil from Rothamsted. These workers showed that the Craibstone soil had a high reserve of bases in all fractions, compared with a very low base reserve in the Rothamsted soil, which was confined mostly to the clay fractions. Hendrick and Newlands considered these chemical methods very tedious and as stated above made a mineralogical analysis of the Craibstone soil and also some Rothamsted soil for comparison.

Details of the method employed are given in their paper and will not be repeated here. It is essentially the same as a method to be described later, which was suggested by Vageler and used, in a modified form, in the present investigation. The sand fractions of the soils were divided into three groups according to the specific gravity of the mineral grains, this was accomplished by means of heavy liquids and the electro-magnet. The three groups are the Orthoclase, Quartz and Ferro-silicate Groups and these were examined microscopically and the most abundant minerals noted.

The mineralogical analysis showed that the Scottish soils have a much higher content of minerals other than quartz, than the English soils. The Ferro-silicate Group is represented, in the Scottish soils, by hornblende and biotite, potential sources of plant food, and in the Rothamsted soil by oxides of iron. Hendrick and Newlands found that the best material for mineralogical

analysis

analysis is the fine sand fraction and are of the opinion that mineralogical analysis is important from the point of view of classification.

Later Hendrick and Newlands (1925) gave the mineral constitution of various soils from England and Scotland.

In this work they modified their original method slightly, analysing only the fine sand. They find that the soils examined can be divided into groups according to the most abundant minerals and especially in the Scottish soils, this is determined by parent material, climate being of little importance.

Hart (1929) used Hendrick and Newlands method for a detailed study of a small area in Scotland. In all soils he found a high silicate content and differences in mineral content was accompanied by textural differences.

Milner (1929) enumerates a number of ways in which the Pedologist could benefit by advice from the Petrologist and from the use of petrographic methods.

Refinements in specific gravity separations of soil minerals have been suggested by Volk (1933), these appear to be of limited application in soil work, but may be useful in the detailed study of particular soils. The scantiness of the literature relevant to the mineral constitution of soils must be noted here. Vageler (1933) ascribes this to the fact, that most soil work has been carried out in temperate countries, where the rate of chemical weathering is very slow, and so the mineral constitution is correspondingly of less importance. Rock weathering in humid tropical countries takes place at about ten times the rate of that in temperate countries and based on this fact, Vageler makes a very strong case for the adoption of mineralogical methods in the study of tropical soils.

As minerals are the reservoir for plant food and colloids which carry that food, in the soil, Vageler states, "of primary importance is the consideration that the permanence of fertility in a soil varies with its content of minerals which are still

liable

liable to decomposition. A soil having a high content of such minerals is, other things being equal, better than a soil with no mineral reserves".

The mineral constitution of a soil is of immense importance to the tropical farmer and only of secondary importance to the temperate farmer. This importance is enhanced by the consideration that artificial fertilisers are, at the present time and probably will be for many years, beyond the reach of most tropical farmers. In the Dutch East Indies, the spread of dust from volcanoes is spoken of as, "natural artificial manuring".

According to Vageler the mineral constitution should be considered in soil selection and he states, "it is clear that a soil will be better, that is, the probability, though not the certainty, of richness in respect to plant foods will be higher, the more mineral reserves it contains. If quartz and acid glass are excluded, 1-5 per cent primary minerals for clay soils, 6-15 per cent for loams and over 15 per cent for sandy soils may be considered high.

Based on the above considerations, the mineral constitution of a number of West Indian soils was determined.