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DETECTION OF NICKELIFEROUS ROCKS BY ANALYSIS OF HERBARIUM SPECIMENS OF INDICATOR PLANTS

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ABSTRACT

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Nearly 2000 herbarium specimens and 232 species of the genera *Homalium* and *Hybanthus* were analysed for nickel in order to identify plant accumulators of nickel which were indicative of nickeliferous (usually ultrabasic) rocks. The specimens were originally collected from all parts of the tropical and warm-temperate World between latitudes 40° N and [illegible]

exceeding 15 μg/g on a dry weight basis, unless they are growing over ultrabasic rocks, in which case nickel concentrations of 25—50 μg/g may be found (Lyon et al., 1970). Values above 100 μg/g are uncommon, even for an ultrabasic environment, and values exceeding 1000 μg/g are restricted to a small group of highly unusual plants which may be termed *hyperaccumulators*. The term hyperaccumulator is used in this report to refer to the concentration analysis of samples sufficiently small to satisfy the requirements of herbarium curators.

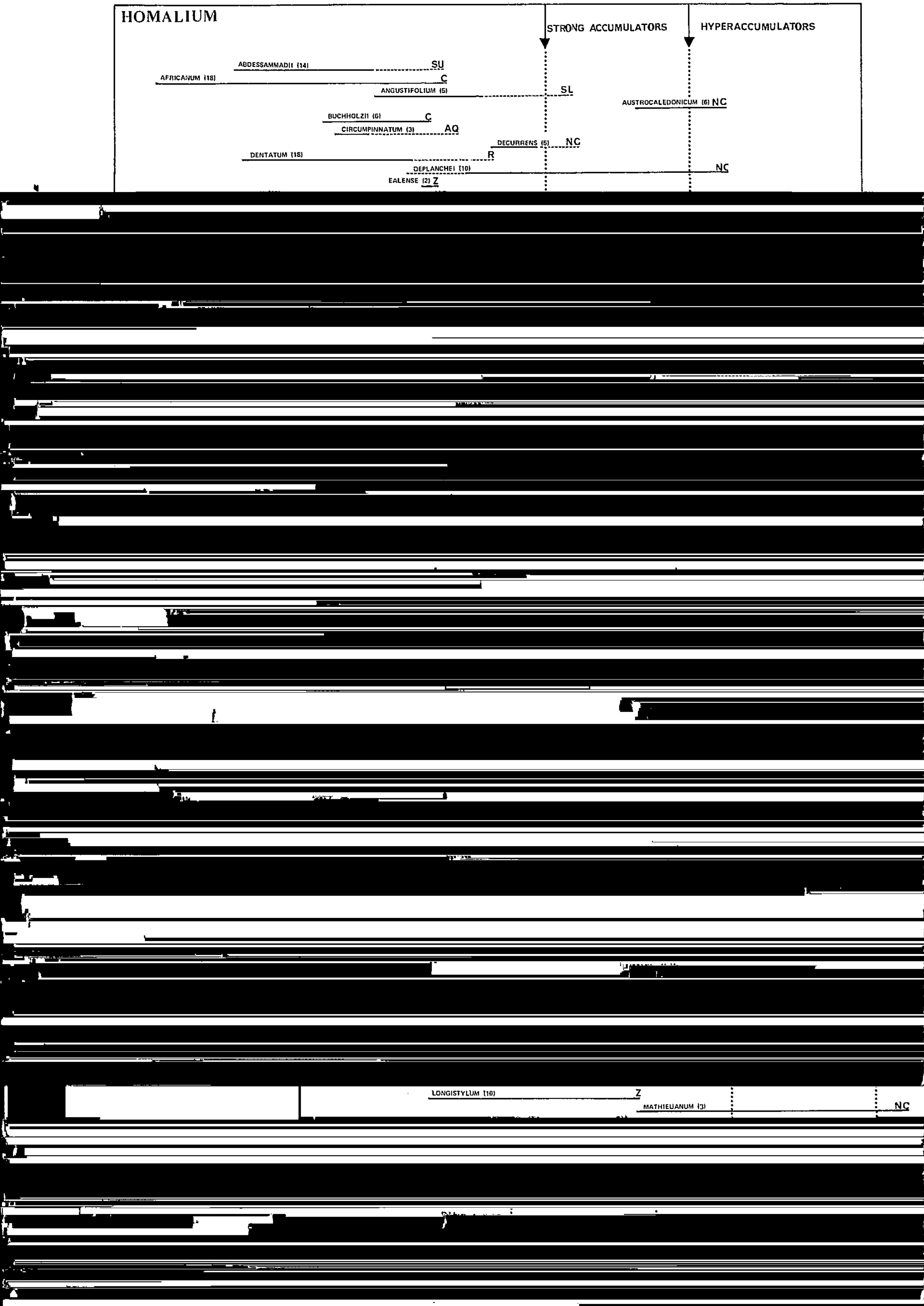
For the work reported in this paper, more than fifty herbaria throughout the World were approached for small samples of leaf material from their collections of *Homalium* and *Hybanthus*. Thirty-five of these institutions (Table I) supplied material.

These samples were analysed for the nickel content in an attempt to find additional nickel accumulators and nickeliferous rocks. Although the nature of the substrate is often unknown for herbarium specimens, studies on known nickel accumulators (Severne and Brooks, 1972; Brooks et al., 1974; Jaffré and Schmid, 1974) have shown that nickel values over 1000 μg/g (dry weight) are only associated with plants growing over ultrabasic rocks. These and other studies showed that values from 100 to 1000 μg/g were invariably associated with ultrabasic areas, except occasionally for plants growing over laterites not overlying ultrabasic rocks, where values of up to 200 μg/g were found

TABLE I

List of co-operating herbaria

Country	Institution	Address
1. Argentina	Fundacion Miguel Lillo	San Miguel de Tucuman
2. Argentina	Museo de Ciencias Naturales	Buenos Aires
3. Australia	Herbarium Australiense, C.S.I.R.O.	Canberra
4. Brazil	Inst. de Pesquisa Agropecuaria	Belem
5. Brazil	Museo Nacional, Universidade Federal	Rio de Janeiro
6. France	Muséum National d'Histoire Naturelle	Paris F75005
7. Germany	Bot. Garten und Museum	Berlin-Dahlem
8. Germany	Herbarium Haussknecht	Jena (DDR)
9. India	Banaras Hindu Univ.	Varanasi 5
10. India	Blattner Herbarium, St. Xaviers College	Bombay
11. India	Central National Herbarium	Howrah 3
12. India	Central Circle, Bot. Survey India	Allahabad
13. India	Eastern Circle, Bot. Survey India	Shillong 3
14. India	Southern Circle, Bot. Survey India	Coimbatore
15. Indonesia	Herbarium Bogoriense	Bogor
16. Netherlands	Rijksherbarium	Leiden
17. New Caledonia	O.R.S.T.O.M.	Nouméa
18. Philippines	Pambansang Museo	Manila
19. Portugal	Centro Botanico	Lisbon 3
20. Portugal	Instituto Botanico, Univ. of Coimbra	Coimbra
21. Portugal	Instituto Botanico, Univ. of Lisboa	Lisbon 2
22. South Africa	Bolus Herbarium, Univ. of Cape Town	Cape Town
23. South Africa	Botanical Res. Inst., D.S.I.R.	Durban
24. South Africa	Compton Herbarium, Kirstenbosch	Cape Town
25. South Africa	National Herbarium	Pretoria


HOMALIUM
STRONG ACCUMULATORS
HYPERACCUMULATORS
ABDESSAMMADII (14) SU
AFRICANUM (18) C
ANGUSTIFOLIUM (5) SL
AUSTROCALEDONICUM (6) NC
BUCHHOLZII (6) C
CIRCUMPINNATUM (3) AQ
DECURRENS (5) NC
DENTATUM (18) R
DEPLANCHEI (10) NC
EALENSE (2) Z
LONGISTYLUM (10) Z
MATHIEUANUM (3) NC

lues which are anomalous and these are also shown by broken lines. The figure clearly illustrates the predominance of New Caledonia as a source of hyperaccumulators (> 1000 μg/g) and strong accumulators (100—1000 μg/g) of nickel.

Identification of nickeliferous (ultrabasic) substrates

TABLE II

Hyperaccumulators (>1000 μg/g dry weight) of nickel

Species	Total No.	No. above 1000 μg/g	Locality	Highest Ni conc. (μg/g dry weight)	Nature of substrate
Homalium					
austrocaledonicum Sleum.	6	4	New Caledonia	1805	ultrabasic
deplanchei Warb.	10	2	New Caledonia	1850	ultrabasic
francii Guillaumin	7	7	New Caledonia	14500	ultrabasic
guillainii Briq.	2	2	New Caledonia	6926	ultrabasic
kanaliense Briq.	6	5	New Caledonia	9420	ultrabasic
mathieuanum Briq.	3	1	New Caledonia	1694	ultrabasic
rubrocostatum Sleum.	2	1	New Caledonia	1157	ultrabasic
Hybanthus					
austrocaledonicus Schinz et Guillaumin	4	4	New Caledonia	13750	ultrabasic
caledonicus (Turcz.) Cretz.	11	2	New Caledonia	5917	ultrabasic for values >1000 μg/g
floribundus F. Muell.	13	2	W. Australia	6680	ultrabasic for values >1000 μg/g

TABLE III

Strong accumulators (100—1000 μg/g dry weight) of nickel

Species	Total No.	No. above 100 μg/g	Locality	Highest Ni conc. (μg/g dry weight)	Nature of substrate
Homalium					
angustifolium Keay	5	1	Sierre Leone	155	unknown
decurrens Briq.	5	1	New Caledonia	176	various incl. ultrabasic
gitingense Elmer	2	2	Philippines	144	unknown
le-ratiorum Guillaumin	7	4	New Caledonia	643	various incl. ultrabasic
panayum F. Villar	11	1	Philippines	507	ultrabasic
pleiandrum Blake	3	2	Puerto Rico	343	ultrabasic
rubiginosum Warb.	1	1	New Caledonia	397	ultrabasic
serratum Guillaumin	6	1	New Caledonia	116	ultrabasic
Hybanthus					
brevilabris Domin.	4	1	W. Australia	229	ultrabasic
linearifolius Urb.	11	1	Cuba	107	ultrabasic
malpighiifolius Standley	1	1	Mexico	638	unknown
setigerus Baill.	3	1	Brazil	130	probably ultrabasic
wrightii Urb.	2	1	Cuba	350	ultrabasic
yucatanensis Millsp.	12	1	Mexico	134	unknown

CONCLUSIONS

The survey has been successful in showing that herbarium specimens may be used to discover new accumulator plants, and to indicate areas of specific geology.

There is no reason why the same principles should not be applied to other genera for other elements. In the present survey, the nickel content of vegetation was used to delineate geology. Nickel itself was not the specific target. Mineral deposits of many elements would be too localised for herbarium surveys to be of use. This is not, however, true of some porphyry copper deposits where mineralization can extend over a large area and could possibly be determined by a herbarium survey.

To date, herbaria have been most co-operative in furnishing small samples for this work, but this attitude may well change if inordinately heavy demands are made upon their services. Curators of herbaria have to maintain a fine balance between providing material for research and preserving irreplaceable specimens; this requirement is likely to prove the most serious limiting factor for future surveys of this nature.

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