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3. South America and Antarctic Peninsula

3.1 Lower Jurassic of South America and Antarctic Peninsula

by A. C. RICCARDI, S. E. DAMBORENEA and M. O. MANCEÑIDO
(With contributions by A. BALDONI, S. BALLENT, Z. GASPARINI, A. v. HILLEBRANDT, M. E. QUATTROCCHIO, W. VOLKHEIMER and A. M. ZAVATTIERI)*

with 10 charts

Introduction

As the editors have pointed out in the Introduction to Part 3, the marine Lower Jurassic is present along the Pacific margin of South America, from Argentina and Chile to Colombia (GEYER 1980; RICCARDI 1983; PALACIOS 1985). However, most information provided in the Lower Jurassic range charts is based on material from Argentina. Systematics and stratigraphic ranges of the palynomorphs, megaflora, foraminifers, ostracods, bivalves and brachiopods, are mainly based on stratigraphic sections exposed in west-central Argentina. According to information provided by Z. GASPARINI for this paper, there are several poorly known records of Early Jurassic vertebrates (HUENE 1927; CHONG & GASPARINI 1972, 1976; GASPARINI 1976, 1979, 1981, 1985).

The ammonite range charts, on the other hand, are based mainly on sections in northern Chile, although the same faunas are also present in other areas, and Hettangian and Sinemurian faunas have also been described from Perú, Colombia, and, most recently (RICCARDI et al. 1988), Argentina. In Antarctica Late Sinemurian ammonites have been described from central Alexander Island (THOMSON & TRANTER 1986).

Comments to correlation table

Ammonites (by RICCARDI)

The succession of ammonite assemblages in the South American Lower Jurassic is mainly due to studies carried out in Chile by HILLEBRANDT (1970, 1973a, b, 1981; HILLEBRANDT &

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SCHMIDT-EFFING 1981). Additional information has been provided by BLASCO et al. (1978, 1980), ESCOBAR (1980) and GEYER (1973, 1974, 1979). A modern systematic study is still wanting, however, for most taxa especially of the lowermost Jurassic, based on collections from different areas. Hence, most of the zonation proposed is provisional and its regional validity remains to be proved. RICCARDI (1984) therefore proposed a more general zonation based on the identification of abundant material collected level-by-level in numerous sections of west-central Argentina. More recently RICCARDI et al. (1988) discovered Hettangian and lowermost Sinemurian ammonites in Argentina, and proposed a succession of biostratigraphic units equivalent to units of Europe and to those proposed by HILLEBRANDT (1981, 1987) for South America outside of Argentina. In order to stress the local nature of RICCARDI's (1984) zonation, the boundaries were shown as not exactly coincident with those of the European Standard Zonation, contrasting with HILLEBRANDT's (1973 b) succession where in most cases the boundaries were shown as strictly coincident. Subsequent minor changes introduced by HILLEBRANDT (1987) in his zonation enhanced the differences in the correlation of each of the two local zonations with the European ones. Leaving aside some nomenclatural differences, however, HILLEBRANDT's and RICCARDI's zonations are mutually compatible, whatever the correlations with the European Zones may be.

Studies carried out in Argentina on brachiopods (MANCEÑIDO 1978, 1981, 1983), bivalves (DAMBORENEA 1982, 1987 a, b; DAMBORENEA & MANCEÑIDO 1988), and microfauna (BALLENT 1985, 1987) were based on material collected from the same sections and (often) levels which provided the ammonites identified by RICCARDI (1984). The stratigraphic ranges of those faunas were thus calibrated against RICCARDI's (1984) ammonite zonation. Both ammonite zonations are here included in the correlation table, although HILLEBRANDT (1987) has recently proposed to extend his zonation introduced for Chile to the whole of South America.

Until quite recently the undefined "*P. planorbis, A. liasicus* and *S. angulata* Zones" (HILLEBRANDT 1987) were only identified in central and northern Chile (CECIONI & WESTERMANN 1968; ESCOBAR 1980; HILLEBRANDT 1987) and northern Perú (TILMANN 1917; GEYER 1979), based on genera and species with pandemic distribution. Equivalent faunas have now been discovered in Argentina by RICCARDI et al. (1988), who proposed a succession of Assemblage Zones, named (ascending order) the *Psiloceras, Waehneroceras-Schlotheimia* and *Badouxia canadensis* Assemblage Zones.

Ammonites probably coeval to the Bucklandi (Standard) Zone are known from Perú (TILMANN 1917; SCHINDEWOLF 1957), northern Chile (HILLEBRANDT 1987), and Argentina (RICCARDI et al. 1988), whilst the Semicostatum Zone is quite well known from Colombia (GEYER 1973), Ecuador (GEYER 1974), Perú (TILMANN 1917; GEYER 1979), Chile (HILLEBRANDT 1973 b, 1981, 1987; ESCOBAR 1980) and Argentina (RICCARDI et al. 1988).

A fauna coeval to the Turneri Zone (see HILLEBRANDT 1987; RICCARDI et al. 1988) is not clearly differentiated in South America.

An "*Epophioceras* Faunule" (RICCARDI 1984; RICCARDI et al. 1988) has been recognized in west-central Argentina on the basis of material referred to *E.* cf. *cognitum* GUERIN FRANIATTE. A similar fauna is known from northern Chile (HILLEBRANDT 1981, 1987) and probably Perú (GEYER 1979), and is considered coeval to the Obtusum Zone.

Most previous references to *Oxynoticeras* in South America were based on material now included in *Fanninoceras* (see below). The "*Oxynoticeras* Faunule" of RICCARDI (1984) exists

Chart 1

STAGES & SUBSTAGES		AMMONITE STANDARD ZONES	AMMONITE ASS. / ZONES		BIVALVE ASSEMBLAGES	BRACHIOPOD ASSEMBLAGES
			Hillebrandt (1987)	Riccardi (1984, 1988)		
TOARCIAN	UPPER	Dumortieria LEVESQUEI	25 "P. fluitans" Z.	Dumortieria faunule	– ? – ? – ? – ? –	LJ 5
			24 "P. lotharingica" Z.	Phlyseogrammoceras tenuicostatum Z.		
			23 P. tenuicostatum Z.			
		Grammoceras THOUARSENSE	22 P. copiapense Z.	Phymatoceras faunule		
		Haugia VARIABILIS	21 P. toroense Z.			
	LOWER	Hildoceras BIFRONS	20 C. chilensis Z. b		5 Propeamussium cf. pumilus	LJ 4
				Collina chilensis Zone a		
			19 P. pacificum Z.	Peronoceras pacificum Zone		
			18 P. largaense Z.	Peronoceras largaense Zone		
		Harpoceras FALCIFER	17 D. hoelderi Z.	Dactylioceras hoelderi Zone		
		Dactylioceras TENUICOSTATUM	16 D. tenuicostatum b	D. tenuicostatum chilense Zone	4 Posidonotis cancellata	LJ 3
				Dactylioceras simplex Zone a		
PLIENSBACHIAN	UPPER = DOMERIAN	Pleuroceras SPINATUM	15 F. disciforme Z.	Fanninoceras Zone		
		Amaltheus MARGARITATUS	14 F. fannini Z.		3 Radulonectites sosneadoensis	
	LOWER = CARIXIAN	Prodactylioceras DAVOEI	13 F. behrendseni			
		Tragophylloceras IBEX	12 E. meridianus Z.		2 Otapiria neuquensis	LJ 2
			11 "Tropidoceras" Z.	Dubariceras Zone		
		Uptonia JAMESONI	10 "Apoderoceras" Z.			
SINEMURIAN	UPPER	Echioceras RARICOSTATUM	9 "E. raricostatum" Z.	Miltoceras faunule		
		Oxynoticeras OXYNOTUM	8 "O. oxynotum" Z.	Oxynoticeras faunule		LJ 1
		Asteroceras OBTUSUM	7 "A. obtusum" Z.	Epophioceras faunule		
	LOWER	Caenisites TURNERI	6 "C. turneri" Z.	Agassiceras Zone		
		Arnioceras SEMICOSTATUM	5 A. semicostatum Z.		1 Otapiria pacifica	?
		Arietites BUCKLANDI	4 "A. bucklandi" Z.	Vermiceras Zone		
HETTANGIAN		Schlotheimia ANGULATA	3 S. angulata Z.	B. canadensis Z.		
		Alsatites LIASICUS	2 A. liasicus Z. b	Waehneroceras - Schlotheimia Z.		
		Psiloceras PLANORBIS	1 P. planorbis Z. c b a	Psiloceras Zone		

in northern Chile (HILLEBRANDT 1981) and was recently (HILLEBRANDT 1987) placed in the Oxynotum Zone. Its presence in Argentina is probable, pending a detailed study of the ammonite fauna.

An Andean ammonite assemblage coeval to the Raricostatum Zone, has yet to be documented. Several Echioceratidae from northern Chile and *Pseudoskirroceras wiedenmayeri* HILLEBRANDT may, respectively, belong to the "*Epophioceras* or *Oxynoticeras* Faunules", below, and the "*Miltoceras* Faunule", above (RICCARDI 1984).

The "*Miltoceras* Faunule" (RICCARDI 1984) or "*Apoderoceras-Eoderoceras* Zone" (HILLEBRANDT 1987) includes species of *Miltoceras* and *Eoderoceras* found in Chile and Argentina (HILLEBRANDT 1973 b, 1981; RICCARDI 1984; RICCARDI et al. 1988).This unit could be coeval to the latest Sinemurian and part of the Jamesoni Zone.

The "*Dubariceras* Zone" (RICCARDI 1984; RICCARDI et al. 1988) is quite well represented in the Río Atuel area, Argentina. It includes, in its lower part, species of *Tropidoceras*, and in its upper part *Dubariceras* spp. and *Eoamaltheus meridianus* HILLEBRANDT (1981). On the basis of these two assemblages HILLEBRANDT (1987) recognized a "Zone of *Tropidoceras*" and a "Zone of *Eoamaltheus meridianus*". *Tropidoceras* appears to be quite rare in Chile and Perú, whilst *Dubariceras* is fairly well represented in Chile where it also occurs above levels with *Eoderoceras* and *Miltoceras*.

The "*Fanninoceras* Assemblage Zone" (RICCARDI 1984; RICCARDI et al. 1988) is quite widespread throughout west-central Argentina, and is even present in central Patagonia. It is characterized by *Fanninoceras* which, in the upper part, occurs together with species of *Arieticeras, Fuciniceras* and *Reynesocoeloceras* (HILLEBRANDT 1981, 1987; RICCARDI, unpublished). According to HILLEBRANDT (1981, 1987) three different assemblages or zones can be recognized (ascending order): Zones of *F. behrendseni, F. fannini* and *F. disciforme*. These faunas are present in Argentina and Chile, and more rarely in Perú (HILLEBRANDT 1987).

A zonation for the Toarcian of Chile was proposed by HILLEBRANDT and SCHMIDT-EFFING (1981), based exclusively on the Dactylioceratidae. Most of these zones can be recognized in Argentina and Chile (RICCARDI 1984; HILLEBRANDT 1987).

The "Zone of *Dactylioceras tenuicostatum*" was divided into two subzones, i.e. *D. simplex* and *D. tenuicostatum* by HILLEBRANDT and SCHMIDT-EFFING (1981). Both subzones, considered as Assemblage Zones by RICCARDI (1984), are quite well represented in Chile, but thus far have not been clearly distinguished in Argentina.

The *D. hoelderi* Zone (HILLEBRANDT & SCHMIDT-EFFING 1981) is well represented in Chile, Argentina and southern Perú (RICCARDI 1984; HILLEBRANDT 1987). It has been considered coeval to the Falcifer Zone of Europe.

Ammonite assemblages of the Bifrons Zone have been divided by HILLEBRANDT and SCHMIDT-EFFING (1981) into the three subzones (ascending order) of *Peronoceras largaense, P. pacificum* and *Collina chilensis*. These subzones were later considered as Assemblage Zones by RICCARDI (1984) and "Zones" by HILLEBRANDT (1987). In this new version, HILLEBRANDT (1987) modified the range of the *C. chilensis* Zone, indicating that it could also be coeval to the lower Variabilis Zone. The ammonites characterizing these three zones are known from central Patagonia to northern Chile and southern Perú. In Argentina, however, a clear distinction among the three zones has not yet been worked out.

The "*Phymatoceras* Faunule" (RICCARDI 1984) present in Argentina and Chile, includes different species of *Phymatoceras*. HILLEBRANDT (1973 b) distinguished two assemblages, on which he subsequently (HILLEBRANDT 1987) based the *P. toroense* Zone, below, and *P. copiapense* Zone, above. These assemblages have been considered as approximately coeval to the Variabilis and Thouarsense Zones, respectively.

The *Phlyseogrammoceras* (?) *tenuicostatum* Assemblage Zone (RICCARDI 1984) is well represented in Argentina, and, more rarely, in Chile (HILLEBRANDT 1987). It has been considered as coeval to the lower Levesquei Zone.

In South America the upper part of the Levesquei Zone is represented by species of *Pleydellia* and *Dumortieria*. On this basis a "*Dumortieria* Faunule" was recognized (RICCARDI 1984). However, according to HILLEBRANDT (1973, 1987) two different assemblages or zones can be differentiated in some localities, i.e. the "*P. lotharingica* Zone", below, and the "*P. fluitans* Zone", above.

Bivalves (by DAMBORENEA)

The bivalve assemblage zones proposed here are mainly based on faunas from Argentina and Chile, where the vertical ranges of species are reasonably well established. These zones can probably be recognized in other places of the South American Andes such as Perú and Colombia-Ecuador, but the data are few and scattered.

The five bivalve Assemblage Zones outlined below were identified on the basis of the vertical distribution of bivalves in off-shore facies, where they are frequently associated with ammonites. Independent bivalve zones may also be recognized in littoral facies, though it is still difficult to accurately correlate them with the off-shore assemblages.

1. *Otapiria pacifica* Assemblage Zone – New (DAMBORENEA). Central Chile (Curepto area) and other Chilean localities; Río Atuel area, Argentina (RICCARDI et al. 1988); with *O. pacifica* COVACEVICH and ESCOBAR; Hettangian-Sinemurian, upper *Badouxia canadensis* Zone to *Agassiceras* Zone.
   In littoral facies, *Quadratojaworskiella* sp. (in HILLEBRANDT 1980) and the first South American *Weyla* may characterize more or less coeval associations. An ill-defined Hettangian bivalve faunule with "*Inoceramus*" sp. (TILMANN 1917; ESCOBAR 1980) and *Palmoxytoma* sp. (RICCARDI et al. 1988) occurs below, but it cannot be identified as a different zone; one or more Sinemurian zones may later also be recognized between 1 and 2.
2. *Otapiria neuquensis* Assemblage Zone – New (DAMBORENEA). Northern Chile to southern Neuquén (Argentina): Río Atuel, upper Río Salado, Cerro Puchenque-Serrucho, Picún Leufú and Piedra Pintada areas. Characteristic are *Otapiria neuquensis* DAMBORENEA, *Palaeoneilo patagonidica, Parainoceramus apollo, Grammatodon costulatus* and *Jurassicardium ? asaphum* and others, associated with the *Miltoceras* faunule and *Dubariceras* Zone of Argentina, ranging up into the lowest part of the *Fanninoceras* Zone.
   The littoral facies is characterized by *Weyla alata, Quadratojaworskiella pustulata, Myoconcha neuquena, Cardinia andium*, and others, which extend into Assemblage Zone 3.
3. *Radulonectites sosneadoensis* Assemblage Zone – New (DAMBORENEA). Southern San Juan to Southern Neuquén in Argentina: Cordón del Espinacito, Río Atuel, upper Río Salado, Cerro Puchenque/Serrucho, Chacay Melehue, Picún Leufú and Piedra Pintada areas; almost certainly also Chubut and Chile. Characterized by *Radulonectites sosneado-*

ensis (WEAVER), *"Pecten" coloradoensis* and ? *Eopecten hartzi*. In littoral facies the following species are abundant, though not confined to this assemblage: *Parallelodon groeberi, Weyla bodenbenderi, Jaworskiella burckhardti, Frenguelliella inexspectata, F. tapiai, Isognomon jupiter, "Astarte" chubutensis, Cucullaea jaworskii, Bakevellia pintadae, Falcimytilus ? gigantoides, Modiolus* cf. *thiollierei, Plicatula rapa, Gervilleioperna (Gervilletia) turgida, Pulvinites liasicus*, and most of the species already mentioned in Zone 2. *Fanninoceras* Zone.

4. *Posidonotis cancellata* Assemblage Zone – New (DAMBORENEA). Argentina, from southern San Juan to Chubut: Cordón del Espinacito, Cerro Puchenque/Serrucho, Cerro Tricolor, Chacay Melehue, Picún Leufú, Cerro Lotena, Pampa de Agnia, and also in northern Chile. Characteristic are *Posidonotis cancellata* and *Weyla alata angustecostata*. The rich and varied littoral fauna mentioned under Zone 3 extends into the lower part of this zone; also common are: *Antiquilima* sp., *Cucullaea rothi, Parallelodon groeberi, Myophorella araucana, Gervillia (Cultriopsis)* sp., *Lycettia hypertrigona, Modiolus gerthi*, etc. Uppermost *Fanninoceras* and *D. tenuicostatum* Zones.
5. *Propeamussium* cf. *pumilus* Assemblage Zone – New (DAMBORENEA). In Argentina at several localities from southern San Juan to Chubut: Cordón del Espinacito, Cerro Puchenque/Serrucho, Cerro Tricolor, Poti Malal, Chacay Melehue; northern Chile. Characterized by appearance of *Propeamussium* cf. *pumilus* (LAMARCK), *Bositra ornati* and *Meleagrinella* sp., some of which may extend into the Middle Jurassic. Characteristic for littoral facies are *Goniomya* sp. 1, *Vaugonia* n. sp. (in HILLEBRANDT 1980), taxa not yet described and/or figured, and, very locally, *Plicatostylus* cf. *gregarius* LUPHER and PACKARD. Toarcian, from *D. hoelderi* Zone upwards. A revision of late Toarcian South American bivalves may permit division of the zone; latest Toarcian-earliest Aalenian bivalve faunas probably belong to a different zone.

Brachiopods (by MANCEÑIDO)

The current state of biostratigraphic knowledge of early Jurassic brachiopods from South America, as revealed from the appended range chart, has been greatly improved as a result of basic field-work carried out in western Argentina during the last 15 years. This allows recognition of a series of major informal assemblages (ascending order):

Brachiopod Faunule(s) LJ 1 – New (MANCEÑIDO). Chile and Perú, in scattered sites along the Andean range to Argentina (cf. RICCARDI et al. 1988). Classical fossiliferous sites yielding species of *Gibbirhynchia* ?, *Zeilleria, Lingula* or *Lobothyris*, sometimes supplemented by early occurrences of *Spiriferina chilensis*, serve as examples of this rather conspicuous faunule. Additional studies are needed to provide an enhanced picture of its actual diversity and to explore distinction of further assemblage(s), especially at the bottom, since Hettangian-early Sinemurian brachiopods are very poorly known.

Brachiopod Assemblage LJ 2 – New (MANCEÑIDO). Argentina, numerous localities from Mendoza and Neuquén (and probably Chubut); Chile and Perú. Characteristic taxa are *Rhynchonelloidea* sp. 1, *Zeilleria* cf. *sarthacensis, Spiriferina* cf. *walcotti, Rudirhynchia* aff. *rudis*; species of *Squamiplana (Cuersithyris)* are also very common and important for correlations. *Dubariceras* and most of *Fanninoceras* ammonite Assemblage Zones.

Brachiopod Assemblage LJ 3 – New (MANCEÑIDO). Widespread in Argentina from San Juan to southern Neuquén; also ? Chile. Distinctive taxa are *Rhynchonelloidea* sp. 2, *Spiriferina tumida ericensis, Lobothyris* cf. *wittnichi*, and undescribed rhynchonellids and zeilleriaceans; not restricted to this assemblage are *Quadratirhynchia* spp., *Tetrarhynchia* ex gr. *subconcinna, Lobothyris subpunctata*, etc. Top of the *Fanninoceras* Assemblage Zone and *Dactylioceras tenuicostatum* Zone.

Brachiopod Assemblage LJ 4 – New (MANCEÑIDO). Argentina: from San Juan to western Chubut; probably Chile. Characterized by *Rhynchonelloidea* sp. 3 and *Telothyris* ex gr. *jauberti*; sometimes associated with *Piarorhynchia* sp., which are more frequent in the *D. hoelderi* Zone, but occasionally may range up into the *Collina chilensis* Zone.

Brachiopod Assemblage LJ 5 – New (MANCEÑIDO). Argentina: southern Mendoza; Chile. Characterized by *Flabellirhynchia?* sp. and its associates. Probably coeval to the entire *Phymatoceras* Faunule and the *Phlyseogrammoceras* Zone. Similar faunas occur in Chile where the conspicuous "*Terebratula*" *domeykana* is associated with the rhynchonellids in beds of roughly this age.

Further sampling is required for detailed correlations and finer subdivisions; e.g., undescribed rhynchonellids from Neuquén which occur in the *Dumortieria* Faunule seem quite distinctive.

Comments to range charts

Palynomorphs (by VOLKHEIMER, QUATTROCCHIO and ZAVATTIERI)

The range charts are based on the papers and unpublished work by VOLKHEIMER (1974), VOLKHEIMER et al. (1978), ARGUIJO and VOLKHEIMER (1985).

A number of species were originally described from the Triassic of Argentina but range into the Lower Jurassic. Original descriptions are by AZCUY & LONGOBUCCO (1983, Ameghiniana **20**: 297–316), HERBST (1965, 1970, 1972, Ameghiniana **4**: 141–152; **7**: 83–97; **9**: 280–288), JAIN (1968, Palaeontogr. B **122**: 1–47), VOLKHEIMER & ZAVATTIERI (1985, III Congr. Latinoamer. Paleontol., Mexico: 43–50), ZAVATTIERI (1986, Rev. Española de Micropaleontologia **18**). *Deltoidospora minor, D. neddeni, Dictyophyllidites mortoni, Todisporites major, T. minor, Auritulinasporites scanicus, Calamospora mesozoica, Osmundacidites araucanus, Rugulatisporites neuquensis, Cadargasporites verrucosus, Marattisporites scabratus, Vitreisporites pallidus, Inaperturopollenites microgranulatus, Araucariacites pergranulatus, Cycadopites nitidus, C. granulatus, Monosulcites angustus*, and cf. *Tenuisaccites* sp.

Brief characterization of Lower Jurassic Palynomorph Assemblages

Pre-Upper Toarcian assemblages. – They are characterized by a high frequency of *Classopollis* and the presence of *Nevesisporites vallatus*; southern part of Neuquén Basin. In the northern part of the basin (western slope of Espinacito Range, Main Cordillera of San Juan), where the studied assemblages are associated with continental, carbonaceous, plant-bearing shales, local elements of the microflora prevail, i.e. *Deltoidospora* spp. (15–55%) and *Classopollis* (40–75%), while *Todisporites minor, Gleicheniidites* sp., *Dictyophyllidites mortoni*

Chart 2

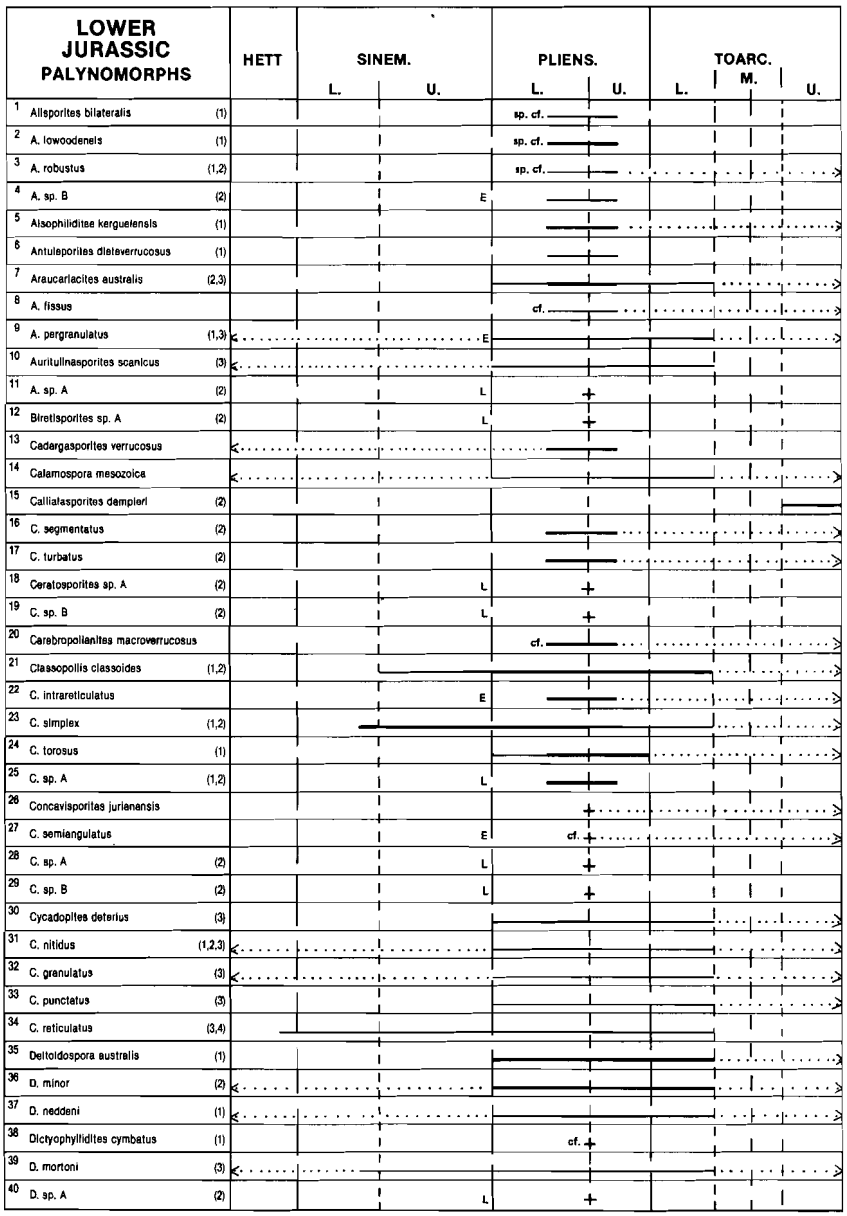
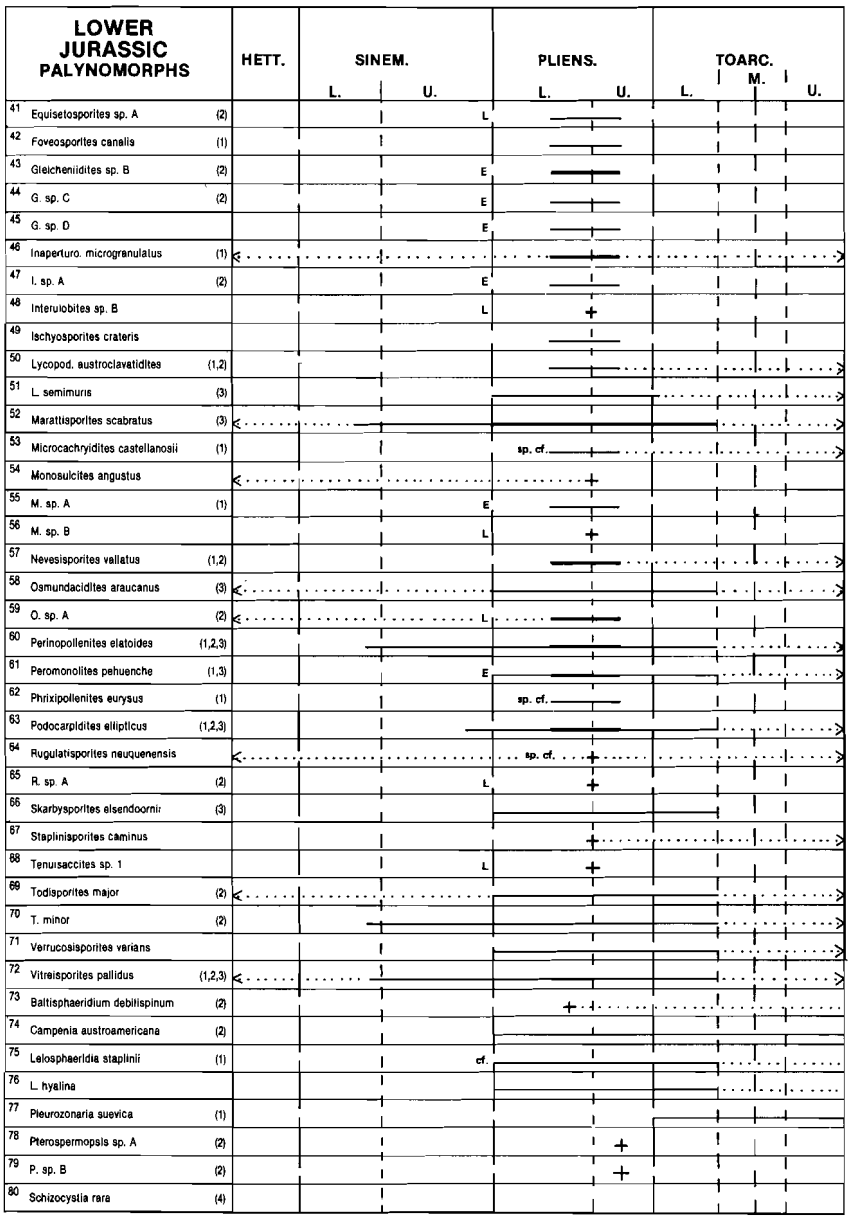

LOWER JURASSIC PALYNOMORPHS
HETT
SINEM.
L.
U.
PLIENS.
L.
U.
TOARC.
L.
M.
U.
1 Allsporites bilateralis (1)
2 A. lowoodenels (1)
3 A. robustus (1,2)
4 A. sp. B (2)
5 Alsophilidites kerguelensis (1)
6 Antuleporites dietaverrucosus (1)
7 Araucariacites australis (2,3)
8 A. fissus
9 A. pergranulatus (1,3)
10 Auritullnasporites scanicus (3)
11 A. sp. A (2)
12 Biretisporites sp. A (2)
13 Cadargasporites verrucosus
14 Calamospora mesozoica
15 Calliatasporites dampieri (2)
16 C. segmentatus (2)
17 C. turbatus (2)
18 Ceratosporites sp. A (2)
19 C. sp. B (2)
20 Cerebropollenites macroverrucosus
21 Classopollis classoides (1,2)
22 C. intrareticulatus
23 C. simplex (1,2)
24 C. torosus (1)
25 C. sp. A (1,2)
26 Concavisporites jurienensis
27 C. semiangulatus
28 C. sp. A (2)
29 C. sp. B (2)
30 Cycadopites deterius (3)
31 C. nitidus (1,2,3)
32 C. granulatus (3)
33 C. punctatus (3)
34 C. reticulatus (3,4)
35 Deltoidospora australis (1)
36 D. minor (2)
37 D. neddeni (1)
38 Dictyophyllidites cymbatus (1)
39 D. mortoni (3)
40 D. sp. A (2)
sp. cf.
cf.
E
L
W. Volkheimer, M. E. Quattrocchio, A. M. Zavattieri

Chart 3


LOWER JURASSIC PALYNOMORPHS
HETT.
SINEM.
L.
U.
PLIENS.
L.
U.
TOARC.
L.
M.
U.
41 Equisetosporites sp. A (2)
42 Foveosporites canalis (1)
43 Gleicheniidites sp. B (2)
44 G. sp. C (2)
45 G. sp. D
46 Inaperturo. microgranulatus (1)
47 I. sp. A (2)
48 Interulobites sp. B
49 Ischyosporites crateris
50 Lycopod. austroclavatidites (1,2)
51 L. semimuris (3)
52 Marattisporites scabratus (3)
53 Microcachryidites castellanosii (1)
54 Monosulcites angustus
55 M. sp. A (1)
56 M. sp. B
57 Nevesisporites vallatus (1,2)
58 Osmundacidites araucanus (3)
59 O. sp. A (2)
60 Perinopollenites elatoides (1,2,3)
61 Peromonolites pehuenche (1,3)
62 Phrixipollenites eurysus (1)
63 Podocarpidites ellipticus (1,2,3)
64 Rugulatisporites neuquenensis
65 R. sp. A (2)
66 Skarbysporites elsendoornii (3)
67 Staplinisporites caminus
68 Tenuisaccites sp. 1
69 Todisporites major (2)
70 T. minor (2)
71 Verrucosisporites varians
72 Vitreisporites pallidus (1,2,3)
73 Baltisphaeridium debilispinum (2)
74 Campenia austroamericana (2)
75 Lelosphaeridia staplinii (1)
76 L. hyalina
77 Pleurozonaria suevica (1)
78 Pterospermopsis sp. A (2)
79 P. sp. B (2)
80 Schizocystia rara (4)
sp. cf.
cf.
W. Volkheimer, M. E. Quattrocchio, A. M. Zavattieri

and *Vitreisporites pallidus* are minor elements. Characteristic elements are *Cadargasporites verrucosus, Auritulinasporites scanicus* and *Skarbysporites elsendoornii.*

The best preserved palynomorph assemblages came from Sierra Chacai Co Formation (Pliensbachian) and the lower part of the Los Patos Formation (Sinemurian-Pliensbachian).

Upper Toarcian assemblages. – Their lower limit is marked by the appearance of *Callialasporites dampieri, C. segmentatus* and *C. turbatus* (Ranges for the last two species in Chart 2, are in error). In certain Jurassic paleoenvironments, e.g. in some deltaic areas at the margin of the Neuquén Basin, Araucariaceae pollen replaced part of the plants producing *Classopollis*, with diminished frequency in some areas from the Late Toarcian. Other important elements of the microflora are *Deltoidospora* spp., *Podocarpidites ellipticus, Vitreisporites pallidus* and *Cycadopites* spp. The best known occurrences are the Los Molles and upper Los Patos Formations in Neuquén and San Juan provinces.

Megaflora (by BALDONI)

In Argentina, Lower Jurassic fossil plants occur in the provinces of Mendoza, Neuquén, Chubut and Santa Cruz.

Mendoza: The main localities are in the Río Atuel area, i.e. Cerro de la Brea, Arroyo La Chilca and Mina Tránsito. The succession and plant taxonomy were first worked out by C. BURCKHARDT, L. WHERLI, and F. KURTZ. HERBST (1964 a, b) reviewed all known material, made important additions and concluded an Hettangian-Lower Toarcian range for this flora.

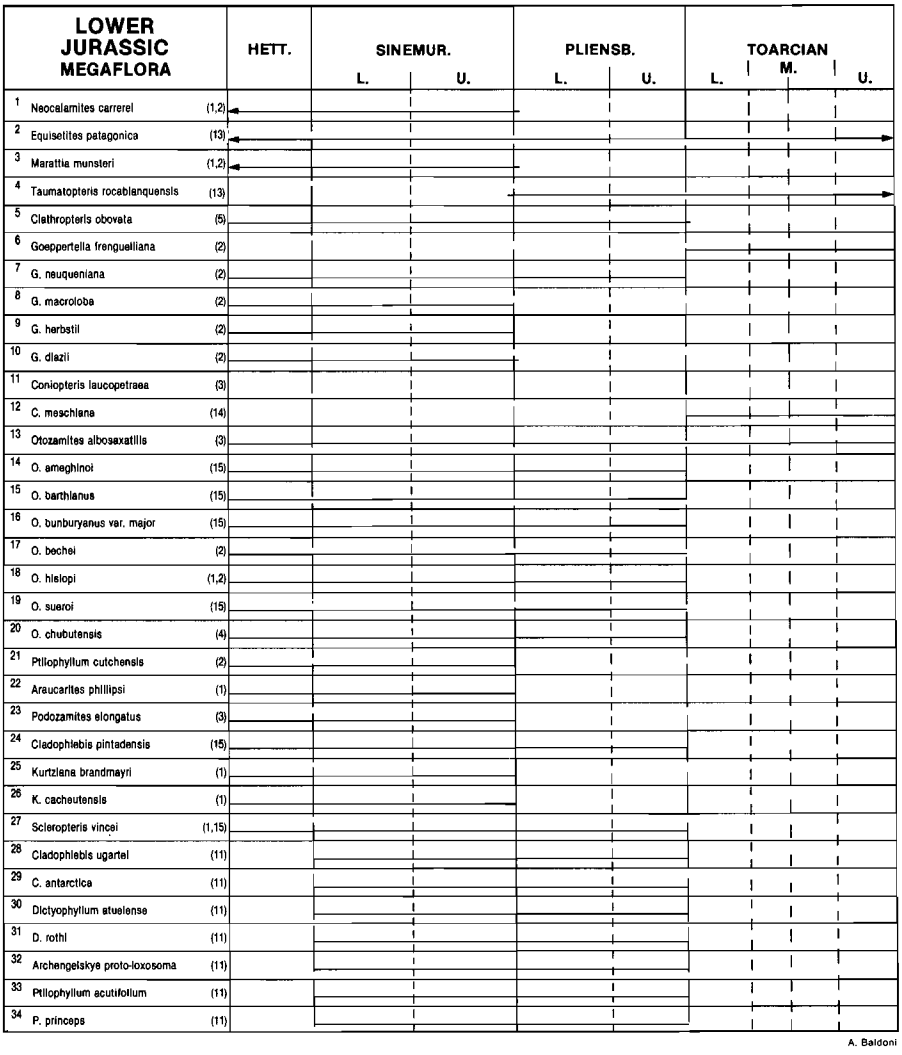
Neuquén: The known plant localities are Piedra del Aguila, Piedra Pintada and Alicurá. The Piedra del Aguila locality was discovered by GROEBER, who studied the geology. The fossil plants were described by FERELLO (1947) and HERBST (1965) who proposed an Early Jurassic age. However, STIPANICIC & BONETTI (1970) assigned to this flora a Late Hettangian age.

The Piedra Pintada locality was discovered by S. ROTH, who studied the geology of the whole area. The fossil plants came from the Piedra Pintada Formation and were studied by KURTZ (1902), FRENGUELLI (1941 a, b, 1948), and HERBST (1966 b). The age of the Piedra Pintada Formation was said to be Late Sinemurian-Early Pliensbachian (STIPANICIC & BONETTI, 1970). The presence of *Fanninoceras* at the same levels (DAMBORENEA et al. 1975), however, indicates Late Pliensbachian (A. C. RICCARDI, pers. commun.).

Chubut: Fossil plants are known from Pampa de Agnia and Cordón de Esquel. The geology of Pampa de Agnia was first studied by PIATNITZKY (1936), who listed the fossils found at different localities. Additional information was provided by SUERO (1948), HERBST (1966 a), STIPANICIC & BONETTI (1970), MUSACCHIO & RICCARDI (1971), MUSACCHIO (1975, 1981), and BLASCO et al. (1979). Fossil plants came from different stratigraphic units, i.e. "Liassic marine sediments", and the Cerro Puntudo Alto, Olte and Carnerero Formations. According to MUSACCHIO & RICCARDI (1971) and BLASCO et al. (1979), the Carnerero Formation is in part Toarcian, the Puntudo Alto Formation is Lower Liassic, and the Olte and Osta Arena formations are Middle Liassic.

From the southern part of the Cordón de Esquel, CAZAUBÓN (1947) described some plants. Stratigraphy and taxonomy are, however, doubtful.

Chart 4



Santa Cruz: Lower Jurassic plants are known from the El Tranquilo-Roca Blanca anticline (Stipanicic 1957; Herbst 1965; Stipanicic & Bonetti 1970).

Bivalves (by Damborenea)

Most of the early Jurassic bivalve species described during the last century and even during the first half of the present century lack reliable stratigraphic and, in some instances, even accurate

Chart 5

geographic data. Whenever possible, the range of species, especially those in Argentina, were based mainly on stratigraphically controlled sections. Otherwise, the ranges were taken from the original data given by different authors, but these were, as far as possible, reinterpreted in the light of updated stratigraphy. Species which lack reliable indication of stratigraphic occurrence in the original publication and have not been re-illustrated since then, have been omitted, such as many of PHILIPPI's (1899) species. Subsequent reproductions of original illustrations are not referred to and references are made only to figured material. For recently revised species, the reader is referred to DAMBORENEA (1987 a, b). Notes by taxon number:

1. Described by TILMANN from several localities of northern Perú from "*Planorbis*-Kalk" and "Arietenschichten", now referred to the Chilingote and Suta formations respectively; Hettangian-Sinemurian (see GEYER 1979, Paläont. Z. **53**).

3. Range said to be restricted to Sinemurian; possibly extending to Upper Hettangian if all the material identified by ESCOBAR (1980) as *O.* cf. *tailleuri* IMLAY is conspecific.
5. Recorded from "Arietenzone" of several localities in northern and central Perú; Sinemurian Suta and Aramachay formations (see GEYER 1979, Paläont. Z. **53**; SZEKELY & GROSE 1972, Bull. Geol. Soc. Am. **83**). Possibly only variety of *Chlamys textoria* (SCHLOTHEIM).
7. BURCKHARDT's (1902) record from Pliensbachian of Piedra Pintada belongs to *J. burckhardti* (JAW.). Initially these two species have frequently been mistaken so that unfigured records of either of them cannot be relied upon. PÉREZ & REYES (1977, Bol. Inst. Inv. Geol. Chile **30**), suggest that the range of this species in Chile is Pliensbachian – Toarcian?, but there is no figured record of that age. *J. gryphitica* is older than *J. burckhardti*, though it is not yet known if their ranges overlap.
9. Long-ranging species, which could extend into the early Sinemurian if some poorly preserved material of that age is conspecific.
13. The material recently figured by HILLEBRANDT (1980) was found in early Pliensbachian deposits (see HILLEBRANDT & SCHMIDT-EFFING 1981, Zitteliana **6**), but according to PÉREZ & REYES (1977, Bol. Inst. Inv. Geol. Chile **30**) this species ranges into the Toarcian as well.
16. Poorly known species in need of revision; range shown is based on figured material only, but probably spanning most of Lias.
18. Repeatedly mentioned from Pliensbachian to early Toarcian deposits of Argentina and Chile, but only figured from Pliensbachian at Piedra Pintada, Neuquén.
20. Includes also the material from Chubut, Argentina, referred to as *C.* cf. *wrighti* BAYLE by several authors.
21. Species sensu lato has an extended geographical range, having been figured from Perú to Chubut, Argentina.
23. Includes the material figured by JAWORSKI (1915) as "*Venilicardia cornuta* D'ORB."; all figured material is from Piedra Pintada, Neuquén, but species is also known from several other localities in Argentina and Chile.
25. The specimens figured by BURCKHARDT (1902) as *Trigonia* aff. *angulata* SOW. are included; consistently found in Pliensbachian of Chile and Argentina.
26. Though PÉREZ & REYES (1977, Bol. Inst. Inv. Geol. Chile 30) consider that this species occurs only in the Toarcian of Chile, all figured material from both Argentina and Chile is Pliensbachian (see 7).
30. Probably a subspecies (or variety) of *C. andium*; their geographic and stratigraphic ranges overlap.
31. Probably a *Neocrassina*; from late Lower Pliensbachian to Lower Toarcian in Argentina; Liassic records of "*Astarte*" [or *Neocrassina*] *andium* GOTTSCHE, a different species of the Middle Jurassic, belong here.
40. Originally described as a variety of *L. marshi* by JAWORSKI (1915); probably includes material described by FERUGLIO (1934) as *Alectryonia keideli* from Chubut Province; very common at several Argentinian localities in the *Fanninoceras* Zone.
43. This and other South American early Jurassic oysters need a thorough revision. Material referred to this species was figured by LEANZA (1942) from Pliensbachian localities in Argentina, though the Chilean material is mainly Sinemurian.

Chart 6

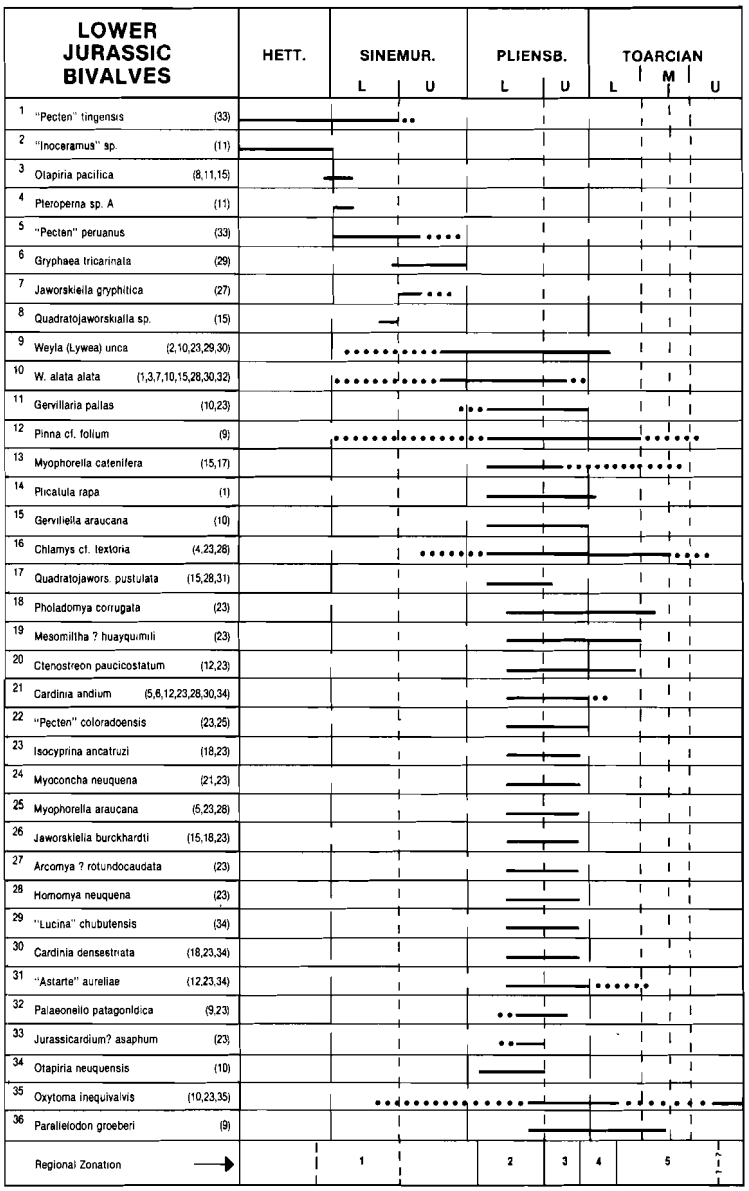
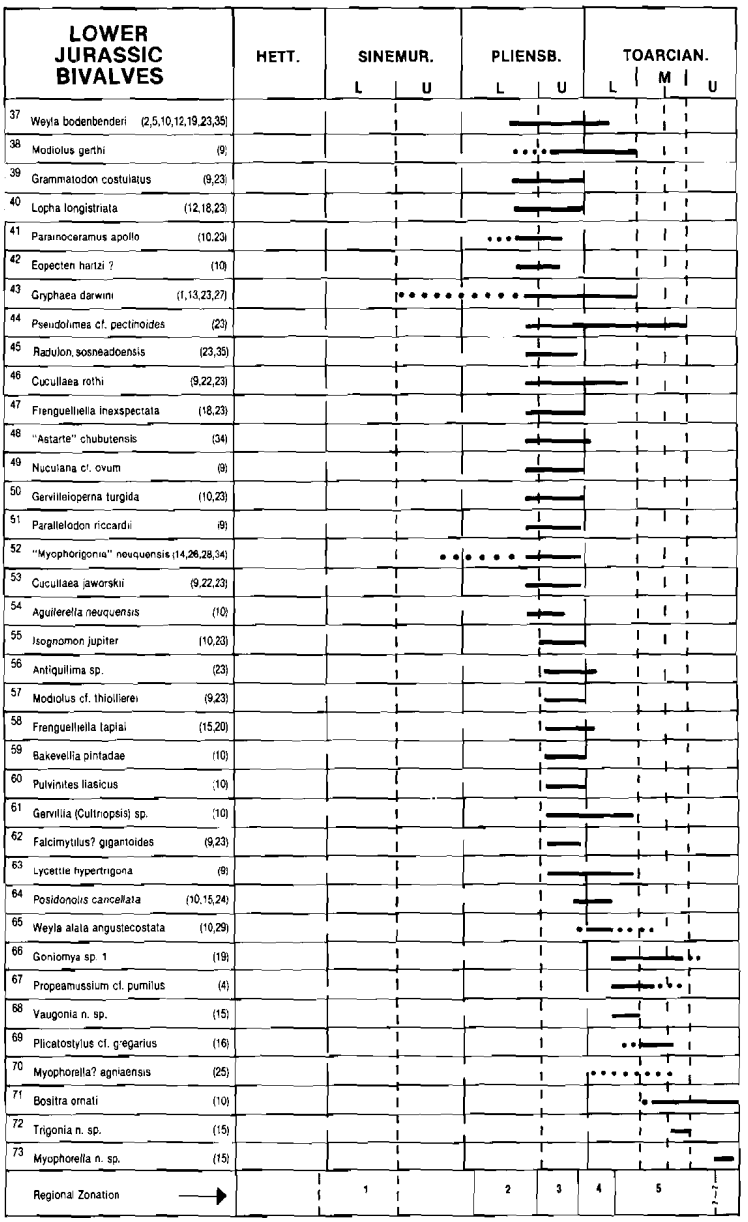

LOWER JURASSIC BIVALVES
HETT.
SINEMUR.
L
U
PLIENSB.
L
U
TOARCIAN
L
M
U
1 "Pecten" tingensis (33)
2 "Inoceramus" sp. (11)
3 Otapiria pacifica (8,11,15)
4 Pteroperna sp. A (11)
5 "Pecten" peruanus (33)
6 Gryphaea tricarinata (29)
7 Jaworskieila gryphitica (27)
8 Quadratojaworskialla sp. (15)
9 Weyla (Lywea) unca (2,10,23,29,30)
10 W. alata alata (1,3,7,10,15,28,30,32)
11 Gervillaria pallas (10,23)
12 Pinna cf. folium (9)
13 Myophorella catenifera (15,17)
14 Plicatula rapa (1)
15 Gervilleila araucana (10)
16 Chlamys cf. textoria (4.23,28)
17 Quadratojawors. pustulata (15,28,31)
18 Pholadomya corrugata (23)
19 Mesomiltha ? huayquimili (23)
20 Ctenostreon paucicostatum (12,23)
21 Cardinia andium (5,6,12,23,28,30,34)
22 "Pecten" coloradoensis (23,25)
23 Isocyprina ancatruzi (18,23)
24 Myoconcha neuquena (21,23)
25 Myophorella araucana (5,23,28)
26 Jaworskiella burckhardti (15,18,23)
27 Arcomya ? rotundocaudata (23)
28 Homomya neuquena (23)
29 "Lucina" chubutensis (34)
30 Cardinia densestriata (18,23,34)
31 "Astarte" aureliae (12,23,34)
32 Palaeonello patagonidica (9,23)
33 Jurassicardium? asaphum (23)
34 Otapiria neuquensis (10)
35 Oxytoma inequivalvis (10,23,35)
36 Parallelodon groeberi (9)
Regional Zonation
1
2
3
4
5
S. Damborenea

Chart 7



S. Damborenea

44. Refers to the material figured by LEANZA (1942) as *Lima duplicata* (SOW.); certainly a *Pseudolimea*, though specific affinities remain poorly known; common in upper Pliensbachian to middle Toarcian at several Argentinian localities.
45. Includes "*Pecten (C.) lens* SOW." figured by LEANZA (1942) which does not belong to that European species.
47. In Argentina found in upper Lower to Upper Pliensbachian of several localities; surprisingly not mentioned from equivalent levels in Chile.
52. This peculiar species, originally thought to be Triassic by GROEBER, is fairly common at certain middle to late Pliensbachian levels in Neuquén and Chubut provinces, Argentina, and was figured from equivalent beds in Chile.
56. Refers to "*Lima succincta* SCHLOTH." figured by LEANZA (1942) which probably does not belong to this European species.
58. Figured records from Argentina and Chile, as well as unpublished records from several localities in Argentina, show that this species has a comparatively short range spanning upper Pliensbachian to lowermost Toarcian.
66. Refers to the material figured by JAWORSKI (1925) as *Goniomya proboscidea* AG.

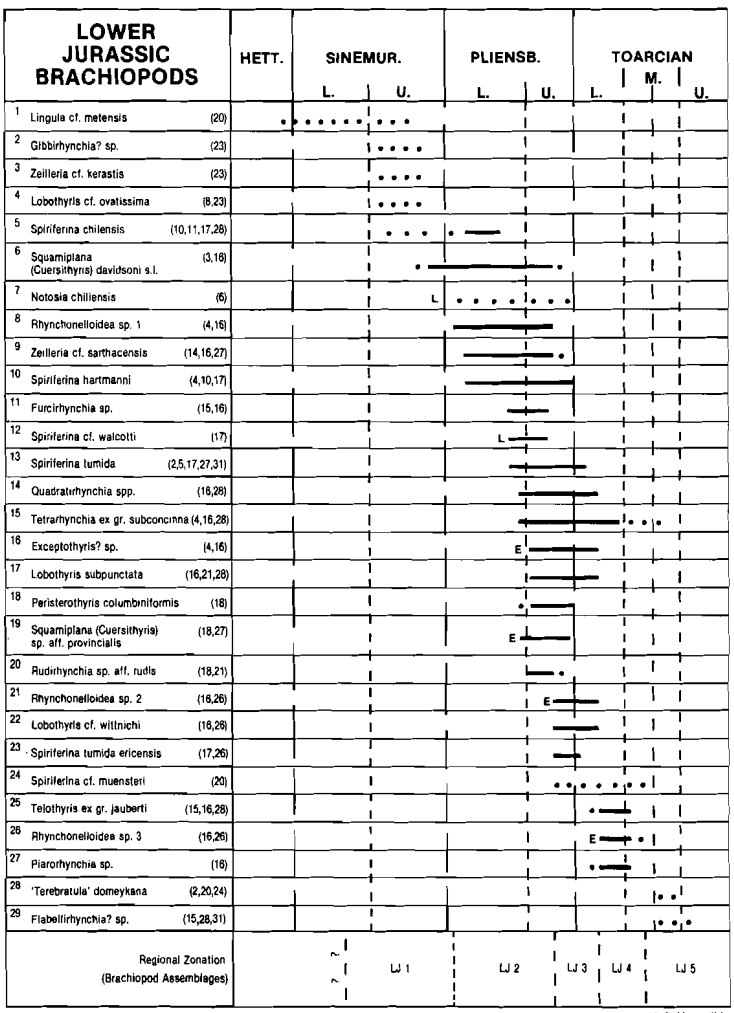
Brachiopods (by MANCEÑIDO)

Knowledge of early Jurassic brachiopods from South America is very uneven, as they have usually been rather superficially treated in monographs of wider scope. For the purposes of an overall synthesis like this, it was not deemed convenient to record every South American Liassic brachiopod which has ever been figured, in order to avoid an unnecessary overburden of illdefined, dubious, unrecognizable or otherwise invalid nominal taxa, often merely backed up by poor-quality illustrations or a few lines of little descriptive value. Such drawbacks are most evident in the case of 19th-century authors (e.g. D'ORBIGNY, CONRAD, GAY, GIEBEL, GABB), but even later contributions often suffer also from insufficient or unreliable information about the geographical and/or stratigraphical provenance of the fossils concerned. As far as possible, however, the appended chart was based on personal sampling, and other Argentine collections with adequate stratigraphic control. Failing that, original information was supplemented by recent stratigraphic data from the literature. From all figured and/or described taxa, only a suite of 29 selected taxa were considered. They are each represented by several specimens that occur at more than one section or in more than a single bed. Because only a small part of MANCEÑIDO's thesis (1978) is published, it was not possible to employ the many new "manuscript" taxa names. This has been partly overcome by resorting to profuse annotations and open nomenclature. Notes by taxon number:

1. Reported by MÖRICKE (1894: 59, 99) from the "Unterer Lias" of the Copiapó region (Chile); thought by WEAVER (1942:162) to be as old as Hettangian, but by HILLEBRANDT (1971: 72) regarded as a distinctive mid- to late Sinemurian element. Indeterminate lingulids of similar age from the lower Santiago Valley, Perú, cannot be ascribed with certainty (cf. WILLARD 1966: 8–10, pl. 2, figs. 1–2).

2. The Upper Sinemurian "*Rhynchonella* cf. *tetraedra* Sow." of STEINMANN (1929: 73, text-fig. 83) from the "Kieselkalke" of the Jauja area in central Perú does not belong to SOWERBY's species, nor to the genus *Tetrarhynchia*; and is herein tentatively assigned to *Gibbirhynchia* based on its resemblance to better known European material of this genus. At least some of the Peruvian rhynchonellids figured by RANGEL (1978, pl. 4) from the Condorsinga Formation further south may also belong here.
3. Also from the "Kieselkalke" of near Jauja, central Perú, STEINMANN (1929: 72, text-fig. 82) figured a brachiopod as "*Waldheimia (Aulacothyris)* cf. *resupinata* Sow."; if indeed a zeilleriacean, it seems akin to DELANCE's (1974: 266, pl. 4, figs. 18–20) species rather than to the younger *Aulacothyris resupinata* s.s.
4. Also from the Peruvian "Kieselkalke" of another locality (near Oroya, NW of Jauja), the qualified identification by BUCKMAN (in DOUGLAS 1921: 264, pl. 15, figs. 1–6) is preferred to STEINMANN's (1929: 72, text-fig. 81) unreserved identification, bearing in mind the wider time-span of the Condorsinga Formation as a whole (Lotharingian-Toarcian) and the risks of homoeomorphy. Conversely, the material from northern Perú illustrated by WILLARD (1966: 8–11, pl. 2, fig. 3) is too poorly preserved to allow a definite opinion.
5. As broadly understood by MANCEÑIDO (1981: 647–652) it includes FUCINI's (1898) "*Spiriferina pinguis* ZIETEN var. *chilena*"; fairly long-ranging taxon, unless differences in rib density and squarish shoulders between the younger Argentine and older Chilean specimens are taxonomically significant.
6. Includes abundant material from the upper Río Salado-Cerro Puchenque area, Argentina, initially described as "*Terebratula subovoides* ROEM." by BEHRENDSEN (1891: 395). According to him, MÖRICKE (1894: 66–67) and JAWORSKI (1926: 152), was in Chile earlier misidentified as "*Terebratula ornithocephala* Sow." by BAYLE & COQUAND (1851: 18, pl. 8, figs. 12–14); umbo characters are indeed unlike most zeilleriaceans (see also PEREZ 1982, pl. 17, figs. 16–18). Internal structures indicate the *Squamiplana* plexus (MANCEÑIDO 1978: 196–205, pls. 2.38, 2.40, 2.41); allocation to subgenus is supported by examination of original material of ALMERAS & MOULAN (1982) and of BEHRENDSEN (1891).
7. Accurate stratic data are missing for these finely preserved shells; presumably Moctezuma Limestone (HARRINGTON 1961) pending field evidence and reassessment of relationships to genera such as *Exceptothyris* or *Loboidothyropsis*.
8. Material from Río Atuel, Mendoza province, figured by BURCKHARDT (1900: 26, pl. 20, figs. 3–4) as "*Rhynchonella vigilii* LEPSIUS", is certainly misidentified with an unrelated species from Toarcian-Aalenian of the Alps; apparently conspecific with "*Rhynchonella tetraëdra* Sow." of BEHRENDSEN (1891: 396) and "*Rhynchonella variabilis* SCHLOTH." of JAWORSKI (1915: 432) (cf. also MANCEÑIDO 1978: 82–89, pl. 2.22).
9. For "*Waldheimia* cf. *subnumismalis* DAV." and "*Zeilleria indentata* Sow." of JAWORSKI (1915: 434) from Río Atuel region, Mendoza, and part of "*Terebratula punctata* Sow." of WAHNISH (1942: 30–31) from Nueva Lubecka (Chubut); considered as extreme variants of a variable species as understood by DELANCE (1974: 122–139) (MANCEÑIDO 1978: 232–238, pl. 2.46, figs. 1–8).
10. For "*S. rostrata* SCHL." of BURCKHARDT (1900: 23, pl. 19, fig. 8) from Río Atuel region, Argentina, and (?) "*Spirifer linguiferoides*" of FORBES (1846: 267, pl. 5, figs. 17–18) from Chile (MANCEÑIDO 1981: 630–636).

Chart 8



11. Includes JAWORSKI's (1926: 145–146) "*Rhynchonella furcillata* THEOD."; genus also recognized in the Piedra Pintada area, Neuquén province (MANCEÑIDO 1978: 131–132, pl. 2.27, fig. 11).
12. Only from Cerro Puchenque area, Mendoza province.
13. Usually misidentified as "*S. rostrata*" in many Argentinian references; also for "*Spirifer tumidus* VON BUCH" of BAYLE & COQUAND (1851: 19–20, pl. 7, fig. 11) from Chile; recently revised by MANCEÑIDO (1981: 637–640, pl. 2, figs. 1–7).

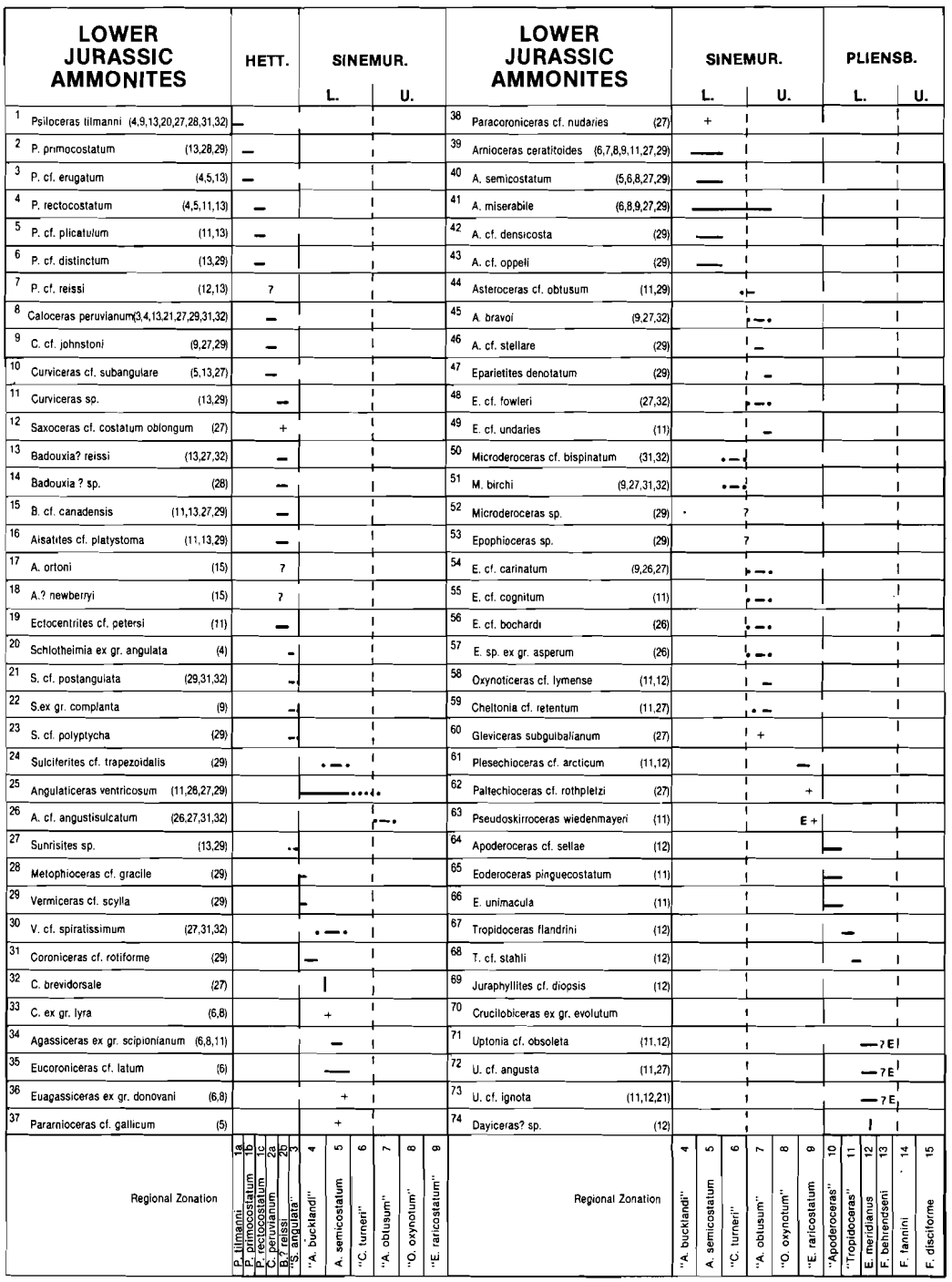
14. Mainly for "*Rhynchonella tetraedra* (Sow.)" of Weaver (1931: 172–174) from Cerro Lotena area, Neuquén province (see Manceñido 1978: 105–116, pl. 2.27); "*Quadratirhynchia*" of Pérez (1982, pl. 12) from Quebrada Asientos, Chile, and of Manceñido & Damborenea (1984, pl. 1, fig. 14) from north of Esquel, Río Negro province, need revision.
15. "*Rhynchonella tetraedra* Sow." of Burckhardt (1900: 22, pl. 19, figs. 3–4) from Cerro Puchenque region, Mendoza province and at least part of "*Rhynchonella variabilis* Schl." of Weaver (1931: 117–178, pl. 12, figs. 33–36) (see Manceñido 1978: 117–123, pl. 2.28); closely related to Davidson's species. Also known from San Juan and Neuquén provinces.
16. For "*Terebratula (Waldheimia)* cf. *punctata* Sow.", "*T. subovoides* var." and "*T.* cf. *subnumismalis* Dav." of Behrendsen (1891: 395–396), from Upper Río Salado area, Mendoza province, and "*Waldheimia punctata* Sow." of Burckhardt (1900: 26, pl. 20, figs. 1–2) from Río Atuel (Manceñido 1978: 209–216, pl. 2.42).
17. "*Terebratula punctata* Sow." of Weaver (1931, pl. 12, fig. 37) from Cerro Lotena area, Neuquén province, and of Pérez (1982, pl. 16, figs. 1–3) from Quebrada Asientos, Chile, show incipient biplication more reminiscent of Davidson's species (cf. Manceñido 1978: 175–184; Almeras & Moulan 1982: 111–135), especially extreme forms such as *L. subpunctata hispanica* (Dubar). Specimens bearing a plano-plicate or even recti-marginate commissure are also known from Argentina.
18. Area of Piedra Pintada, Neuquén province; perhaps also congeneric with "*Terebratula perovalis* Sow." of Wahnish (1942: 28–30, pl. 1, fig. 3) from the middle Lias of Nueva Lubecka, Chubut province.
19. Includes part of "*Terebratula punctata* Sow." of Wahnish (1942: 30–31) from Nueva Lubecka, Chubut province. Also Mendoza and Neuquén provinces (see note 6).
20. For some Chilean forms (Perez 1982, pl. 17) and well-preserved material from Piedra Pintada, Argentina (Manceñido 1978: 97, pl. 2.25, 2.26).
21. For "*Homoeorhynchia* (?) cf. *lineata* (Young & Bird)" of Volkheimer et al. (1978: 216, pl. 1, figs. 8–10); later assigned to *Rhynchonelloidea*, based on serial sections.
22. For "*Lobothyris* ? sp. II (cf. "*Terebratula" wittnichi* Choff.)" of Volkheimer et al. (1978, pl. 1, figs. 4–5) which was tentatively referred to *Lobothyris subpunctata hispanica* (Dubar) by Almeras & Moulan (1982: 125). Currently under revision. Affinities of the Chilean "*Terebratula" copiapensis* Möricke (1894: 63–64, pl. 2, fig. 5) remain also uncertain.
23. "*S.* aff. *tumida* (v. Buch)" of Volkheimer et al. (1978, pl. 1, figs. 6–7).
24. Described by Möricke (1894: 60) from the Lautaro Formation in the Copiapó region, of Chile; awaiting proper illustration. Possibly also present in Argentina.
25. With a wide range of variants in Argentina, some approaching Jaworski's (1926: pl. 4, fig. 20) illustrations from Cerro Puchenque, Mendoza province; Weaver's record (1931: 180–181) from Río Atuel region is based on distorted material; material of Feruglio (1934: 55, pl. 4) from "Horizon N°4." of Rio Genua north of Nueva Lubecka, Chubut, is fragmentary; better preserved specimens are known from Chacay Melehue to Cerro Lotena areas, in Neuquén province (cf. Manceñido 1978: 184–189, pl. 2.37, figs. 1–5). Perhaps comprising part of *T. copiapensis* Möricke in Chile.

26. Includes the forms compared by VOLKHEIMER et al. (1978: 216, table 2) with *Homoeorhynchia cynocephala* (RICHARD).
27. Occurs in Cerro Lotena area, Neuquén province, and between upper Río Salado and Cerro Puchenque, Mendoza province.
28. Originally described from the "Oolitique moyen" of Doña Ana, Chile, suggestive of Bajocian or Dogger, was later found in the same area in the Punilla Formation, which was referred to the upper Lias-lower Bajocian (THIELE 1964: 161, 193–197, pl. 4, fig. 8); MÖRICKE (1894: 64, pl. 2, fig. 2) included additional material from the Toarcian of Copiapó, Chile, yet the age is somewhat uncertain (HARRINGTON 1961: 178; RANGEL 1978, pl. 44, fig. 6; PÉREZ 1982, pl. 17, figs. 1–3); possible relationships to *Monsardithyris* gr. *catzigrasae* should be explored, and material outside type area may not be conspecific.
29. For "*Rhynchonella vilsensis* OPPEL" of JAWORSKI (1926: 146–147, pl. 1, figs. 4 a–c), WINDHAUSEN (1931, pl. 26, fig. 9) and WEAVER (1931: 174–175, pl. 12, figs. 31–32); reference to this Callovian species from the Alps is misleading.
Note – Pending confirmatory evidence, TILMANN's (1917) report of "Liassic" brachiopods from drift boulders in central Perú, have been left aside because most are suspect of being (late) Triassic (MANCEÑIDO 1981: 654). Likewise, the records of *Lingula* sp. and *Orbiculoidea annae* FERUGLIO (1934) from Río Genua, north of Nueva Lubecka, Argentina, are also rejected, because "Horizon N°1" is not early Jurassic but late Palaeozoic.

Ammonites (by HILLEBRANDT)

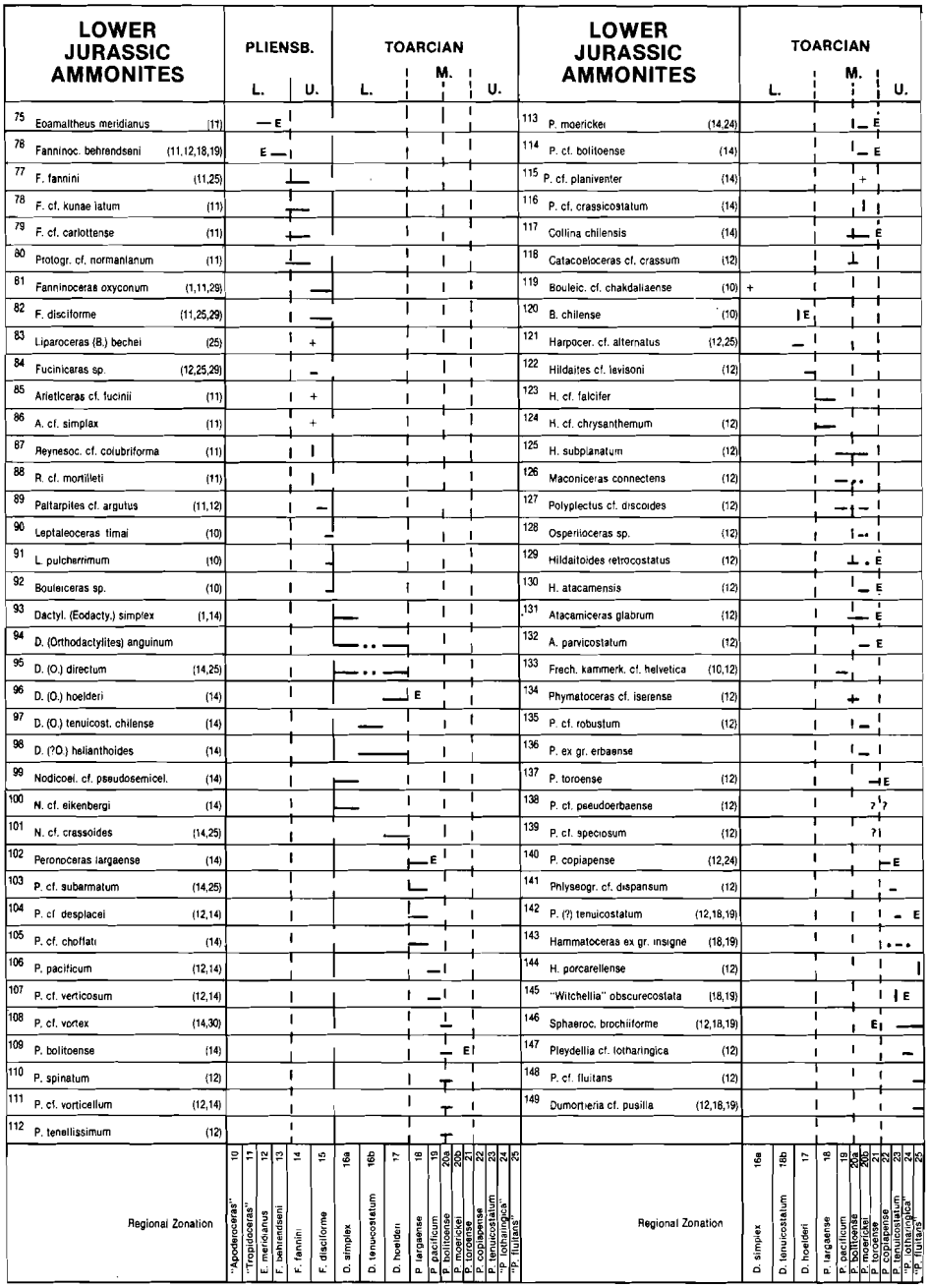
1. Coiling in *Psiloceras tilmanni* and *P. planorbis* are very similar; cross-section and septal suture of *P. planorbis* are unknown. Consequently *P. tilmanni* is retained. *P. pacificum* from North America is very similar.
7. *P.* cf. *reissi* figured by v. HILLEBRANDT (1987) probably does not belong to *Badouxia*? and is distinguished by morphology and suture with phylloid saddles.
8. Badly preserved and mainly crushed specimens of *C. peruvianum* are difficult to distinguish from *P. rectocostatum*; in both species density of ribs is variable and, especially, the cross-section differs.
10. Found together with other species of *Curviceras* which are not yet described.
11. Homeomorph to *Storthoceras haploptychum* which has a much more complicated suture. Described by ESCOBAR (1980) as *Schlotheimia* cf. *angulata*, but figured specimens show ribs without ventral interruption.
13. Genus questionable; *Discamphiceras* is similar in morphology but has a more complicated suture.
75. *E. meridianus* and *F. behrendseni* are phyletically connected; *Galaticeras* (?) sp. of v. HILLEBRANDT (1987) is an intermediate form.
90–92. Was named for "*Bouleiceras*" sp. of v. HILLEBRANDT (1973) by WIEDENMAYER (1980, p. 137).

Chart 9



A. v. Hillebrandt

Chart 10



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