THE EMERGENT LITTORAL DEPOSITS IN FUERTEVENTURA AND THE EVOLUTION OF THE CANARIAN MARINE FAUNAS DURING THE QUATERNARY

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ABSTRACT

K/Ar ages (MECO and STEARNS, 1981) and paleontological determinations (MECO, 1975,1977,1981,1982,1983) show that "Quaternary" (CROFTS, 1967, LECOINTRE,TINKLER and RICHARDS, 1967) littoral deposits on Fuerteventura are early Pliocene. Upper Pleistocene and Holocene strand lines are represented by two episodes of marine transgression, the Jandian and the Erbanian.

The type locality of the Jandian is Las Playitas, on the southeast coast of Fuerteventura. Basal white sandstone is overlain by conglomerate with abundant basalt clasts in a white sandstone matrix. Both are fossiliferous, whith abundant *Strombus bubonius* and other elements of a Senegalese fauna. Jandian deposits reach a mean altitude of +5-6m above present M.S.L. The type locality of the Erbanian is La Jaqueta beach, near the middle of the south coast of Fuerteventura. Erbanian deposits are conglomerates with a mean altitude of +4-5m above present M.S.L. Contained fossils are forms now occuring in the Canary Islands, among which *Cerithium vulgatum* is predominant; Senegalese forms are absent. (MECO, POMEL, AGUIRRE and STEARNS, 1986,1987).

The Canarian zone is specially sensitive to climatic changes. The study of evolution of its marine fauna fossil shows: a reduction in the number of species during the Quaternary, predominance of few species made up of many specimens, disappearance of Bivalvos as the principal species, The arrival of the Senegalese species during the Jandian accompanied by a increasse an the number of *Patella* and *Thais haemastoma*, the Holocene explosion of the *Cerithium vulgatum*. The faunas indicate a climatic similar to the present except during the Jandian.

THE PLIOCENE PLATFORM DEPOSITS OF EASTERN FUERTEVENTURA

The emergent littoral-marine deposits on Fuerteventura belong to two principal groups: early Pliocene deposits on elevated coastal platforms and recent Quaternary at modest elevations in topographic situacions comparable to modern beach deposits.

In Cliff exposures along the NW coast of Fuerteventura, from Aljibe de la Cueva to Jandía, a prominent unconformity separates older rocks of the "basement complex" from younger shallow-water marine deposits; alluvial deposits and/or lavas of Pliocen and Pleistocen basalts. The surface of unconformity is very probably exposed, but it is not likely anywhere to exceed +40 to +50 m. In the coast, elevation of the unconformity ranges from +7 to +16m, in part because of iregularities in the surface, in part because of variations in distance from inner margin, and in part because of gentle warping.

CROFTS (1967) assigned these marine conglomerates to a series of "raised beaches" and suggested altimetric correlations with the Pleistocene succesion of the Atlantic coast of Morocco. His observations were included in a summary report on the Canary Islands (LECOINTRE, TINKLER and RICHARDS, 1967).

Fossiliferous marine conglomerates at Aljibe de la Cueva are clearly littoral. Beach ridges can be identified. They were variously assigned to +7m, +10m, and +16m "beaches" by (CROFTS in 1967). Nevertheless, they constitute a single stratigraphic unit, deposited near, and at the limit of, a single episode of transgression which only partially submerged a preexisting platform. (MECO and STEARNS, 1981). They contain a characteristic fossil assemblage (MECO, 1975, 1977, 1981, 1982, 1983): Strombus coronatus Defrance (reported as Strombus bubonius in CROFTS, 1967), Rothpletzia rudista Simonelli (endemic fossil heretofore know only from the "Miocene" of Gran Canaria (i.e. early Pliocene)), Ancilla glandiformis (Lamarck), Conus mercati Brochi, Nerita emiliana Mayer, Patella ambroggi Lecointre, Chlamys pesfelis (linne), Hinnites encorlanianus Cocconi, Gryphaea virleti (Deshayes), Lucina leonina (Basterot), etc.

Littoral conglomerate is younger than the main mass of flows on the north side of the Barranco de Los Molinos (10 km to S. of Aljibe de la Cueva) (4.25 my) and older than the capping flows in the Barranco de Esquinzo (1.83 my) and in the Barranco de la Cruz (2.7 my), from which it is separated by several meters of alluvial and eolian deposits (MECO and STEARNS, 1981).

It is thus Pliocene.

UPPER PLEISTOCENE MARINE DEPOSITS: THE JANDIAN (LAS PLAYISTAS), TYPE LOCALITY. (Figs. 1 and 2)

Due to the remoteness of the Canary Islands, and also to its Atlantic condition, Mediterranean terminology cannot be properly used for strand lines. On the other hand, Africa is just about a hundred kilometres away from Fuerteventura, but the rich Senegalese fossil fauna, existing in the Canaries, with abundant Strombus bubonius unknow in the marine Quaternary of the African Atlantic coast, of the north of Senegal, would distort the meaning of Moroccan terminology.

When the criterion of the height of the deposits with regard to the present M.S.L. was applied to the Canaries, Pliocene deposits were wrongly considered as Quaternary (MECO and STEARNS, 1981). On the other hand, some common litological and paleontological features occur in the deposits of the different islands. All this justifies the convenience of creating a proper terminology for the faunistic-climatic episodes of the recent Quaternary marine deposits of the Canaries, avoiding thus beforehand correlations with remote or very different deposits.

The Jadian can also be called deposits with Strombus bubonius though this should not imply anything but a warm climate. Strombus bubonius have been extruded by the sea from Jandian deposits appearing in the modern berm, and the same thing could have happened at the erosional marine surface filling in the Erbanian (Canarian holocene marine deposits). Jandian and Erbanian are defined by MECO, POMEL, AGUIRRE and STEARNS (1986, 1987).

At the bottom of Jandian deposits, we can always find a very cemented light-coloured sandstone, generally visible at low tide even in some scattered localities (Maspalomas on Gran Canaria, Matasblancas on Fuerteventura, Matagorda on Lanzarote). It can only be seen on some occasions, as it frequently remains covered by the sand of present beaches, which can reach up to 2 m in Maspalomas on certain days.

A thin section study of this sandstone (BLANC in MECO et al., 1986, 1987) proves that the deposit is marine, shallow, littoral and originated in unsteady and oxygenated waters. It contains organic remains, mainly all kind of algae, part of which are micritized in a

marine environment. A partial dissolution of the cement shoes a later emersion. The beginnig of cementation was in a phreatic environment and there are vestigial remains of a grey marine magnesian calcite cement. The Sandstone contains very few Strombus bubonius.

Over the sandstone appears conglomerate which represents the "transgressive maximun" and reaches 2 to 3 m above the present berm, though its bottom is at about the zero level. Its height above M.S.L. is +5-6 m and varies slightly depending on the area. The conglomerate is composed of rounded and subrounded basaltic clasts. Its cement contains a high proportion of light-coloured elements. It does not contain sandstone boulder clasts. All this suggest that the Jandian transgression started with the rapid redistribution of a huge amount of sand, and not much later the conglomerates originated by the erosion and rounding of basalt cliffs (similar to present conglomerates of Aljibe de la Cueva), wich of course took longer, marking the end of the transgression. The conglomerate contains abundant Strombus bubonius, sometimes in hundreds, as it occurs at the locality of Matas Blancas. At the back of the berm, the conglomerate is not usually cemented and merges into sandy clayey continental elements; it is the storm level, where a very abundant fauna appears, the number of species being relatively low. The fauna collected at Las Playitas, protected by colluvion, is the same kind found at other Jandian sites, but here the fauna has not undergone further mixtures. This fauna contains a fourth part of Senegalese species presently absent in the Canaries. The Strombus bubonius represents over 6%. Other warm elements are Conus testudinarius (almost 14%), Harpa rosea ... One of the most abundant is Thais haemastoma, but this species, though living at present in the Gulf of Guinea, also exists in the Canaries and the Mediterranean; its presence does not infer a warm episode. However, an increase in the population is noticeable during the Jandian and some of its morphological features can be related to Senegalese populations. Besides, Siderastraea radians, an Equatorial Atlantic coral, appears (ZIBROWIUS & BRITO s classification). The prominent group is the one of the Patella (almost 56%).

The Jandian, considering the meaning of its fauna, is related to Eemian and out of radiocarbon range (Patella at the Jandian type locality Las Playitas is 45.000 B.P., GIF-7319, G. DELIBRIAS). In Fuerteventura, a lava flow from the Montaña Arena volcano, dated by thermoluminiscence as younger than -51.000 years- (POMEL et al 1985) reaches a beach with Patella, at El Cotillo, also dated 35.000 BP (GIF-5347). On the other hand, at La Playa del Hombre, in Gran Canaria, a flow of lava

overlaying presumably Jandian marine deposits, has been dated 94.6x10^3 ± 11x10^3 by thermoluminiscence (Cler. 48TL, POMEL et al. 1985).

HOLOCENE MARINE DEPOSITS: THE ERBANIAN (LA JAQUETA, TYPE LOCALITY) (Fig. 3)

The Erbanian takes its name from Erbania, the former name of Fuerteventura. Its type locality is La Jaqueta, in the middle of the southern coast of the Island. It is also present at Las Playitas and generally at all sites where the Jandian has been preserved. The Erbanian, in spite of having some beach-rocks, visible at low tide, is formed by conglomerates, which contain boulder clast from Jandian sandstone and dark cement. The Erbanian desposits lay directly over continental deposits. The Erbanian sea carved a notch in the cliffs and a coastal erosion platform on the Jandian conglomerates. The Erbanian berm is about 0.5m below the Jandian one and its height is 4-5 m above present M.S.L.

The fauna, analogous to the extant one in the Canaries, is characterized by the abundance of Cerithium vulgatum, reaching the rate of 70% in the collected samples, and by the decrease of Patella (11%) and Thais haemastoma (2%).

The Erbanian has been dated 1400 ± 70 B.P. (GIF-7039), 1326 ± 151 B.P. (LGQ 82, Cerithium) and 1204 ± 149 B.P. (LGQ 83, Patella). The results suggest the existence of high stand deposits of beach ridge. This indicates either a rise in the Canarian sea-level during the seventh century or an increase in the frequency of tempests, resulting into the building of a beach ridge.

THE EVOLUTION OF MARINE FAUNAS IN THE CANARY ISLANDS DURING THE QUATERNARY (Figs. 4 and 5)

Marine deposits are found in Agaete (Gran Canaria). Its age, deduced from its position between the basaltic flows, its height nearly 100 m above the present sea-level, and its fauna, may correspond with a marine transgression at the beginning of the Lower Pleistocene or of the beginnig of the Middle Pleistocene.

The fauna studied by LECOINTRE (1966) and that later collected by MECO contais an enormous number of Glycymeris bimaculata (Poli). Pecten jacobaeus (Linne) is present. The fauna does not have characteristical

species of the Pliocene or Patella (various species) which will be so abundant later in the Recent Quaternary. The other species are represented by fewer individuals and still exist in the Lusitan Atlantic.

On the north coast of Gran Canaria (Arucas) there are also marine deposits of the Middle Pleistocene. These deposits are covered by a tephritic flow from the Arucas Volcano. It has been dated by k/Ar ages as 0.297-0.326 ± 0.30 my (LIETZ and SCHMICKE, 1975). Its height above the present sea-level is 35 m. Its fauna contains numerous Patella and less frequently Cerithium vulgatum Bruguiere, Littorina striata King and Monodonta turbinata Born. Thais haemastoma linne is very rarely found. Its principal features are the presence of Nucella plessisi (Lecointre), well know fossil of the Moroccan Pleistocene marine deposits, and above all the lusitan character of each of the species. This corresponds with of a warm climate, similar to present, but not hot enough to permit the arrival of the Senegalese species.

It is notable that the Patella is very variable in its decoration. There are Patella without ribs and an oval form, with wide ribs alternating with thin ones, it is star-shaped, and finally with numerous ribs of the same size. There are also all the intermediate stages. The original form could be as the most similar to that of the ancestor of the Lower Pliocene of the Canaries and North Africa the Patella ambroggii Lecointre. The Patella will be even more numerous and as variable in the Jandian deposits. The different forms of Canarian Patella have been attributed to various species of complicated synonymys. LECOINTRE (1966) mentions Patella oculus Born and Patella longicosta Lamarck which can be found alive today in South Africa but it is only a case of morphological convergence.

The fauna of the Jandian deposits shows the increase of Patella and Thais haemastoma (Linne) concurring with the arrival of Senegalesse fauna (Conus testudinarius Bruguiere, Strombus bubonius Lamarck, Harpa rosea Lamarck, Siderastraea radians (Pallas). On the other hand, Cerithium vulgatum Bruguiere almost completely disappears. It is remarkable that the number of species is very low. 95 % of the specimens belong to only five different species.

The fauna of the holocene marine deposits (Erbanian) is made up of at least thirty species and nearly three quarters of the individuals belong to Cerithium vulgatum Bruguiere. The Patella has been reduced to a tenth part. Thais haemastoma (Linne) is

represented by two per cent as in the marine deposits of the Middle Pleistocene of the Arucas coast. The senegalese elements have totally disappeared.

However many problems remain, especially chronological ones. A programme has still to be organised to date by U/th, K/Ar, Oxygen isotopes and radiocarbon. A comparison of the sea-levels of the Canary Islands with these of the Western Sahara should be done

	Lower Pleistocene	Middle Pleistocene	Jandian Upper Pleistocene	Erbanian Holocene
Locality	AGAETE	ARUCAS COAST	LAS PLAYITAS	LA JAQUETA
Number of samples	uncounted	4.412-2.427	1.237	2.287
Glycymeris bimaculata	numerous	0.	0.	0. %
Venus verrucosa	numerous	0.	0.41	0.22
Pecten jacobaeus	few	0.	0.	0.
Patella	0.	22.91-41.66	55.77	11.02
Thais haemastoma	0.	0.64- 1.15	16.43	1.97
Vermetus	very few	1.50- 2.72	2.85	0.04
Conus testudinarius	0.	0.	13.59	0.
Strombus bubonius	0.	0.	6.17	0.
Erosaria spurca	0.	0.	0.16	1.35
Conus mediterraneus	frequent	0.	0.	2.62
Cerithium vulgatum	0.	14.78-21.10	0.	70.27
Monodonta	0.	6.80-10.96	0.49	0.09
Columbella rustica	few	0.77- 1.40	0.	3.89
Total	-	47.40-78.99	95.87	91.47

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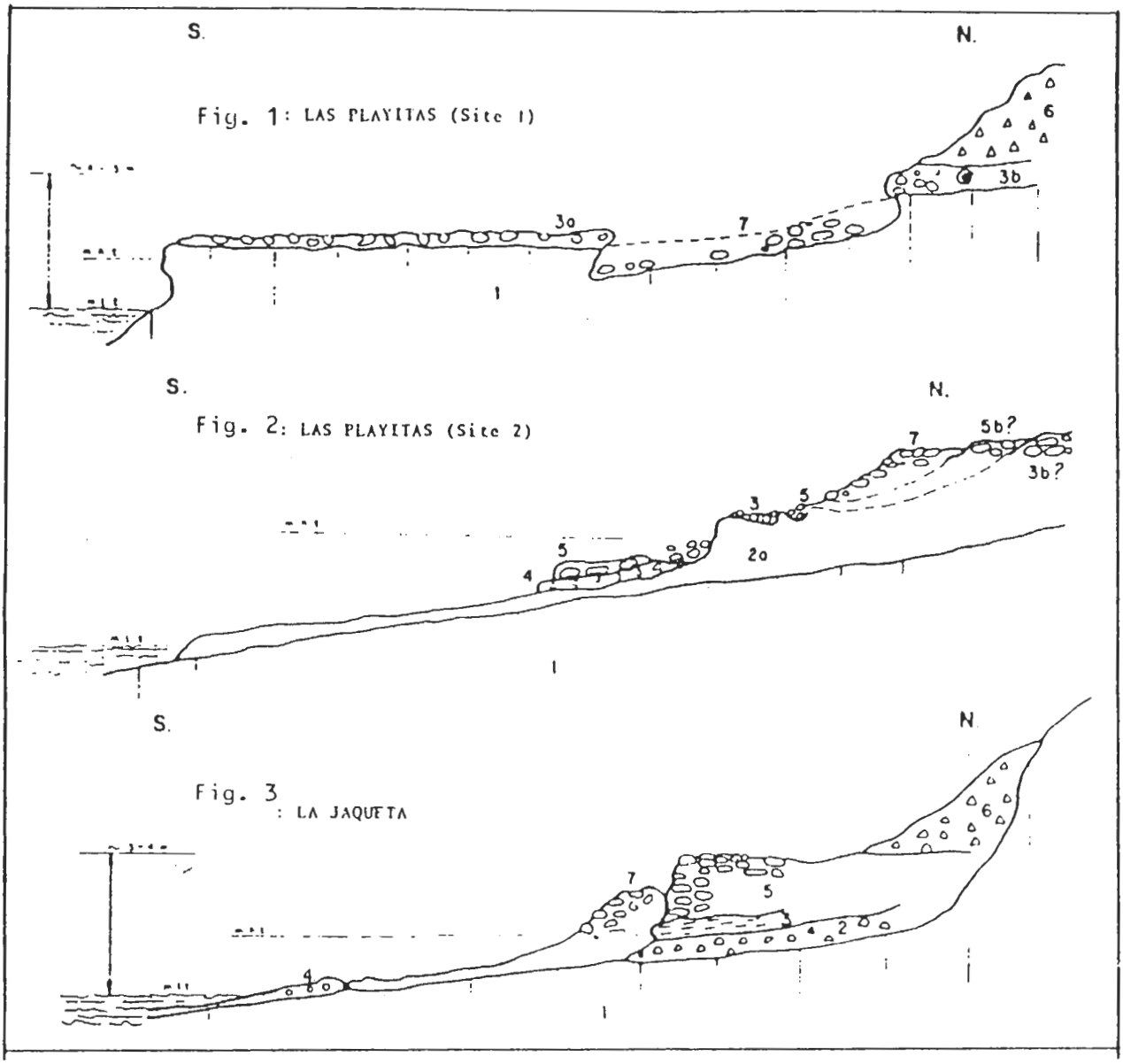


Fig. 1: LAS PLAYITAS (Site 1)

Fig. 2: LAS PLAYITAS (Site 2)

Fig. 3 : LA JAQUETA

LAS PLAYITAS SECTIONS (Site 1 in the west end of the beach, and site 2 at 200m east)

1.- Miocene basalts.
2.- Sandstone bearing *Strombus bubonius* (Jandian sandstone).
3a.- Jandian conglomerate beleved in the Erbanian.
3b.- Conglomerate bearing *Strombus bubonius* (Jandian conglomerate).Berm and its back side (storm level) numerous fossils.
4.- Alluvial. Salmon coloured terrestrial deposits with sharp clasts and land gastropoda.
5.- Erbanian conglomerates containing clasts of Jandian sandstone (2), and marine solution pools filling related to an Erbanian berm removed at present by man (5b).
6.- Colluvion.
7.- Moderm berm.

LA JAQUETA SECTION

1.- Miocene basalts.
2.- Alluvial.
3.- Back-shore sands and silts.
4.- Erbanian beach-rock.
5.- Erbanian berm.
6.- Colluvion.
7.- Modern beach and berm.

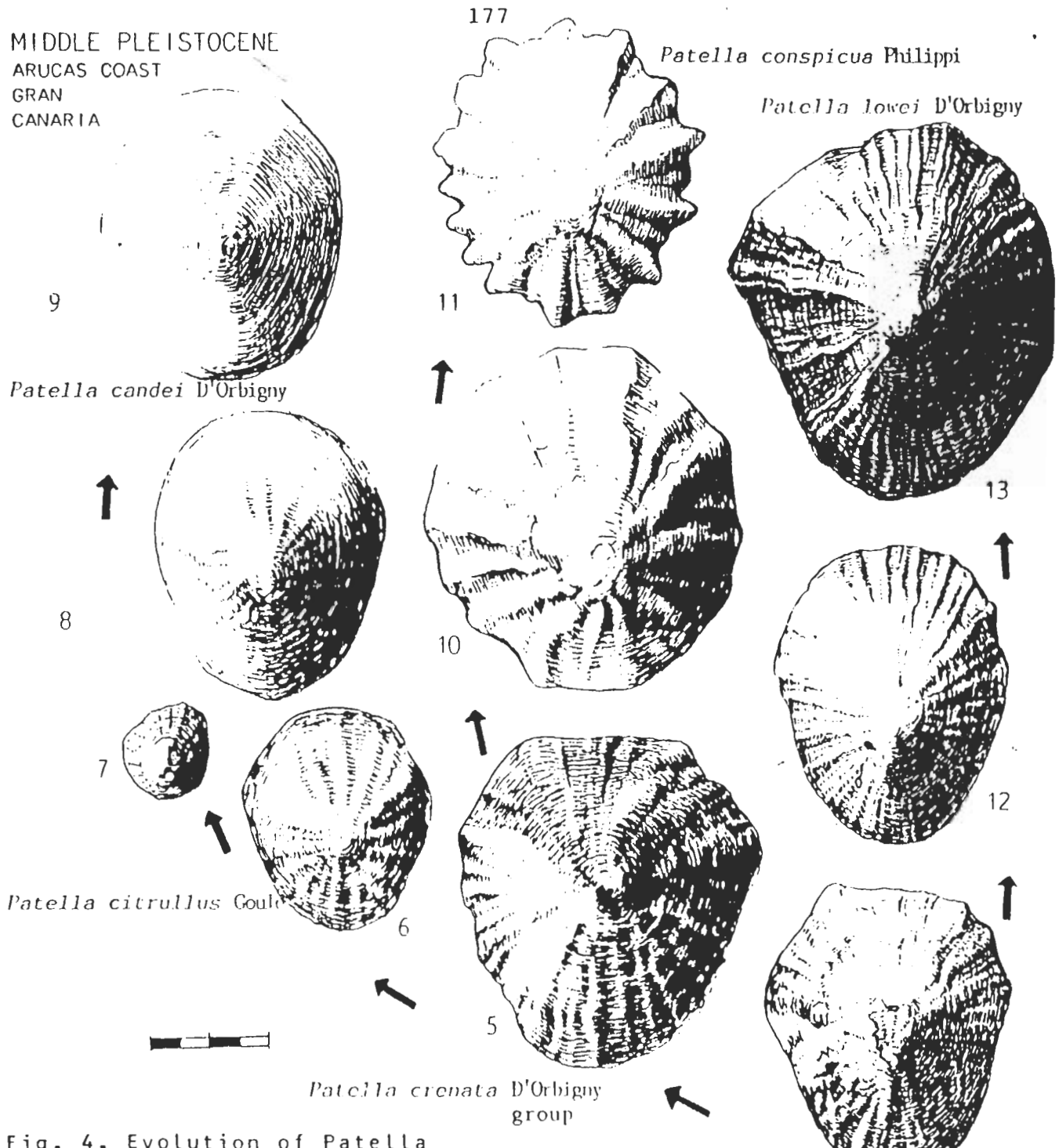


Fig. 4. Evolution of Patella

LOWER PLIOCENE

Patella ambroggi Lecointre

LAS PALMAS, GRAN CANARIA

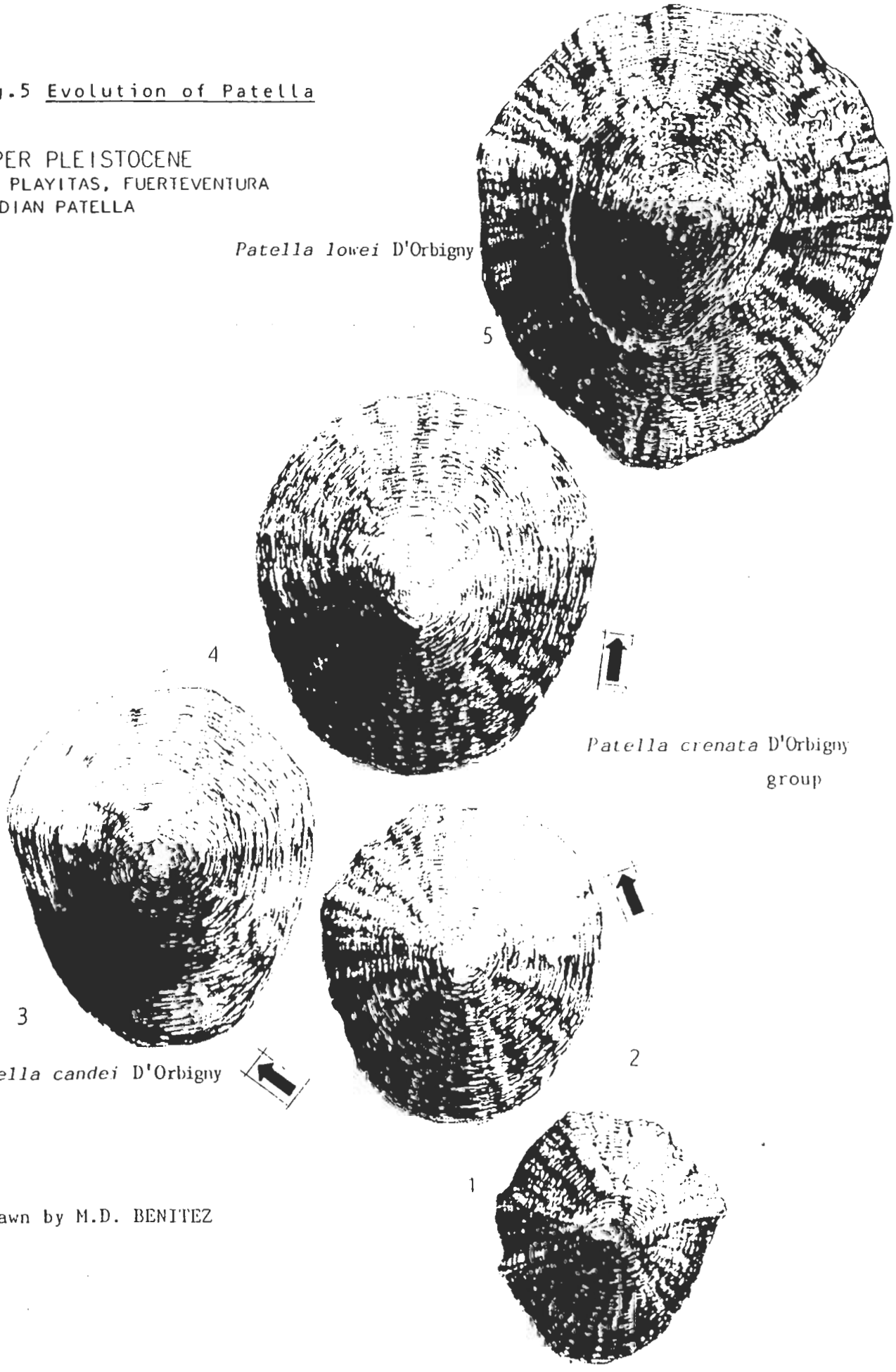
ALJIBE-CUEVA, FUERTEVENTURA

EL GARAJAO, LANZAROTE

Drawn by M.D.BENITEZ

Fig.5 Evolution of Patella

UPPER PLEISTOCENE
LAS PLAYITAS, FUERTEVENTURA
JANDIAN PATELLA



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