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THE PRESENCE OF NYPA PALMS IN EUROPE: A SOLVED PROBLEM

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ABSTRACT

Some new evidences for the autochthony of *Nypa* palms were found during a palynological study of Eocene sediments in the Spanish Pyrenees. Percentages of *Spinizonocolpites* Muller 1968 of nearly 40 per cent, a possible phylogenetic relationship between *Spinizonocolpites baculatus* and *Spinizonocolpites echinatus* and the appearance of fossil pollen and fruits of *Nypa*, restricted to the Eocene, make it unlikely that Nypa should be transported along the shores of the Tethys Sea.

The genus Nypa, at present restricted to the mangrove environment of the Indo-Malesian region, is only represented by its fossil fruits and pollengrains in a few places in Europe during the Eocene. An extensive investigation of fossil *Nypa* fruits has been published by Tralau in 1964. He noted the geographic distribution along the shores of the former Tethys and adjoining seas (S. England, Belgium, France, N. Italy, S. Poland, N. Hungary and W. Russia). Fossil *Nypa* fruits occur in Europe exclusively in the Eocene. From the Palaeocene only one single specimen: *Nypa pernambucensis* Dolianiti 1955 was found in Brazil.

The pollengrains of *Nypa* have not yet been recognized in Europe to the same extent as macrofossils, although Germeraad, Muller & Hopping (1968) suggest a similar geographic distribution of *Nypa* pollengrains and macrofossils. However, there seems to be a discrepancy in the European dispersal pattern of micro- and macrofossils from *Nypa*. The pollengrains from *Nypa* were described by Muller (1968) as the formgenus *Spinizonocolpites*. The occurrence of *Spinizonocolpites baculatus* Muller 1968 and *Spinizonocolpites echnatus* Muller 1968 was mentioned in the marine Ypresian deposits of S. England: Bagshot Sands and Bracklesham Beds by Durand & Olivier-Pierre (1969). Nevertheless the absence of *Spinizonocolpites* in the Eocene London Clay is surprising, because *Nypa* fruits are frequently found in these deposits.

Kedves (1960) mentioned *Monocolpopollenites nupharoides* from the Dorog Basin in Hungary, but a resemblance to the pollengrains of *Nuphar* (familia *Nymphaeacea*) is suggested. In a later publication, however, Kedves (1969) stated that there is, regarding the structure of the exine, an indisputable resemblance to *Nypa* pollen. In the Paris Basin *Spinizonocolpites* is discovered in Eocene deposits at several localities: Durand & Olivier-Pierre (1969) write about this appearance in W. France and S. England.

It is striking that *Spinizonocolpites* in European samples is always found in low percentages, but according to Kedves (1969): "it is not excluded that the hypothetical *Nypa* pollen encountered in a few per cent in the deposits, implies an extensive mangrove vegetation nearby."

Untill now there seems to be no absolute evidence for the presence of *Nypa* palms in Europe. Van

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Steenis (1962a) maintains "that the European Eocene deposits got their truly tropical component from allochthonous drift material carried by the Tethys" and (1962b): "beyond the proper thermo-ecological perimeter for germination and growth." Tralau (1964) rejects this proposition with palaeogeographical, palaeozoological and palaeoclimatological arguments. The fact that recent *Nypa* fruits do not apparently occur in reasonable quantities outside its present-day range, has also been used as an indication for the autochthony of *Nypa* palms in the European Eocene.

In the course of our palynological study of Palaeogene strata in the Ribagorzana and Isabena valleys (province of Huesca, southern Spanish Pyrenees) *Spinizonocolpites baculatus* Muller 1968 and *Spinizonocolpites echinatus* Muller 1968 were found and counted. Table 1 shows the distribution and frequency of *Spinizonocolpites* in the samples of the Montañana and Santa Liestra Formation. *Spinizonocolpites* is not found in the Palaeocene and Upper Eocene samples. The percentages of *Spinizonocolpites* are remarkably high in the Lower Eocene deposits with a maximum of 39 per cent of the total sum of angiosperms. These percentages are as high as the percentages of *Spinizonocolpites,* counted by Muller (1968) in Sarawak, Malaysia, where recent *Nypa* still grows today. The high percentages in the Spanish Eocene can probably be explained through the environment: the first *Spinizonocolpites* appears in a transitional zone between a shallow marine and a deltaic facies. In the deltaic sequence of the Montañana Formation the highest percentages of *Spinizonocolpites* were counted. The percentages are found to be lower in the floodplain deposits of the Santa Liestra Formation. Most European *Spinizonocolpites* were counted in shallow marine deposits and, accepted that *Nypa* palms are autochthonal, this environ-

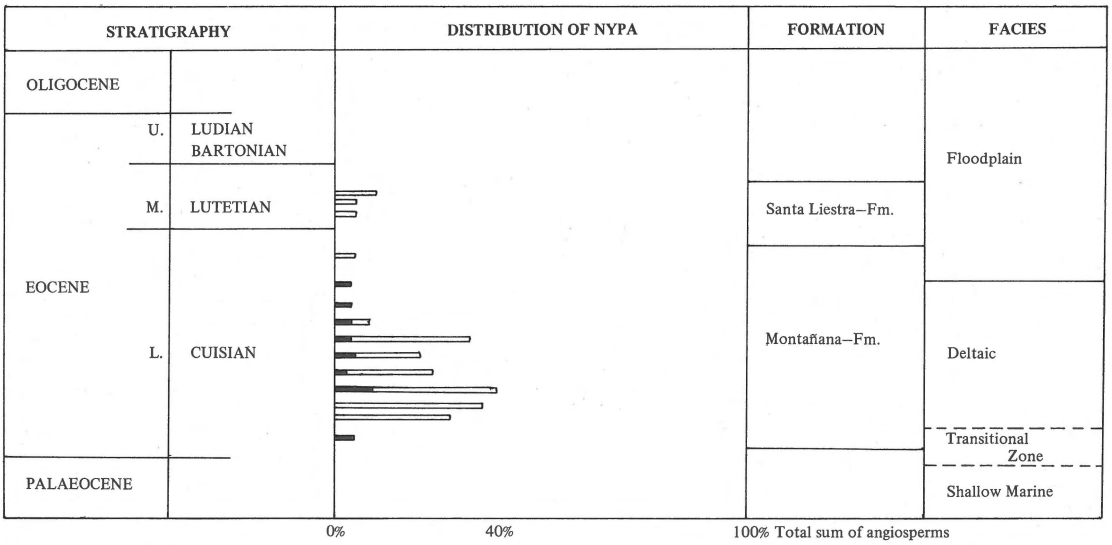
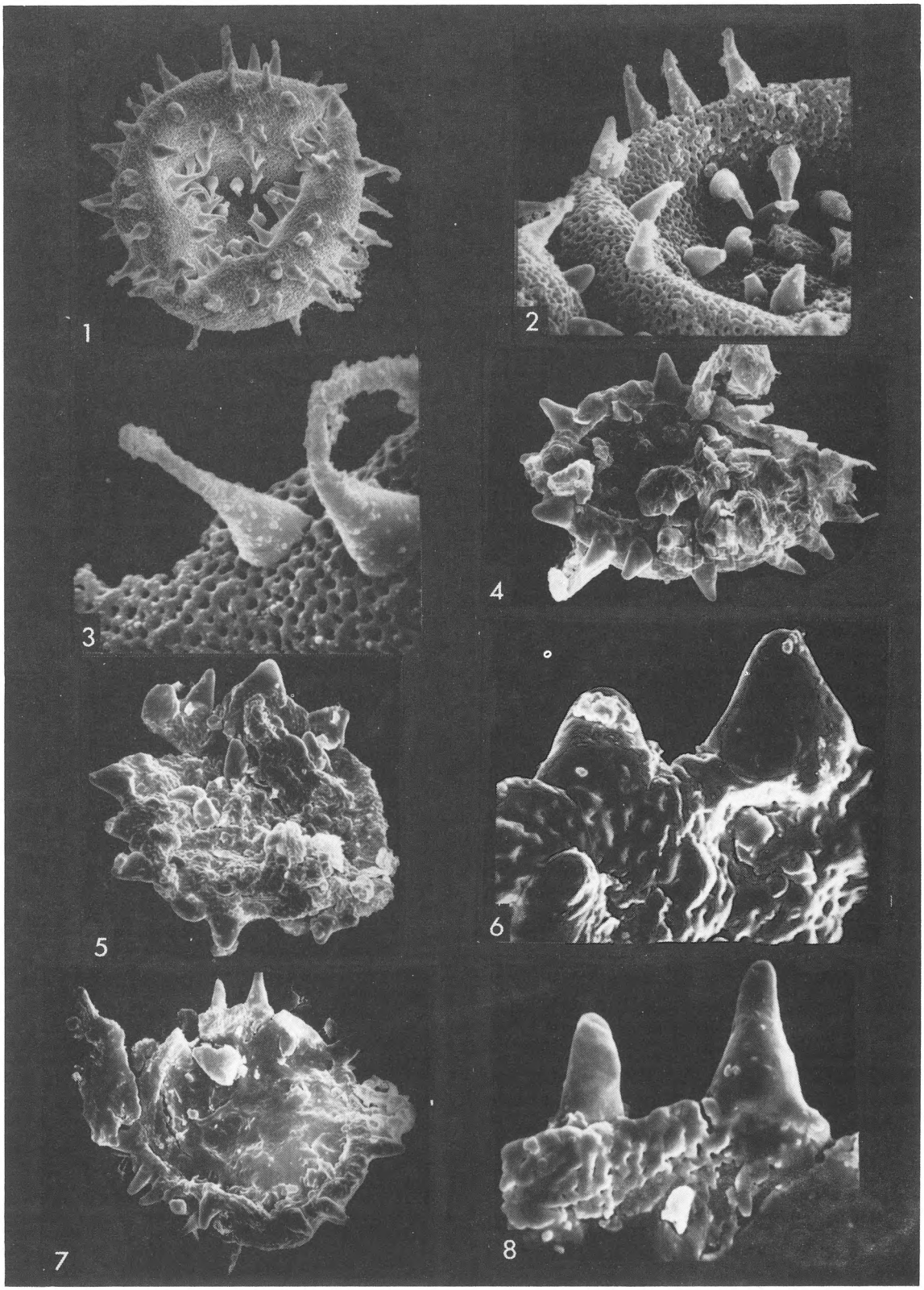


Table 1: the distribution of *Spinizonocolpites baculatus* (black)
Spinizonocolpites echinatus (white)

PLATE 1 Scanning Electron Microscope photographs.

1. *Nypa fruticans* pollen (recent), magn.: 2000x
2. *Nypa fruticans* pollen, detail: the border of the aperture with echinae and the reticulum. magn.: 5000x
3. *Nypa fruticans* pollen, detail of photograph 2, magn.: 10000x
4. *Spinizonocolpites echinatus* Muller 1968 (fossil), magn.: 1900x
5. *Spinizonocolpites echinatus* Muller 1968, magn.: 1900x
6. *Spinizonocolpites echinatus* Muller 1968, detail of photograph 5, magn.: 10000x
7. *Spinizonocolpites echinatus* Muller 1968, magn.: 1900x
8. *Spinizonocolpites echinatus* Muller 1968, detail of photograph 7, magn.: 10000x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ment may be the explanation for the low values.

Muller (1968) suggests a possible phylogenetic relationship between *Spinizonocolpites baculatus* and *Spinizonocolpites echinatus.* The stratigraphical distribution points to dominance of *Spinizonocolpites baculatus* in the Palaeocene and of *Spinizonocolpites echinatus* in the Eocene and younger sediments. In our investigated area Palaeocene samples do not show *Spinizonocolpites.* So far as we know, it seems that it took the Palaeocene for *Nypa* to arrive from the Indo-Malesian region along the shores of the Tethys Sea to southwestern Europe. A successive appearance and extension of *Spinizonocolpites* can be found in the studied samples: the percentages of *Spinizonocolpites baculatus* are relatively low and decrease to the top of the Montañana Formation on the boundary of Middle and Upper Cuisian; afterwards only *Spinizonocolpites echninatus* appears. *Spinizonocolpites* disappears in the investigated area during the Lutetian. Germeraad, Muller & Hopping (1968) explain this disappearance in S. America and Nigeria at the end of the Eocene through an increasing aridity coupled with the development of a pronounced seasonal climate. An other element is the worldwide cooling of the climate from the Oligocene onwards. Some of our specimens show a thickening of the outer exine with a fusing of the spines. We think that this may be an indication of a marginal position and that we have found *Nypa* at the periphery of its geographic distribution range.

The results of our palynological study of Eocene sediments in the Spanish Pyrenees, give new evidences in favour of the autochthony of *Nypa* palms in southwestern Europe. Percentages of nearly 40 per cent in the Lower Eocene can not be explained by drifting, especially when we know that the pollengrains of *Nypa* never reaches high percentages in recent deposits, because *Nypa* is not a very high pollen producer. These high percentages are not so exceptional, when we know that *Nypa* is completely dominant in its environment and forms a formation on itself. Even the relatively low percentages of *Spinizonocolpites* in the Santa Liestra Formation, deposited in a tidal river facies, may suggest that *Nypa* was growing there autochthonally in a narrow zone.

Until now pollen and fruits of *Nypa* were not found in the Palaeocene and Oligocene, although *Nypa* occurs in the Indo-Malesian region from Upper Cretaceous to Recent and the palaeogeographic conditions were not fundamentally changed, so far as we know today.

Our samples from the Spanish Pyrenees are statistically studied with computer techniques. All species, present in the Montañana and Santa Liestra Formation are compared with each other, to look for a possible association of *Spinizonocolpites* with other species. This association may be of importance because, in the case of the allochthony of *Nypa,* the whole association and not only *Nypa* should be transported. Six species show the same stratigraphical distribution as *Spinizonocolpites.* From these species the mean, the standard deviation and the linear correlation coefficient in regard to *Spinizonocolpites* were calculated. It may be assumed that species with the same dispersal pattern ought to show mostly a comparable standard deviation, and the linear correlation coefficient should indicate a high relationship between the species concerned.

Table 2 shows a high linear correlation of species

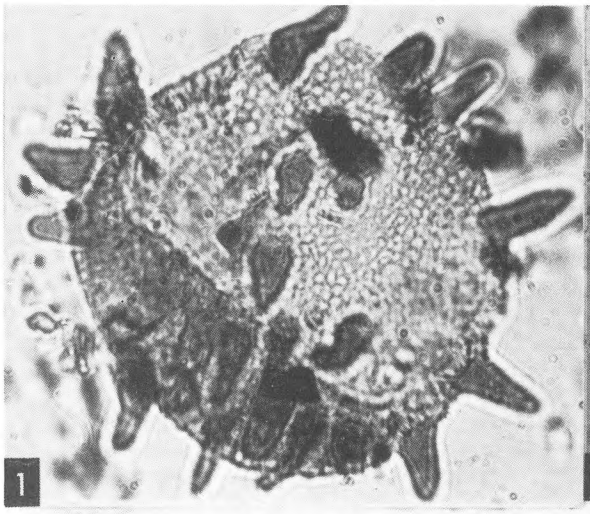
TABLE 2

	Mean %	standard deviation	correlation coefficient
1. Spinizonocolpites Muller 1968	5.6	7.15	–
2. Reticulosporis minimus sp. nov.	0.8	11.90	0.76
3. Cupressacites cuspidataeformis (Zaklinskaja 1957) Krutzsch 1971	1.8	10.85	0.68
4. Vacuopollis Pflug 1953	0.6	16.25	0.30
5. Tricolpopollenites montananensis sp. nov.	0.9	20.30	0.64
6. Tetracolporites convexus sp. nov.	0.2	16.48	0.66
7. Graminidites laevigatus Krutzsch 1970 (publication of 2, 5, 6 is in preparation)	0.2	23.90	0.08

PLATE 2

1. *Spinizonocolpites echinatus* Muller 1968
2. *Spinizonocolpites echinatus* Muller 1968
3. *Spinizonocolpites echinatus* Muller 1968
4. *Spinizonocolpites baculatus* Muller 1968
5. *Spinizonocolpites echinatus* Muller 1968
6. *Spinizonocolpites echinatus* Muller 1968

All magnifications: 1000x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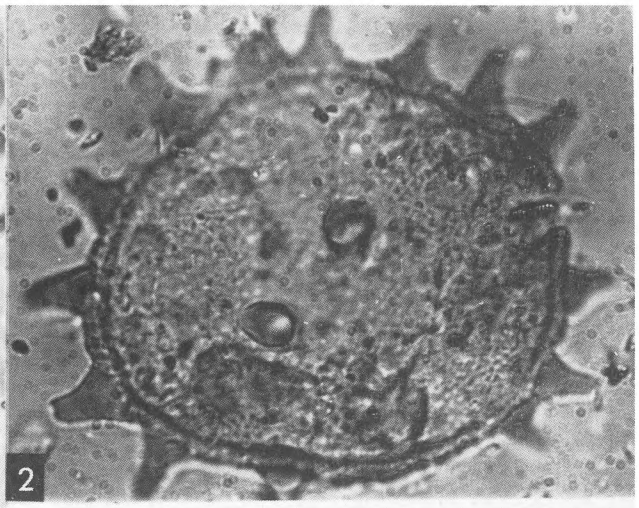
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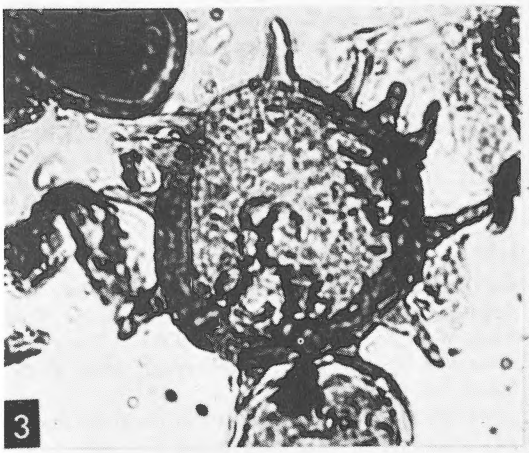
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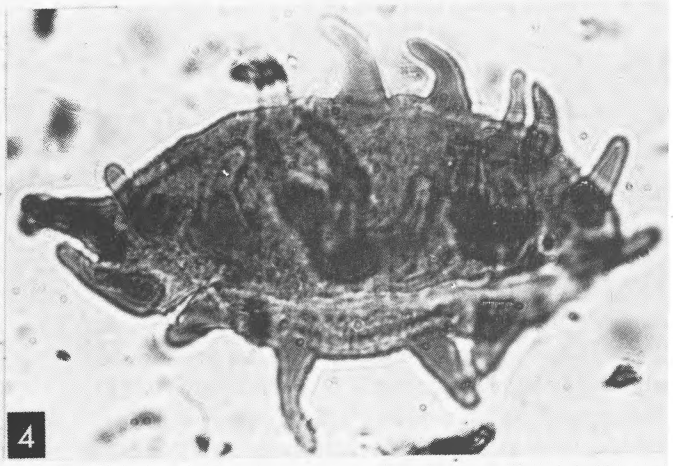
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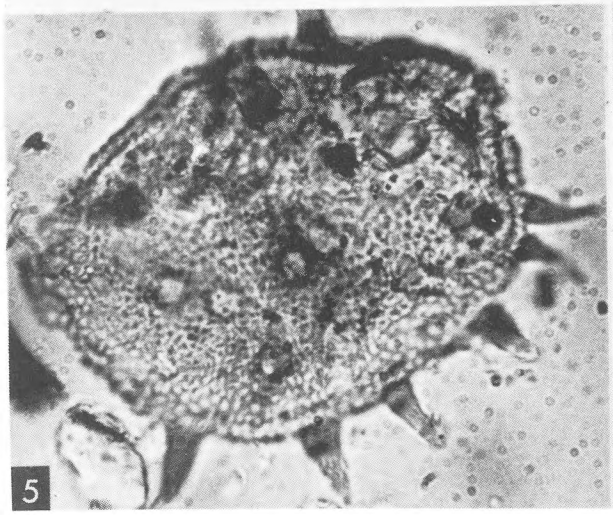
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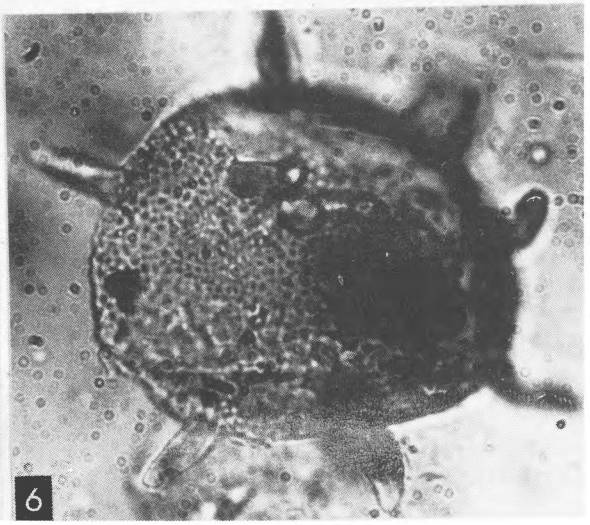
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2, 3, 5 and 6 and a low linear correlation of the other two with the distribution of *Spinizonocolpites* (no. 1), but reciproque values of the standard deviation in relation to the mean. Therefore our statistical data do not provide positive evidence for the theory of drifting of *Nypa*.

Conclusion: We have found new and in our opinion convincing arguments for the autochthony of *Nypa* palms during the Eocene in southwestern Europe: the high percentages of *Spinizonocolpites*, the stratigraphical distribution and frequency of *Spinizonocolpites baculatus*, *Spinizonocolpites echinatus* and recent *Nypa* pollen and the statistical relationship between *Spinizonocolpites* and other species make it unlikely that *Nypa* should be transported along the shores of the Tethys Sea. The first appearance in the Lower Eocene and the disappearance before the end of the Eocene also plead against a drifting process.

ACKNOWLEDGMENTS

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