

## DISTRIBUTION OF PLATYSPERMIC GONDWANIC SEEDS

JOSÉ HENRIQUE MILLAN\*

Departamento de Geologia e Paleontologia, Museu Nacional,  
Universidade Federal do Rio de Janeiro, 20942-Rio de Janeiro, RJ, Brasil

### ABSTRACT

The paper contains the stratigraphic and chronological distribution of platyspermic gondwanic seeds in the countries and regions, viz., Brasil, South African Republic, Zaire, Mozambique, Madagascar, Argentina, Antarctica, Australia and India. Among the species reported, 33 belong to the genus *Samaropsis*, 12 to the genus *Cordaicarpus*, 4 to the genus *Cornucarpus*, 2 to the genus *Alatocarpus* and 1 to the genera *Nummulospermum* and *Eucerospermum*.

*Key-words* — Platyspermic seeds, Gondwanaland, *Samaropsis*, *Cordaicarpus*, *Cornucarpus*, *Alatocarpus*, *Nummulospermum*, Brasil.

### सारांश

गोंडवाना के चिपिटबीजी बीजों का वितरण — होजे हेनरीक मिलन

इस शोध-पत्र में गोंडवाना देशों एवं क्षेत्रों अर्थात् बाजील, दक्षिणी अफ्रीकी गणराज्य, जायर, मोजाम्बिक, मेडागास्कर, अर्जेंटाइना, अंटार्कटिका, ऑस्ट्रेलिया एवं भारत में बीजों का स्तरिक तथा कालानुक्रमी वितरण प्रस्तुत किया गया है। वर्णित जातियों में 33 सैमारॉप्सिस वंश की, 12 कोर्डायिकॉर्पस वंश की, 4 कॉर्नुकार्पस वंश की, २ अलैटोकार्पस वंश की तथा एक-एक नमुलोस्पर्मम् एवं यूसेरोस्पर्मम् वंशों की हैं।

### INTRODUCTION

**I**N GONDWANALAND, two general types of seeds or ovules, preserved as casts or impressions, are recognized: the radiospermic and the platyspermic. The former are symmetrical in more than two planes and the latter are symmetrical in two or in only one plane.

Maithy (1965) has proposed a scheme to classify gondwanic seeds. This scheme was later called by Millan (1969) as "Maithy Scheme" and it consists of a rational method of work to compare and to identify species of seeds. Since then, other contributions were made in order to modify such scheme (Millan, 1974a) and to finish it off and to put it up to date (Millan, 1974b).

Millan (1974b) presented thesis "Docência-Livre" in National Museum, Federal University of Rio de Janeiro, in which he discussed the distribution of these seeds, specially the platyspermic ones. The discussion, then, was made in a much more

general and extensive way than that other discussions held in the I International Symposium on Gondwana in Argentina, in 1967. But now, under the invitation of the Organising Committee for Dr K. R. Surange Commemoration Volume and considering the most recent studies on the subject and a greater interest on the part of the specialists about it, we decide to present a new source of information about these seeds, up dating the bibliography from 1974 onwards, specially that related to the new Brazilian occurrences.

### DISTRIBUTION

We have distinguished in this paper two different levels of distribution of the gondwanic seeds: the stratigraphical level and the chronological level. Both levels are intrinsically related to the taphoflorulae or paleofloristic associations of restricted limits within the stratigraphical level which define the occurrence of fossils' populations in local tombs (Millan, 1971).

\*Under auspices of the National Council of Research (CNPq).

TABLE 1 — GONDWANIC TAPHOFLORULAE

TAPHOFLORULA	COUNTRY				
	BRASIL	South Africa			Zaire
		South African Republic	Madagascar	Mozambique	
Bainha	B				
Bairro 20	B-20				
Barro Branco	BaB				
Carvão Irapuá	CI				
Hospital	H				
Joaquim Branco	JB				
"Lauro Müller"*	LM				
Mariana Pimentel	MP				
São Marcos	SaM				
Sítio da Mina	SM				
Sítio Itapema	SI				
"Ecça"		E			
Mavonono			M		
Chipanga				C	
Kaindamaso				K	
Luena				L	
	COUNTRY				
	Antarctica	Argentina	Australia		India
			New South Wales	Queensland	
Dry Valley	DV				
Elizabeth and Alexandra Ridges	EAR				
Amundsen	A				
Ohio and Wisconsin Ridges	OWR				
Pecora	P				
Bajo de Los Véz		BLV			
Betancourt		Bet			
Piedra Shotel		PS			
"Glacial Stage"*			GS		
"Greta"*			G		
Dudley			D		
Beach Bar			BB		
Minnie Creek					
Three-mile Creek					MC
Barwon Park					TMC
Pentland					BP
Dawson River					Pe
Baralaba					DR
Belmont					Be
Srirampur Colliery					SC
Jubille Mine					JM
Deep Mine					DM
Central Mine					CM
Gaurbotha Nalla					GN
Kamrai Nalla					KN
Johilla River					JR
Ganjra Nalla					GaN
Chicharia					Ch
Salaia					S
Near Beli					NB
Karkoti-Malhadu					KM
Dhamni					Dh

\*Due to the absence of data in original papers, these names are provisory to taphoflorulae.





The use of taphoflorula is better than that of florula, word commonly analogous but not homologous, because of the implications of its use referring to living populations. The taphoflorulae would stand for taphoflora as it was formerly used by Taytadzan (1961, in: Archangelsky, 1965). So, we were then able to name the palaeofloristic provinces of the Upper Palaeozoic (Gothan & Weyland, 1954) as Gondwanic, Angarian, Euroamerican and Cathaysic taphoflorae.

The denominations of the gondwanic taphoflorulae, only of those whose seeds had been adequately described, are presented in this paper (Table 1). In some cases, they are of current use, but are not so current in other cases. These denominations were extracted from original papers, among which we can refer those by Archangelsky and Arrondo (1969) in Argentina; Høeg and Bose (1960) in Zaire and Mozambique; Besairie (1967) in Madagascar; Rigby and Schopf (1969) in Antarctica; Walkom (1922, 1928, 1935) and Carey (1934) in Australia; Dolianiti (1948), Millan (1972, 1974a, 1974b, 1977), Rigby (1972), Oliveira (1977) and Corrêa da Silva and Arrondo (1977) in Brasil. In India, since there are lots of known taphoflorulae and lots of authors, the denominations were included in the bibliography.

We give emphasis to the fact that all the seeds mentioned in Tables 2-13 were only included as taphoflorulae, those which had already been adequately described and figured. Such kind of procedure allowed us to relate not only the seeds to the taphoflorula but also to relate it to the stratigraphical level, so that we can use it not merely in a descriptive way but in a more utilitarian way as index-fossils. Thus we suggested (Millan, 1980) the stratigraphic use of the following species: *Samaropsis millerii*, *S. barcellosa*, *S. indica*, *S. thomasi*, *S. seixasii*, *S. longii*, *S. goraiensis*, *Cordaicarpus nitens*, *C. zeillerii*, *Cornucarpus furcatus*, *C. patagonicus* and *Nummulopermum bowenense*.

It is possible to notice that there are 13 known taphoflorulae with seeds in India. There are 11 such taphoflorulae in Brasil and in Australia, 5 in Antarctica, 3 in Argentina, 2 in Zaire, 1 in Madagascar, 1 in Mozambique and 1 in South African

Republic. The total number of these taphoflorulae are up to 48 (Table 1).

The nomenclature of their units, considering the stratigraphic distribution of these seeds, is based on authors such as Bigarella and Salamuni (1967), Rocha-Campos (1972) and Soares *et al.* (1977) to Brasil and Argentina; Robinson (1967) and Ghosh and Sastry (1967) to India; Høeg and Bose (1960) to Zaire and Mozambique; Besairie (1967) to Madagascar; McElroy (1969) and Banks *et al.* (1969) to Australia; Harrington (1965) and McElroy (1969) to Antarctica and on Ryan (1969) to South African Republic.

The species of the genus *Samaropsis*, (Table 2) are stratigraphically distributed in Brasil, Tubarão Group, Rio Bonito Formation and in Itararé Subgroup in Rio Grande do Sul and São Paulo states; in the South African Republic, in the Ecca Series; in Zaire, in the Lower and Upper Lukuga Series; in Mozambique, in the Tetè Coal Measures; in Argentina, in the Nueva Lubecka Formation; in Antarctic, in the Beacon Group, in Buckley Coal, Measures and in Mount Glossopteris Formation; in Australia, in New South Wales, in Upper Kutung Series and in Upper New Castle Coal Measures, and in Queensland, in the Upper and Lower Bowen Series, and in India, in Talchir, Karharbari-Barakar, Raniganj and Panchet formations.

The species of the genus *Cordaicarpus* (Table 3) are stratigraphically distributed in Brasil, Tubarão Group, Rio Bonito Formation and in Itararé Subgroup in São Paulo State; in Zaire in the Upper Lukuga Series; in Madagascar in Sakoa Series; in Argentina in Nueva Lubecka Formation; in Australia in New South Wales, in Upper Kutung Series and in the Lower Greta Coal Measures and in India in the Karharbari-Barakar and Panchet formations.

The species of the genus *Cornucarpus* (Table 4) are stratigraphically distributed in Brasil Tubarão Group, in Rio Bonito Formation and in Itararé Subgroup in São Paulo and Rio Grande do Sul states; in Argentina, in Nueva Lubecka Formation; in Australia, in New South Wales, in the Lower Greta Coal Measures.

The species of the genus *Alatocarpus* (Table 5) are stratigraphically distributed

TABLE 3 — STRATIGRAPHIC DISTRIBUTION OF *CORDAICARPUS* SPECIES IN GONDWANIC TAPHOFLORULAE

SPECIES	STRATIGRAPHY					
	BRASIL	AFRICA	ARGENTINA	AUSTRALIA	INDIA	
	Tubarão Group	Zaire Upper Lukuga Series	Nueva Lubecka Formation	New South Wales Upper Kutung Series	Karharbari-Barakar formations	Panchet Formation
	Itararé Subgroup Lower Pack, São Paulo	Rio Bonito Formation		Lower Greta Coal Measures		
1. <i>Cordaicarpus barbosanus</i> Millan, 1979	SM					
2. <i>C. chichariensis</i> Lele, 1962						
3. <i>C. emarginatus</i> Walkom, 1935				GS	G	Ch
4. <i>C. irapuensis</i> Oliveira & Pontes, 1977		B, H, SaM				
5. <i>C. karharbarensis</i> Maithy, 1965						SC
6. <i>C. mucronatus</i> Hoeg & Bose, 1960		L				
7. <i>C. nitens</i> (Feruglio) Millan, 1979	SM		Bet			
8. <i>C. oliveiranus</i> (White) Millan, 1965		JB				
9. <i>C. ? ovatus</i> Walkom, 1935				GS		? S
10. <i>C. prolatus</i> Walkom, 1935				GS		
11. <i>C. rocha-camposii</i> Oliveira & Pontes, 1977		B, B-20				
12. <i>C. zeillerii</i> Maithy, 1965		B, H, SaM	M			SC

TABLE 4—STRATIGRAPHIC DISTRIBUTION OF *CORNUCARPUS* SPECIES IN GONDWANIC TAPHOFLORULAE

SPECIES	STRATIGRAPHY					
	BRASIL		ARGEN- TINA	INDIA	AUS- TRALIA	
	Tubarão Group		Nueva Lubecka Forma- tion	Talchir Forma- tion	Karhar- bari- Barakar forma- tions	New South Wales
	Itararé Subgroup	Rio Bonito Forma- tion				
Upper Pack, São Paulo	Rio Grande do Sul				Lower Creta Coal Mea- sures	
1. <i>Cornucarpus cerquihensis</i> Millan, 1977	SI					
2. <i>C. furcatus</i> (Surange & Lele) Maithy, 1965		B, H, SaM, B-20	JR	SC		
3. <i>C. patagonicus</i> (Feruglio) Corrêa da Silva & Arrondo, 1977	MP		Bet, PS			
4. <i>C. striatus</i> Walkom, 1935						G

TABLE 5—STRATIGRAPHIC DISTRIBUTION OF *ALATOCARPUS* SPECIES IN GONDWANIC TAPHOFLORULAE

SPECIES	STRATIGRAPHY
	INDIA Karharbari- Barakar formations
1. <i>Alatocarpus indicus</i> Lele, 1968	GN
2. <i>A. cf. johillensis</i> (Saksena) Lele, 1968	GN, GaN

TABLE 6—STRATIGRAPHIC DISTRIBUTION OF *NUMMULOSPERMUM BOWENENSE* IN GONDWANIC TAPHOFLORULAE

SPECIES	STRATIGRAPHY	
	AUSTRALIA	INDIA
	QUEENSLAND	
<i>Nummulospermum bowenense</i> Walkom, 1921	Lower Bowen Series TMC, BP, Ba	Upper Bowen Series MC Karharbari- Barakar formations SC

only in India, in the Karharbari-Barakar formations.

The species *Nummulospermum bowenense* (Table 6) is stratigraphically distributed in Australia, in Queensland, in the Lower and Upper Bowen Series, and in India, in the Karharbari-Barakar formations.

Finally, the species *Eucerospermum opimum* (Table 7) is stratigraphically distributed only in Argentina, in Nueva Lubecka Formation.

Now, taking into account the chronological distribution of the seeds, we notice

TABLE 7—STRATIGRAPHIC DISTRIBUTION OF *EUCEROSPERMUM OPIMUM* IN GONDWANIC TAPHOFLORULAE

SPECIES	STRATIGRAPHY
	ARGENTINA Nueva Lubecka Formation
<i>Eucerospermum opimum</i> Feruglio, 1951	Bet



that they are distributed from the Upper Carboniferous to the Triassic (Tables 8-13).

Each geologic period, except for the Triassic, was subdivided into their respective floors containing only stratigraphic units where gondwanic taoflorulae with seeds, described and figured, occur (Table 14). The limits and extension of such units are approximate and were suggested in this paper based on the bibliography we could find. So, we were obliged to use the European nomenclature for the geological floors because of the lack of a more

TABLE 8

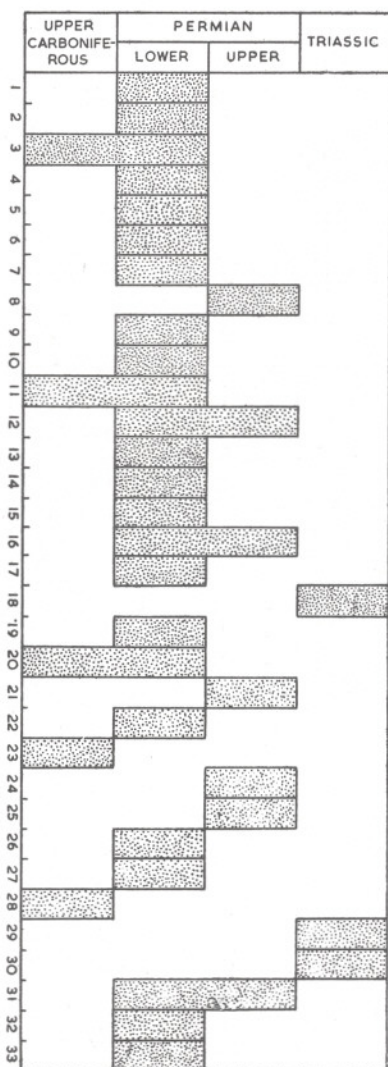
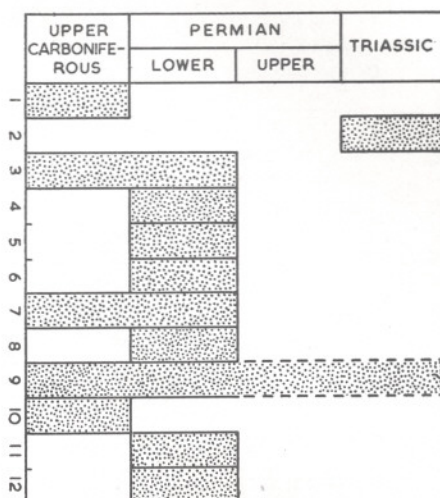


TABLE 9



adequate nomenclature for the Gondwana.

In Brasil, these seeds occur in Carboniferous and Permian, from the transition Westphalien-Stephanien to Sakmarien; in the South African Republic, in Lower Permian, from Artinskien to Kungurien; in Mozambique, in Lower Permian, in the Kungurien; in Zaire, in Lower Permian, from Artinskien to Kungurien; in Antarctica, in Carboniferous and Permian; in Argentina, in Lower Permian, from Sakmarien to Kungurien; in Australia, in New South Wales, from Upper Carboniferous to Upper Permian and in Queensland, in Permian, from Artinskien to Tatarien and, finally, in India from Upper Carboniferous to Triassic.

The species of the genus *Samaropsis* (Table 8) are chronologically distributed in Brasil from Upper Carboniferous to Lower Permian; in South African Republic, in Lower Permian; in Zaire, in Lower Permian; in Mozambique, in Lower Permian; in Argentina, in Lower Permian; in Antarctica, in Permian; in Australia, from Upper Carboniferous to Upper Permian and in India, from Upper Carboniferous to Triassic.

The species of the genus *Cordaicarpus* (Table 9) are chronologically distributed in Brasil from Upper Carboniferous to Lower Permian; in Zaire, in Lower Permian; in Madagascar, in Lower Permian; in Argentina, in Lower Permian; in

TABLE 10

	UPPER CARBONIFEROUS	LOWER PERMIAN
1		
2		
3		
4		

TABLE 11

	UPPER CARBONIFEROUS	LOWER PERMIAN
1		
2		

TABLE 12

	UPPER CARBONIFEROUS	LOWER PERMIAN

TABLE 13

	UPPER CARBONIFEROUS	LOWER PERMIAN

Australia, from Upper Carboniferous to Lower Permian and in India, from Lower Permian to Triassic.

In Brasil, the species of the genus *Cornucarpus* (Table 10) are chronologically distributed in the Lower Permian; in Argentina in the Lower Permian; in Australia in the Lower Permian and in India from Upper Carboniferous to Lower Permian.

The species of the genus *Alatocarpus* (Table 11) are chronologically distributed in India in the Lower Permian.

In Australia and India, the species of *Nummulospermum bowenense* (Table 12) is chronologically distributed in Permian.

The species *Eucerospermum opimum* (Table 13) is chronologically distributed in Argentina in the Lower Permian.

In India these seeds were described and figured from Triassic, although there are references from Santa Maria Formation, Upper Triassic of Rio Grande do Sul, Brasil (Pinto, 1956), but they are poorly preserved and under no conditions for a better characterization.

Nevertheless, most of these structures are distributed in Permian from Sakmarien to Tatarien.

### CONCLUSIONS

The analysis of the distribution of platyspermic gondwanic seeds led us to the following conclusions:

1. Uptil now 53 species are known from Gondwanaland: 33 of them belong to the genus *Samaropsis*, 12 to the genus *Cordaicarpus*, 4 to the genus *Cornucarpus*, 2 to the genus *Alatocarpus*, 1 to the genus *Nummulospermum* and 1 to the genus *Eucerospermum*.

2. In Brasil, occur 13 *Samaropsis* spp., 6 *Cordaicarpus* spp. and 3 *Cornucarpus* spp.; in South African Republic 1 species of *Samaropsis*; in Zaire 3 *Samaropsis* spp. and 1 species of *Cordaicarpus*; in Mozambique 1 species of *Samaropsis*; in Madagascar 1 species of *Cordaicarpus*; in Argentina 2 *Samaropsis* spp., 1 species of *Cordaicarpus*, 1 species of *Cornucarpus* and 1 species of *Eucerospermum*; in Antarctica 3 species of *Samaropsis*; in Australia 8 *Samaropsis* spp., 3 *Cordaicarpus* spp., 1 *Cornucarpus* species and 1 *Nummulospermum* species and in India 9 *Samaropsis* spp., 4 *Cordaicarpus* spp., 2 *Alatocarpus* spp., 1 *Cornucarpus* species and 1 *Nummulospermum* species.



TABLE 14 — STRATIGRAPHIC UNITS WHERE GONDWANIC TAPHLOFLORULAE OCCUR WITH SEEDS

GEOLOGY AND STRATIGRAPHY	COUNTRY OR REGION						
	BRASIL	AFRICA		ANTARCTICA	ARGENTINA	AUSTRALIA	INDIA
TRIASSIC		South African Republic	Madagascar	Mozambique	Zaire	New South Wales	Queensland
UPPER	{ Tatarien Kazanien						
PERMIAN	{ Kungurien Artinskien Sakmarien	Ecca Series	Sakoa Series	Tete Coal Measures	Lukuga Series	Upper Newcastle Coal Measures	Upper Bowen Series
LOWER		Rio Bonito Formation Itararé Subgroup			Victoria Subgroup	Greta Coal Measures	Lower Bowen Series
UPPER CARBONIFEROUS	{ Stephanien Westphalien				Nueva Lubecka Formation		Barakar Formation Karharbari Formation Talchir Formation

3. Uptil now there are, in Gondwanaland, 48 taphoflorulae where the seeds are conveniently described and figured: 13 of them in India, 11 in Brasil, 11 in Australia, 5 in Antarctica, 3 in Argentina, 2 in Zaire, 1 in Madagascar, 1 in Mozambique and 1 in South African Republic. The denominations of such taphoflorulae, adopted in this paper, are used in some cases but in other cases they differ greatly from those used till now because we made our option according to the more adequate data available in the literature.

4. The seeds are stratigraphically distributed in Tubarão Group in Brasil, in Sakoa Series in Madagascar, in Lukuga Series in Zaire, in Ecca Series in South African Republic, in Tete Coal Measures in Mozambique, in Beacon Group in Antarctica, in Nueva Lubecka Formation in Argentina, in Upper Kutung Series and in Greta Coal Measures and Upper Newcastle Coal Measures in New South Wales, Australia, and in the Lower and Upper Bowen Series in Queensland, Australia, and in the Talchir, Karharbari-Barakar, Raniganj and Panchet formations in India.

5. In the chronological distribution of *Samaropsis* spp., approximately 6% are

exclusive of Upper Carboniferous, 9% of Carboniferous and Permian, 9% of Permian *sensu lato*, 54% of Lower Permian, 12% of Upper Permian and 9% of Triassic.

6. In the chronological distribution of *Cordaicarpus* spp., approximately 25% belong to Upper Carboniferous, 8% to Carboniferous and Permian, 8% dubiously belonging from Upper Carboniferous to Triassic, 50% to Lower Permian and 8% to Triassic.

7. In the chronological distribution of *Cornucarpus* spp., 25% belong to Carboniferous and Permian and 75% to Lower Permian.

8. The chronological distribution of *Alatocarpus* spp., *Eucerospermum opimum* and *Nummulospermum bowenense* is meaningless due to the occurrence of very small number of species and belonging to Permian and mainly to Lower Permian.

#### ACKNOWLEDGEMENTS

The author is grateful to his wife, Profa. Cleusa de S. Millan, for the typewriting work and to Profa. Maria da Gloria F. G. da Silva for the revision of English text.

#### REFERENCES

- ARCHANGELSKY, S. (1965). Tafofloras paleozoicas y comozoicas de Argentina. *Soc. Argent. bot.*, **10**(4): 247-291.
- ARCHANGELSKY, S. & ARRONDO, O. G. (1969). The Permian taphofloras of Argentina with some considerations about the presence of "northern" elements and their possible significance. *IUGS Symp., Buenos Aires 1-15 October 1967, Gondw. Strat.*,: 71-90.
- BANKS, M. R., CAMPBELL, K. S. W., DICKINS, J. M., JERSEY, M. J., WILLIAMS, A., BALME, B. E. & DEAR, J. F. *et al.* (1969). Correlation charts for the Carboniferous, Permian, Triassic and Jurassic systems in Australia. *IUGS Symp., Buenos Aires 1-15 October 1967, Gondw. Strat.*,: 467-483.
- BESAIRIE, H. (1967). Progres dans l'étude du Gondwana de Madagascar de 1960 a 1966. *IUGS Symp., Buenos Aires 1-15 October 1967, Gondw. Strat.*,: 197-200.
- BIGARELLA, J. J. & SALAMUNI, R. (1967). A review of South American Gondwana geology. *IUGS Symp., Reviews prepared for the First Symposium on Gondwana Stratigraphy*: 7-138.
- CAREY, S. W. (1934). The geological structure of the Werrie Basin. *Proc. Linn. Soc. N.S.W.*, **59**: 351-374.
- CORRÊA DA SILVA, ZULEIKA, C. & ARRONDO, O. G. (1977). Tafoflora Permiana de Mariana Pimentel, Município de Guaíba, Rio Grande do Sul, Brasil. *Pesquisas, Porto Alegre*, **7**: 27-44.
- DOLIANITI, E. (1948). A Paleobotânica no Brasil. *Div. Geol. Miner., DNPM, Bol.*, **123**: 1-87.
- GHOSH, P. K. & SASTRY, M. V. A. (1967). A review of the Lower Gondwanas of India. *IUGS Symp., Reviews prepared for the First Symp. on Gondwana Stratigr.*,: 269-304.
- GOTHAN, W. & WEYLAND, H. (1954). *Lehrbuch der Paläobotanik*. Akad. Verlag, Berlin, 535 pp.
- HARRINGTON, H. J. (1965). Geology and morphology of Antarctica in: *Biogeography and Ecology in Antarctica. Monog. Biol.*, **15**: 1-71.
- HØEG, O. A. & BOSE, M. N. (1960). The Glossopteris Flora of the Belgian Congo. *Ann. Mus. Congo*, **8, Geol.**, **32**: 1-109.
- MAITHY, P. K. (1965). Studies in the Glossopteris Flora of India. 18—Gymnospermic seeds and seed-bearing organs from the Karharbari beds of the Giridih Coalfield, Bihar. *Palaeobotanist*, **13** (1): 45-56.
- MC ELROY, C. T. (1969). Comparative lithostratigraphy of Gondwana sequences in eastern Australia and Antarctica. *IUGS Symp., Buenos Aires 1-15 October, 1967, Gondw. Strat.*,: 441-466.

- MILLAN, J. H. (1969). The gymnospermic and platispermic seeds of the *Glossopteris* Flora from Brazil and correlated foreign regions. *IUGS Symp., Buenos Aires 1-15 October, 1967, Gondw. Strat.*,: 107-122.
- MILLAN, J. H. (1971). Tafoflóruas do Grupo Tubarão. *Ciênc. Cult.*, 23 (supl.): 82-83.
- MILLAN, J. H. (1972). *Macroflórua carbonífera de Monte Mor, Estado de São Paulo*. Tese de Doutorado (Dr. Sc. thesis). Inst. Geociênc., Univ. São Paulo, 165 pp.
- MILLAN, J. H. (1974a). As sementes platispérmicas do Gondwana face ao Esquema Maithy. *An. Acad. Brasil. Ciênc.*, 46(3/4): 537-548.
- MILLAN, J. H. (1974b). *Sementes platispérmicas da Bacia do Paraná e demais regiões gondvânicas*. Tese de Docência-Livre (thesis), Museu Nac., Univ. Fed. Rio de Janeiro, 80 pp.
- MILLAN, J. H. (1977). Sementes platispérmicas do Eogondwana de Cerquilha, São Paulo (Bacia do Paraná). *An. Acad. Brasil. Ciênc.*, 49 (4): 581-595.
- MILLAN, J. H. (1980). Sobre uma possível utilização estratigráfica de sementes gondvânicas. *An. Acad. Brasil. Ciênc.*, 52 (2): 353-358.
- OLIVEIRA, MARY E. C. B. de (1977). *Tafoflora Eogondvânica da Camadã Irapuá, Formação Rio Bonito (Grupo Tubarão), SC*. Tese de Doutorado (Dr. Sc. thesis). Inst. Geociênc., Univ. São Paulo, vol. I, 301 pp., vol. II, 38 pp.
- RIGBY, J. F. & SCHOPF, J. M. (1969). Stratigraphic implications of antarctic paleobotanical studies. *IUGS Symp., Buenos Aires 1-15 October, 1967, Gondw. Strat.*,: 91-106.
- RIGBY, J. F. (1972). The Upper Palaeozoic Flora at Lauro Müller, Santa Catarina, southern Brazil. *An. Acad. Brasil. Ciênc.*, 44 (supl.): 279-293.
- ROBINSON, PAMELA L. (1967). The Indian Gondwana formations: A review. *IUGS Symp., Reviews prepared for the First Symp. on Gondwana Stratigr.*,: 201-268.
- ROCHA-CAMPOS, A. C. (1972). Late Paleozoic geology of northern Paraná Basin. *Internatn. Symp. Carbon. Perm. Syst. South American, Exc. Guide-Book*, 68 pp.
- RYAN, P. J. (1969). Stratigraphy of the Eccia Series and lowermost Beaufort beds (Permian) in the Great Karroo Basin of South Africa. *IUGS Symp., Buenos Aires 1-15 October, 1967, Gondw. Strat.*,: 945-965.
- SOARES, P. C., LANDIM, P. M. B., SINELLI, O., WERNICK, E., WU, F. T. & FIORI, A. P. (1977). Associações litológicas do Subgrupo Itararé e sua interpretação ambiental. *Rev. Bras. Geociênc.*, 7(2): 131-149.
- WALKOM, A. B. (1922). The *Glossopteris* Flora of the Lower and Upper Bowen Series. *Qd. geol. Surv.*, 270: 1-64.
- WALKOM, A. B. (1928). Notes on some additions to the *Glossopteris* Flora in New South Wales. *Proc. Linn. Soc. N.S.W.*, 53(5): 555-564.
- WALKOM, A. B. (1935). Some fossil seeds from the Upper Palaeozoic rocks of the Werrie Basin. *Proc. Linn. Soc. N.S.W.*, 60(261/262): 459-463.