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PHYTOCHEMICAL AND BIOGEOCHEMICAL
STUDIES ON NICKEL ACCUMULATION
BY SOME NEW CALEDONIAN PLANTS.

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A B S T R A C T

A herbarium survey of Homalium and Hybanthus species was successful in the detection of a number of accumulators of nickel. The term 'hyperaccumulator' was defined as those plant species that contain more than 1000 $\mu\text{g/g}$ of nickel in their leaves on a dry weight basis. Their ability to indicate areas of specific geology and their use as indicators in mineral exploration was evaluated. All new hyperaccumulators of nickel that were 'discovered' were confined to the ultramafic complex in New Caledonia. The possible evolutionary significance of nickel accumulation in the order Violales is noted.

Plant-soil relationships for three New Caledonian hyperaccumulators of nickel; Hybanthus austrocaledonicus, Homalium kanaliense and Homalium guillainii were investigated, and the relationship between nickel uptake and the uptake of other elements examined statistically. The lack of interelement relationships, both stimulatory and antagonistic, of nickel with other minerals pointed to a mechanism of accumulation dependent on organic constituents, with the absence of competition from other ions indicating the specific nature of the absorption at the root.

The highly unusual accumulation of nickel in the 'latex' type exudate from the trunk of Sebertia acuminata is reported. A nickel citrate complex was isolated from the exudate and leaves of this species and identified by the use of spectrophotometry, high-voltage paper electrophoresis and gas-liquid chromatography - mass spectrometry. The complexed nickel comprises approximately 40% of the total weight of the crude latex. Citric acid was also implicated in the chelation of nickel in several other New Caledonian accumulators. Extraction procedures indicated that the nickel citrate was located primarily in the vacuoles.

Nickel citrate extracts from the plant material were compared with various synthetic nickel citrate solutions by electrophoresis and spectrophotometry. Evidence for a 2 : 1 anionic citrate - nickel complex was obtained for solutions in which the mole ratio of citrate to nickel approached and exceeded 2 : 1.

Gas liquid chromatography coupled with mass spectrometry was used in the identification of organic acids occurring in the investigated plants. High malic and citric acid concentrations were found in the hyperaccumulator species. A good correlation between citric acid and nickel content in the leaves of a number of New Caledonian plants growing over ultrabasic substrates was found.

Although nickel is translocated, and exists in the plant cell as a citrate complex, it appears unlikely that it is absorbed at the roots as such. A more specific mechanism based on the carrier concept is postulated to account for the specificity of the absorption.

Nickel accumulation in the Rhodesian hyperaccumulator Pearsonia metallifera is also described. Another organic acid rather than citric acid is involved with nickel chelation. Mass spectral evidence indicated an uncommon structure. A positive identification could not be made.

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