STUDIES IN PLANT NUTRITION.

By

A.H.K. PETRIE.

Thesis submitted for the Degree of

Doctor of Science

in the University of Adelaide.

1938.

Preface.

The papers collected in this thesis reflect a development of thought extending over about fourteen years. The work on ion intake was commenced in Melbourne, and the early results on the effect of temperature suggested to me that the Donnan equilibrium might play a part in this process. The obvious test of this possibility, the study of intake at different hydrogen-ion concentrations, was commenced in Melbourne and continued at Cambridge. But the theory of the operation of the Donnan equilibrium in a living system was only developed when I had the help and supervision of Mr. G.E. Briggs at Cambridge.

It was perhaps natural on commencing work at the Waite Institute in 1931 that these earlier detailed studies should give way to a type of investigation more broadly conceived. My more recent work is concerned largely with the study of the interrelations of the physiological drifts that characterize ontogeny. It soon became clear that the physiology of ontogeny in the higher plant was closely concerned with nitrogen metabolism; so that collateral intensive studies of nitrogen metabolism became essential. Fortunately I was able in these studies to have the co-operation of Professor J.G. Wood, since the gigantic labour of the type of investigation performed would have been impossible without team work. My other collaborators, Messrs. L.A.T. Ballard and R.F. Williams helped me in the positions of junior members of the staff working under my supervision.

It is made sufficiently clear in the individual papers what part of the work described represents original contributions to science. The ion intake work was the first serious and detailed consideration of the application of the Donnan equilibrium in a plant tissue; it represents a foundation upon which further work could be planned, and shows that the Donnan equilibrium can be only one factor among a number that determine the intake of ions.

The work on nitrogen metabolism represents an entirely new experimental approach. A great deal of work has been done on this subject since the beginning of the century, but all of it is limited by its qualitative

nature: I felt that to make any real further advance nitrogen metabolism must be approached from the conception of the steady state. This new quantitative approach, as can be seen from the individual papers, is yielding valuable results.

The study of physiological ontogeny is a long range one, and the papers here included concern early stages of the investigation. Other phases are dealt with in papers by my assistants, either published or in manuscript.

October, 1938. A.H.K. PETRIE