

STUDIES ON CRUCIFERAE: VI. GEOGRAPHICAL DISTRIBUTION AND CONSERVATION STATUS OF *BOLEUM* DESV., *GUIRAOA* COSS. AND *EUZOMODENDRON* COSS.

by

C. GOMEZ-CAMPO

Abstract. Maps of distribution are given for three Spanish-endemic monotypic genera belonging to the tribe *Brassicaceae*. The area of *Euzomodendron* Coss. seems to be linked to soil conditions, while that of *Boleum* Desv. appears to be more related to the amount of rainfall. *Guiraoa* Coss. can be viewed as an opportunistic poorly-competitive weed. From the conservation point of view, no direct threat has been detected for any of these taxa, but there are reasons whereby all should be included within the category of «vulnerable».

Resumen. Se dan mapas de distribución para tres géneros monotípicos de la tribu *Brassicaceae*, todos endémicos de España. La distribución de *Euzomodendron* Coss. parece ligada a condiciones de suelo, mientras que la de *Boleum* Desv. da la impresión de estar más relacionada con la cantidad de precipitación. *Guiraoa* Coss. podría verse como una mala hierba con poca capacidad para la competencia con otras. Aunque no parece existir ninguna amenaza directa contra ellos, los tres táxones deben incluirse dentro de la categoría de «vulnerables».

I N T R O D U C T I O N

At least five genera of Crucifers are endemic to the Iberian Peninsula i. e. *Lycocarpus* O. E. Schulz, *Teesdaliopsis* (Willk.) Gand., *Boleum* Desv., *Guiraoa* Coss. and *Euzomodendron* Coss. The last three were selected because they belong to the tribe *Brassicaceae*, a tribe whose center of variation is found in the South Western Mediterranean region. The maximum diversity corresponds to Morocco, but a good deal of it extends to the neighbouring countries, particularly Spain and Algeria. A land bridge over the strait of Gibraltar persisted until the Pliocene, and this apparently favoured the migration of much diversity toward the Southwest of Europe.

From a phylogenetic point of view, *Boleum* is obviously related to *Vella*, another genus with six representatives in the steppes and mountains of Morocco, southern and eastern Spain, and northwestern Algeria. *Boleum* seems to be somewhat more evolved, as judged by its indehiscent fruit.

Euzomodendron should definitely be included within the same group (sub-tribe *Vellinae*) as *Boleum* or *Vella*. In the three genera, the filaments of the inner stamens are united in pairs. The cotyledons show a strong tendency to be acutely notched (GÓMEZ-CAMPO, 1974). Seeds are winged only in *Euzomodendron*, but a close look at the seeds of *Boleum* or *Vella* reveals that they very often show vestigial wings. Recent studies (CLEMENTE, 1977) on the calyx and corolla of the *Brassicaceae*, fully confirm the same view. Hair type and distribution are also alike for the three genera. The fruit is longer in *Euzomodendron*, but it has robust valves with narrowed base resembling that of *Vella*.

Guiraoa (sub-tribe *Raphaninae*) is a relative of the widely distributed genus *Rapistrum* Crantz and also of a small handful of genera (*Ceratocnemum* Coss. & Balansa, *Otocarpus* Dur., etc.) endemic to Northwestern Africa.

The three taxa —*Boleum*, *Guiraoa* and *Euzomodendron*— are currently considered to be either rare or very localized, two conditions which are frequently associated with the status of «endangered». This acted as a major stimulus to undertake and to carry out the present work.

METHODS

The herbaria of Real Jardín Botánico de Madrid (MA), Facultad de Farmacia de la Universidad Complutense de Madrid (MAF), Jardín de Aclimatación de Montjuich (BCF), Istituto Botanico de Firenze (FI), Jardin des Plantes (P), University of Reading (RDG), British Museum (BM) and Royal Botanic Gardens, Kew (K) were consulted.

Extensive field work in the involved areas helped to confirm ancient localities, to score some new ones and to check the conservation situation in each case.

RESULTS

1. *Boleum asperum* (Pers.) Desv., Jour. Bot. Appl. 3; 163 (1814)

At present, only the following localities have been recorded for this species:

ZARAGOZA: Sierra del Bizcuerno (South of Caspe), 1860 (MAF); *ibid.*, 1877, Loscos (MAF); Road from Caspe to Maella, Km. 33-36, 1976, Gómez-Campo (MA); Val de Fabara (E. of Caspe), 1877, Loscos, (BCF); Barranco de Valcuerna (N. of Caspe, near Candasnos), 1948, Font Quer (MAF, BCF); *ibid.*, 1972, Cardona (BCF); *ibid.*, 1973, Fernández-Casas (MAF); North of Osera, gypsaceous hills, 1956, Sandwith (BM); South of Monegrillo, 1951 y 1954, O. Bolós & J. Braun-Blanquet (BCF): Aranda de Moncayo, 1960 (MAF).

With only the last as an exception, the above localities are placed around the sub-desertic area «Los Monegros» where the average rainfall is about 300-350 mm. *Boleum* localities are therefore sparsely distributed in a ring which stays in the 325-350 mm. rainfall area. Four of the populations are at the eastern side of this ring, and only two at the western side (Fig. 1).

Soils are of xerorendzine type, with more or less abundance of gypsum. Some of these localities, as that north of Osera, are strongly gypsaceous, often with cristalized calcium sulphate in the surface. In other places there may be a tendency to brown calcareous soils or to the presence of sandstones.

The plant was never too abundant. Only a few hundreds of individuals were growing, for instance, in La Valcuerna or in the road to Maella. Evidence for a sharp decrease in at least some populations was also found: only three plants could be seen by 1976 in the Val de Fabara, a place where *Boleum* was mentioned as «very abundant» one century ago.

Several other prospective areas were explored without success. With four other persons, a circle 20 km in diameter in the heart of Los Monegros was scanned without seeing a single plant. The species also seemed to be absent in the area immediately north of Caspe (El Sable area) or immediately west of that city (Chiprana area). Ochoa, who

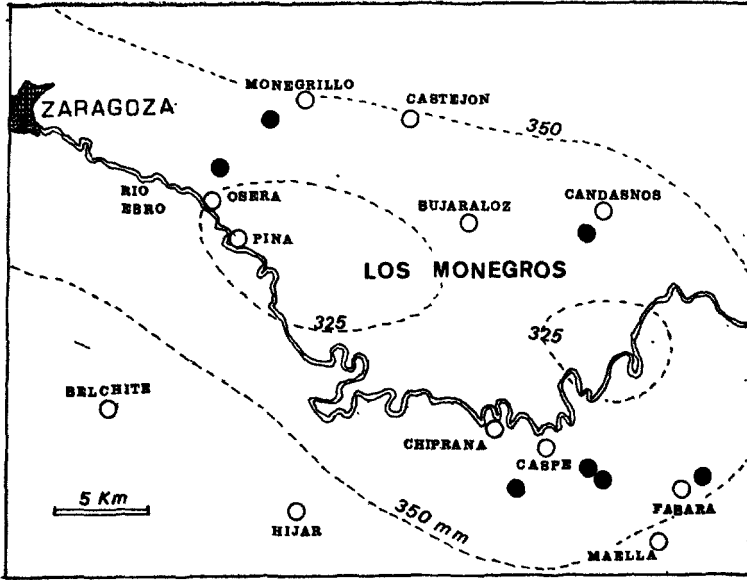


Fig. 1.—Distribution of *Boleum asperum* (Pers.) Desv.

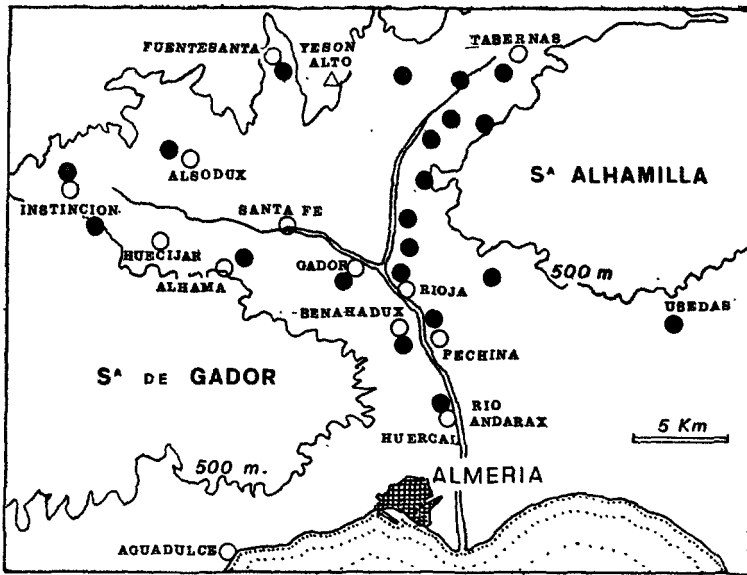


Fig. 2.—Distribution of *Euzomodendron bourgaeum* Coss.

has intensively worked in this region, has never found *Boleum* outside the mentioned localities (personal communication). Boldú (pers. comm.) has done a similar work in the Lérida province (East of Fabara) and expressed a similar opinion.

Aranda de Moncayo (at the west of Zaragoza city) has higher altitude and rainfall than the other localities. The author explored the area several hours without finding the plant. The record is presumably an error, but if the presence of *Boleum* can be eventually confirmed there, this would constitute an exception to the pattern described above.

The following companions of *Boleum* were recorded from La Valcuerna slopes. They include gypsophilous species and also weeds:

- | | |
|---|---|
| <i>Asphodelus aestivus</i> Brot. | <i>Plantago albicans</i> L. |
| <i>Eruca vesicaria</i> (L.) Cav. | <i>Centaurea aspera</i> L. |
| <i>Launaea resedifolia</i> (L.) O.
Kuntze | <i>Chenopodium vulvaria</i> L. |
| <i>Reseda lutea</i> L. | <i>Artemisia herba-alba</i> Asso |
| <i>Limonium echoides</i> (L.) Miller | <i>Helichrysum stoechas</i> (L.)
Moench |
| <i>Limonium catalaunicum</i> (Willk.
et Costa) Pign. subsp. <i>proc-</i>
<i>erum</i> (Willk.) Pign. | <i>Stipa parviflora</i> Desf. |
| <i>Glaucium corniculatum</i> (L.) Ru-
dolph | <i>Lithodora fruticosa</i> (L.) Griseb. |
| <i>Linum strictum</i> L. | <i>Helianthemum origanifolium</i>
(Lam.) Pers. subsp. <i>glabratum</i>
(Willk.) Guinea et Heywood |
| <i>Malcolmia africana</i> (L.) R. Br. | <i>Brachypodium distachyum</i> (L.)
Beauv. |
| <i>Erucastrum nasturtiifolium</i>
(Poir.) O. E. Schulz | <i>Dittrichia viscosa</i> (L.) Greuter |
| <i>Herniaria fruticosa</i> L. | <i>Rosmarinus officinalis</i> L. |
| <i>Teucrium polium</i> L. subsp. <i>cap-</i>
<i>itatum</i> (L.) Arcangeli | <i>Euphorbia nicaeensis</i> All. |

Between Caspe and Maella, *Boleum asperum* grows in the borders of a bushy vegetation dominated by *Rosmarinus*:

- | | |
|--|--|
| <i>Rosmarinus officinalis</i> L. | <i>oleoides</i> (L.) Jahandiez et
Maire |
| <i>Retama sphaerocarpa</i> (L.) Boiss. | <i>Helichrysum stoechas</i> (L.)
Moench |
| <i>Artemisia herba-alba</i> Asso | |
| <i>Rhamnus lycioides</i> L. subsp. | |

<i>Lygeum spartum</i> Loefl.	<i>Helianthemum squamatum</i> (L.)
<i>Oryzopsis miliacea</i> (L.) Benth.	(Pers.)
& Hooker	<i>Genista scorpius</i> (L.) DC.

In the area north of Osera, the vegetation is still more characteristic for gypsum soils:

<i>Ononis tridentata</i> L.	<i>Helianthemum squamatum</i> (L.)
<i>Lepidium subulatum</i> L.	Pers.
<i>Rosmarinus officinalis</i> L.	<i>Moricandia moricandioides</i>
<i>Sideritis scordioides</i> L. subsp. <i>ca-</i>	(Boiss.) Heywood
<i>vanillesii</i> (Lag.) P. W. Ball	<i>Linum suffruticosum</i> L.
<i>Gypsophila hispanica</i> Willk.	<i>Herniaria fruticosa</i> L.

2. *Euzomodendron bourgaeum* Coss., Not. Pl. Crit. 145 (1852)

This species is restricted to the gypsaceous soils north of Almería city. The following localities are known:

ALMERÍA: Huércal de Almería, 1931, Sennen (BCF); Pechina, 1977, Gómez-Campo (MA); Benahadux, Sagredo (pers. comm.); Baños del Chorrillo, 1977, Gómez-Campo (MA); Gádor (foothills), 1890, Porta & Rigo (MA); *ibid.*, 1931, Sennen & Pau (BCF); *ibid.*, 1944, Sennen (MAF); Cueva de Los Ubedas, Sagredo (pers. comm.); Instinción, Sagredo (pers. comm.); Illar, Sagredo (pers. comm.); between Santa Cruz and Alsodux, Sagredo (pers. comm.); between Santa Fé and Hué-cijar, 1951-52, Bourgeau (FI, P); Sierra Alhamilla foothills, between Tabernas and Rioja, 1890, Porta & Rigo (FI, P); *ibid.*, 1957, Rivas-Goday (MAF); *ibid.*, 1965, Bellot & Rivas-Goday (MAF, RDG); *ibid.*, 1969, Carreras & Valdés-Bermejo (MA, MAF); *ibid.*, 1971, Rivas-Goday & Izco (MAF); Fuente Santa, Sagredo (pers. comm.); El Tablazo, P. Rueda (pers. comm.).

The overall area has the shape of a triangle with Instinción, Tabernas and Huércal in the corners (Fig. 2). Additionally, there is an apparently discontinuous branch running eastwards through the southern slopes of Sierra Alhamilla. Beyond any doubt, the highest concentration of individuals occurs between Tabernas and Rioja, where a cluster of small populations make the plant relatively abundant. Also the northern

slopes of Sierra de Gádor contain some populations but they are rarer.

The distribution of this taxon seems to be closely adjusted to the presence of calcium sulphate in the soil. Very often *Euzomodendron* can be seen as the only colonizer of gypsum-rich clayish slopes with very active soil dynamics. The gypsum area climbs up to 400 or 500 m. of altitude in the Alhamilla and Gádor Sierras, and at least there, the *Euzomodendron* has been seen to climb too. Toward the North (Sierra de Filabres) both the gypsum and the plant vanish before reaching that altitude.

Although not fully explored, the area South of Yesón Alto hill in the center of the mentioned triangle, is very like to contain further populations of *Euzomodendron*. The species seems to be completely absent in the East of Tabernas, even though there are several other gypsaceous areas with very similar vegetation.

Some companions of *Euzomodendron* in the area of Pechina are:

<i>Stipa tenacissima</i> L.	var. <i>lagascana</i> (DC.) O. E.
<i>Lygeum spartum</i> Loefl.	Schulz
<i>Anthyllis terniflora</i> (Lag.) Pau	<i>Ephedra fragilis</i> Desf.
<i>Helianthemum</i> sp.	<i>Launaea arborescens</i> (Batt.)
<i>Andropogon hirtum</i> L.	Murb.
<i>Salsola genistoides</i> Juss. ex Poir.	<i>Ononis natrix</i> L.
<i>Artemisia herba-alba</i> Asso	<i>Limonium</i> sp.
<i>Thymelaea hirsuta</i> (L.) Endl.	<i>Sedum sediforme</i> (Jacq.) Pau
<i>Diplotaxis crassifolia</i> (Raf) DC.	<i>Frankenia corymbosa</i> Desf.

Most of these companions were also present below the Baños de El Chorrillo. One hundred meters of altitude above, in the Baños themselves, most of the species were also present on a different substrate (shales and micacites) but *Euzomodendron* was completely absent.

3. *Guiraoa arvensis* Coss., Not. Pl. Crit. 98 (1851)

This species lives in an area extending through Alicante, Murcia and Almería provinces (Figure 3) but it occurs very sparsely within it. The following localities have been compiled:

ALICANTE: Villajoyosa, 1958, Rivas-Goday (MAF); Venta de Lanuza, RIGUAL (1972); Sierra de Aguas de Bussot, 1923, Font Quer

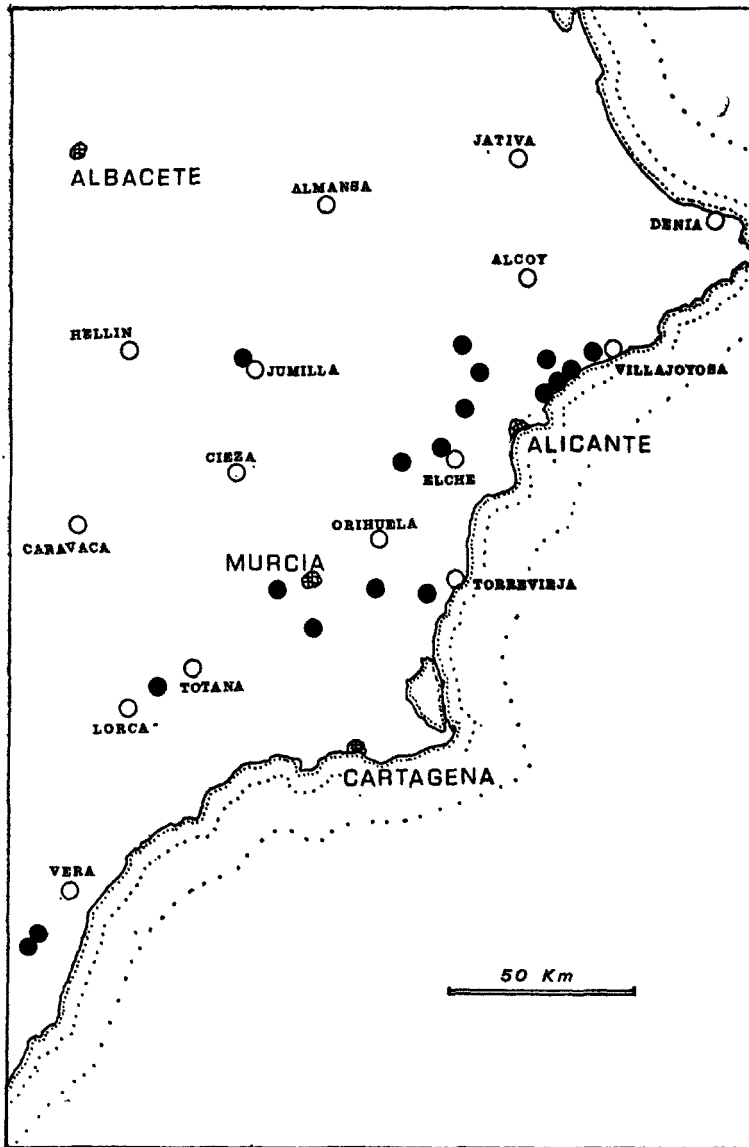


Fig. 3.—Distribution of *Guiraoa arvensis* Coss.

(BCF); *ibid.*, 1965, Rivas-Goday (MAF); *ibid.*, 1967, Rigual (RDG); El Campello, 1968, Gómez-Campo (MA); Cabeso d'Or, RIGUAL (1972); Sierra de San Pascual, RIGUAL (1972); Coveta de Fumá, RIGUAL (1972); El Maigmo, 1923, Font Quer (BCF); *ibid.*, 1928, Ellman & Sandwith (K); Pantano de Elche, RIGUAL (1972); Sierra de Crevillente, 1925, Font Quer (BCF); Sierra de Castalla, 1862, Leresche (K); San Miguel de Salinas, 1933, Ripley (K); Pujalv  rer, Canada (in WILLKOMM 1893). MURCIA: Jumilla, 1850, Cosson (P); *ibid.*, 1854, Guirao (BM); Alcantarilla, ESTEVE-CHUECA (1972); Puerto de la Cadena, 1854, Guirao (K, P); *ibid.*, 1854, Bourgeau (BM, MA, P); *ibid.*, 1928, Ellman & Sandwith (BM); Lorca, Sierra de Tercia, 1928, Ellman & Sandwith (K); *ibid.*, 1883, Rouy. ALMER  A: Los Casta  os, SAGREDO (1975); Venta del Chocolate, 1974, Sagredo (MAF); R  o Aguas, 1963, Losa (MAF).

The last three localities from Almer  a are very close to each other; according to SAGREDO (1975), they correspond to a distinct infra-specific taxon. Anyway, the finding of the species in Almer  a has been an interesting event. The abundance of known populations is maximum in Alicante province and decreases toward Murcia.

The habitat is variable. Though saline or gypsaceous soils are very common in the whole area, *Guiraoa* can grow on a diversity of substrates. It can be found, for instance, on saline soils near the sea level in Venta de Lanuza. Only 40 km away it reaches 1.300 m of altitude near the summit of El Maigmo where it grows on calcareous stony slopes. Most often it behaves as a weed in roadsides or cornfields, but this is not always the case. In Venta de Lanuza, for instance, it can be found in association with the arbustive vegetation of *Globularia alypum* L. and *Salsola genistoides* Juss. ex Poir. Under such conditions, the height of the plant only rarely surpasses 30-50 cm. However, it can reach 1,6-1,8 m in the street sides of a neighbouring touristic urbanization.

Some evidence for sharp decreases in population density has been found in at least two cases. In Jumilla (Murcia) the place where the species was first collected, an intensive search of three days in 1966 was completely unsuccessful. According to some local informers, it seems that the last individual was seen some twelve years before. Another one-day search in Pujalv  rer area yielded the finding of a single small individual. On the contrary, exploding populations have

been observed in the embankments of new roads in the east Alicante area (El Campello and Venta de Lanuza). Such populations are, however, ephemeral. *Guiraoa* seems to play the role of an initial colonizer that soon gives way to other species.

A wide road embankment near El Campello was almost exclusively occupied by *Guiraoa* in 1968. Only nine years later, *Guiraoa* was completely absent, its place being occupied by the following vegetation:

<i>Andropogon hirtum</i> L.	<i>Thymelaea hirsuta</i> (L.) Endl.
<i>Dittrichia viscosa</i> (L.) Greuter	<i>Globularia alypum</i> L.
<i>Cheirolophus intybaceus</i> (Lam.) Dostál	<i>Psoralea bituminosa</i> L.
<i>Anthyllis terniflora</i> (Lag.) Pau	<i>Helichrysum stoechas</i> (L.) Moench
<i>Anthyllis cytisoides</i> L.	<i>Stipa tenacissima</i> L.

A similar substitution has started in the embankments of the new highway Alicante-Valencia, near Venta de Lanuza. *Guiraoa arvensis* and *Moricandia arvensis* were the only colonizers in 1975. By 1977 the diversity had increased significantly with the introduction of *Oryzopsis miliacea* (L.) Benth. & Hooker, *Halogeton sativus* (L.) Moq., *Sal-sola kali* L., *Carrichtera annua* (L.) DC., etc.

DISCUSSION

The three genera selected for this study may represent three different situations from both the ecological and the conservational points of view. The correlation between the presence of *Euzomodendron* and the distribution of gypsum soils in the area north of Almería, is evident. In turn, the area of *Boleum* can be tentatively related to a certain level of rainfall, as the localities so far known are in the borders of Los Monegros, an extension with minimum precipitation. Soil and rainfall might be the major factors defining the area of distribution of these two genera. On the contrary, *Guiraoa* seems to be somewhat less strict for soil or climate requirements, but probably more susceptible to the competence of other plant species. It can apparently survive in sparse localities as a marginal component of the vegetation, and use temporal opportunities to multiply, whenever deep habitat disturbances occur. But still, its success is rather limited, since it is very far from being a common weed in the region.

It is estimated that none of the three taxa fall within the category of «endangered» which is defined by the International Union for the Conservation of Nature (Threatened Plants Committee) for those species subject to a direct threat or those where recent sharp decreases in number of individuals have been reported. Evidence for local drops of this type has been detected in *Boleum* and *Guiraoa*, but this should have a compensation in the fact that new localities have been discovered with the effect of making the areas of distribution larger than originally reported. Ironically but logically, focusing attention into narrow endemics with conservation purposes may result in finding that the plant is more common than previously thought.

The three taxa fall, certainly, within the next UICN category of «vulnerable» species defined as «taxa believed likely to move into the endangered category in the near future if the causal factors continue operating». Factors as over-exploitation, extensive destruction of habitat, etc. are obviously present in the three concerned areas. The case of *Boleum* may be the closest to the «endangered» category. *Guiraoa* on the contrary, might be more toward the side of the next category of plants which are simply «rare» without apparent present or future threats.

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Escuela T. S. de Ingenieros Agrónomos
Universidad Politécnica
Madrid-3