

## City spore concentrations in the European Economic Community (EEC)

### IV. Summer weed pollen (*Rumex*, *Plantago*, *Chenopodiaceae*, *Artemisia*), 1976 and 1977

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#### Summary

This paper describes observations on the airborne pollen concentrations of four anemophilous weeds of very common occurrence in Western Europe, *viz.* *Rumex* spp. (sorrel and dock), *Plantago* spp. (plantain), *Chenopodiaceae* (goosefoot family) and *Artemisia* spp. (mugwort). Comparative results are recorded from London, Leiden, Brussels, Munich and Marseilles for the summers of 1976 and 1977 and this study is one of a series involving international collaboration between workers in cities of the European Economic Community. The literature on the clinical significance of summer weed pollen is reviewed and it is concluded that the pollen of *Artemisia* is likely to be of importance in areas where the weed is of common occurrence in late summer. The pollen of the other summer weeds is unlikely to be important, but may contribute to the problems of the pollen sensitive patient under exceptional circumstances.

#### Introduction

Reports on local or regional airborne pollen counts in Europe, as determined with volumetric pollen traps, include those of Hamilton (1959), Hyde (1959a,b), Davies, Denny & Newton (1963), Davies (1969), Stix (1970, 1978a,b), Assem (1973), Stix & Ferretti (1974), Leuschner (1974), Nolard-Tintinger (1975, 1978), Aytuğ (1975), Malléa *et al.* (1976), Fückler (1976), Mullins *et al.* (1977), Viander & Koivikko (1978), Brown & Jackson (1978), Engström & Nilsson (1978), Spieksma (1978), Wachter (1978). Differences in the methods used and in the manner in which the results are presented make these studies difficult to compare.

Comparative accounts of the content of the air in cities of the EEC by the members of the working party 'Aerobiologistes du Marché Commun' have included grass pollen (Bagni *et al.*, 1976), Alternaria and Cladosporium spores (Bagni *et al.*, 1977), Urticaceae pollen (H. Charpin *et al.*, 1977). The working party now presents pollen counts for

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four anemophilous weeds of regular occurrence each summer: *Rumex* spp. (sorrel and dock), *Plantago* spp. (plantain), *Chenopodiaceae* (goosefoot family) and *Artemisia* spp. (mugwort). Data was available for 1976 and 1977 from London, Leiden, Brussels, Munich and Marseilles.

### Materials and methods

The methods and sites employed were as described by Bagni *et al.* (1976) with the exceptions that results from Leiden are substituted for Bologna, and results from Marseilles for Strasbourg.

#### Leiden—52° 23'N, 4° 29'E

In 1976 the trap was operated on a flat roof 4 m high, but because of building work was transferred to a 12 m high flat roof at the University Hospital (Academisch Ziekenhuis). A comparison of results obtained before and after removal of the trap suggested this removal had no significant effect. The University Hospital is situated in SW Leiden, not far from meadows and small areas of woodland, and there are parks and private gardens. The climate of Leiden is described as moderate atlantic.

#### Marseilles—43° 22'N, 5° 22'E

The trap is situated on the flat 30 m high roof of the Medical School of Marseilles in the centre of the city and is surrounded by higher hospital buildings. The hospital lies in a garden; there are a few parks in the city, and pines, olives and mediterranean type shrubs around the city. The climate is mediterranean.

### Results

#### *Rumex*

The airborne pollen concentrations in 1976 and 1977 at the five cities are shown in Figs 1 and 2. The counts of *Rumex* pollen grains were low, but they were sampled throughout May, June and July. Successive flowering of several species of dock and sorrel is thought to occur.

The most commonly occurring species of *Rumex* in the environments of the cities are, for Leiden and Brussels: *R. crispus* and *R. obtusifolius*; for Munich: *R. acetosa*; and for Marseilles: *R. acetosa*, *R. acetosella*, and *R. bucephalophorus*.

The courses in the pollen counts at Leiden, Brussels and Munich are very similar in both years, when the pollen grains appeared in mid-May. At Marseilles, the *Rumex* pollen count differs only slightly from those at the other cities on the continent. At London, *Rumex* pollen was found about two weeks later than on the continent, both in 1976 and in 1977.

#### *Plantago*

The *Plantago* pollen counts are given in Figs 3 and 4. Airborne pollen concentrations are low, irregular and prolonged. The most common species in and around the cities are: for Leiden and Brussels: *P. lanceolata* and *P. major*; for Munich: *P. lanceolata*, *P. media* and *P. major*; and for Marseilles: *P. lanceolata*, *P. coronopus* and *P. major*.

In both years 1976 and 1977 the *Plantago* pollen count was extremely low at Leiden and Brussels. At Leiden, the pollen grains sampled in May and June are predominantly from *P. lanceolata*, whereas in July and August *P. major* is the major source.

At Munich, the highest concentrations of *Plantago* pollen were recorded between the end of June and the first half of July. Pollen morphological studies indicate that throughout the season pollen grains of *P. lanceolata* are dominating. In the first three weeks of June 1976, at London, there was a relatively high count of plantain pollen, but this was not observed in 1977. As with the *Rumex*, the *Plantago* pollen appeared about a month later in London than in the continental cities.

#### *Chenopodiaceae.*

In addition to the pollen grains from the genus *Chenopodium*, in Marseilles those of the *Amaranthaceae* are also included.

The species, most commonly occurring are: for London and Munich, *C. album*; for Leiden, *C. album*, *C. rubrum* and *Atriplex* spp.; for Brussels, *C. album* and *C. rubrum*; and for Marseilles, *C. album* and *A. halimus*.

Very low pollen concentrations were recorded at Leiden, Brussels and Munich in comparison to the other cities; at Marseilles the higher concentration of *Chenopodiaceae* pollen is found in the last weeks of August and the first weeks of September.

#### *Artemisia*

Of the four summer weeds dealt with in this report, *Artemisia* has the clearest airborne appearance of its pollen (Figs 7 and 8). Commonly occurring species of *Artemisia* are: for London, Leiden, Brussels and Munich: *A. vulgaris*; and for Marseilles: *A. annua*. Both years, 1976 and 1977, give very similar pictures. The pollination period is relatively sharply limited to four weeks in August at London, Leiden, Brussels and Munich. In Marseilles *Artemisia* pollen is sampled a month later, in September and, in 1977, at the beginning of October. The lower counts are observed at Munich, then Leiden, followed by Brussels and London with somewhat higher concentrations, the highest being in Marseilles.

## Discussion

### *Comparison of pollination periods*

As the numbers of weed pollen grains in the air can vary greatly within short distances, e.g. between city centres and the suburbs, the numerical differences between the counts recorded in the five cities will not be discussed here. Of more interest is a comparison of the pollination periods of the four summer weeds at the five European cities.

In general, the observations are in agreement with previous data on pollen calendars from the same country or region (see the national contributions in J. Charpin, Surinyach & Frankland, 1975).

The observed airborne pollen concentrations at the five cities are too low as to allow for any meteorological analysis. Therefore, the discussion must be confined to a simple but not uninteresting consideration of some local features.

*London.* The pollen of *Rumex* (Figs 1 and 2) and of *Plantago* (Figs 3 and 4) do not appear in the air over London before the very end of May, which is approximately one month later than at the other four cities. This kind of delay was not observed for the appearance of *Urtica* pollen at the same localities (H. Charpin *et al.*, 1977).

*Leiden.* For all summer weeds investigated, the pollen counts at Leiden are very low, and show little or no peculiarities.

*Brussels.* The courses of the pollen counts closely resemble those of Leiden, at no more than 180 km distance.

*Munich.* The picture of the pollen count at Munich is very similar to those at Leiden and Brussels, the only qualitative difference being a relatively high *Plantago* pollen concentration at the end of June and the first half of July (Figs 3 and 4).

*Marseilles.* The most typical features in these mediterranean observations are the late pollination periods of the Chenopodiaceae/Amaranthaceae (Figs 5 and 6) and of *Artemisia* (Figs 7 and 8). The main reason for this delay must be the mediterranean climate, characterized by a shortage in rainfall during the warmer summer months of July and August (H. Charpin *et al.*, 1977), and the mild temperature of September and October.

#### Allergological considerations

The role of summer weed pollen in the aetiology of allergic diseases of the upper respiratory tract or pollinosis is little known (the term 'hay fever' is best reserved for allergy to grass pollen).

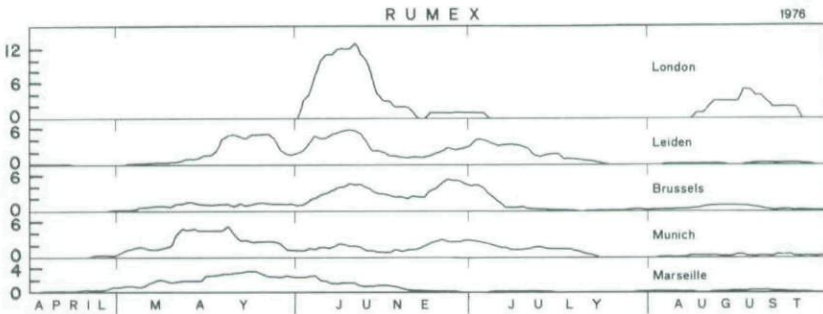


Fig. 1. Ten-day running means of daily pollen counts of *Rumex*, per  $\text{m}^3$  of air, in 1976, at five European cities.

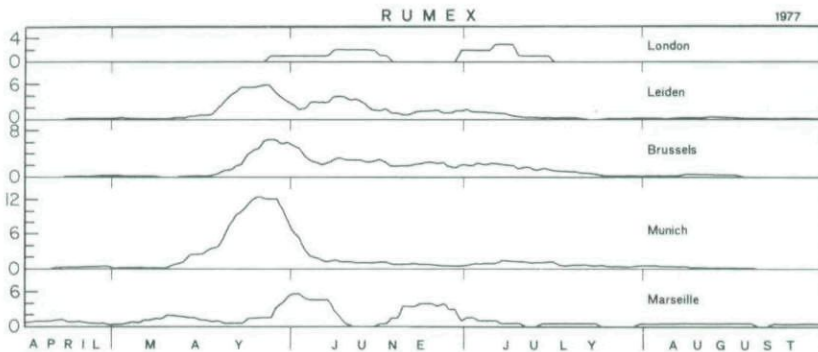


Fig. 2. Ten-day running means of daily pollen counts of *Rumex*, per  $\text{m}^3$  of air, in 1977, at five European cities.

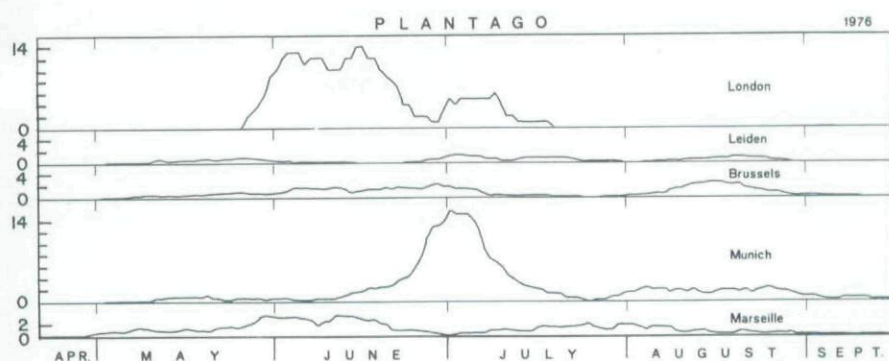


Fig. 3. Ten-day running means of daily pollen counts of *Plantago*, per  $\text{m}^3$  of air, in 1976, at five European cities.

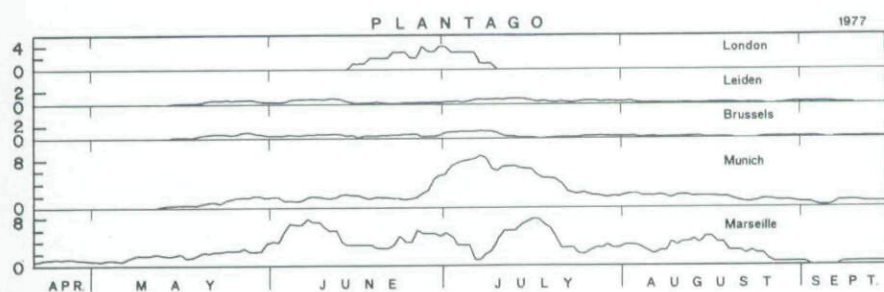


Fig. 4. Ten-day running means of daily pollen counts of *Plantago*, per  $\text{m}^3$  of air, in 1977, at five European cities.

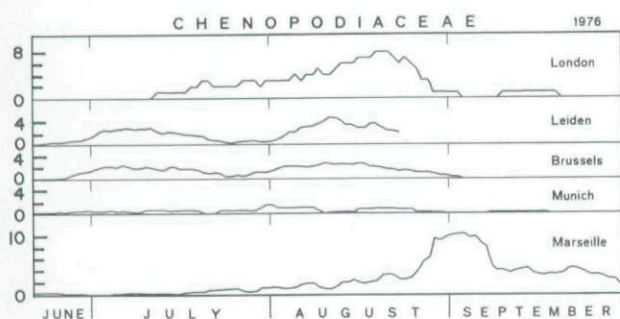


Fig. 5. Ten-day running means of daily pollen counts of *Chenopodiaceae*, per  $\text{m}^3$  of air, in 1976, at five European cities.

There is a general assumption that under normal circumstances in urban areas and especially in the large cities, the airborne pollen concentrations of *Rumex*, *Plantago*, and the *Chenopodiaceae* are far too low to be a significant cause of allergic reactions. On the other hand, their pollen is considered to have allergenic properties (Hyde, 1959b; Johnson, 1963; Wodehouse, 1971; Wachter, 1978).

Reports dealing with allergies to these weeds include the following:

*Rumex*. Solomon (1969) concluded that the aerobiological and clinical data suggested that specific sensitivity to *Rumex* pollen may contribute significantly to the severity of

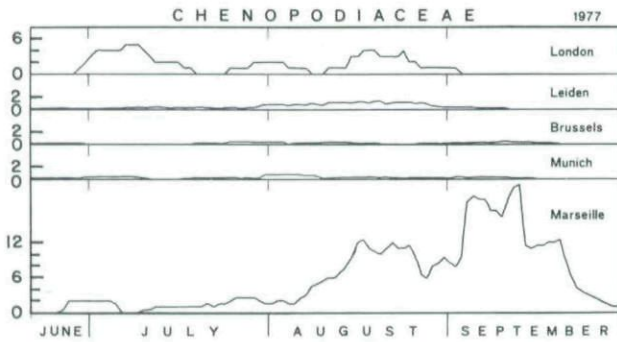


Fig. 6. Ten-day running means of daily pollen counts of *Chenopodiaceae*, per  $\text{m}^3$  of air, in 1977, at five European cities.

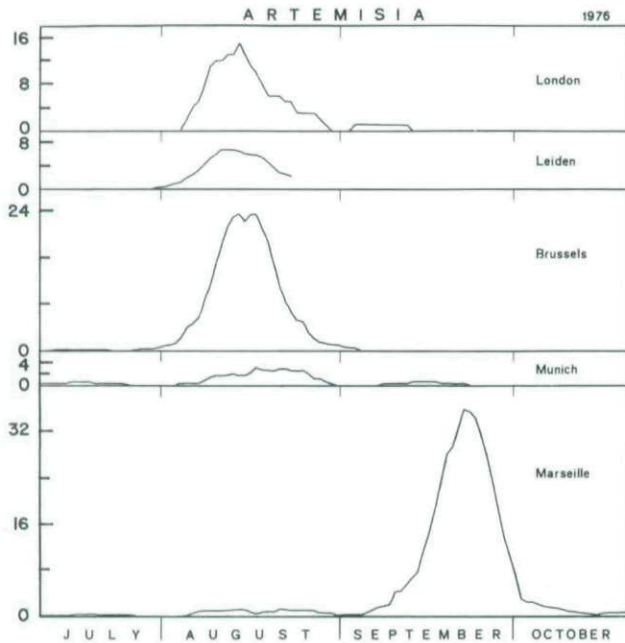


Fig. 7. Ten-day running means of daily pollen counts of *Artemisia*, per  $\text{m}^3$  of air, in 1976, at five European cities.

pollinosis in selected patients. Whether exposure to *Rumex* pollen alone was a significant source of pollinosis was, in his view, unclear. More recently, Wagazuma & Matsuyama (1974) reported an extremely high incidence of 57% reactors to *Rumex* pollen extracts among ninety-seven hay-fever sufferers in the Sapporo region.

*Plantago*. Charpin, Aubert & Charpin (1962) concluded that 6% of patients with pollinosis gave positive skin reactions to extracts of *Plantago*. Wachter (1978) refers to observations of much higher frequencies by Duchaine (1962) and DÜngemann (1972). Voorhorst (1965) observed fairly strong and more frequent skin reactions than he had

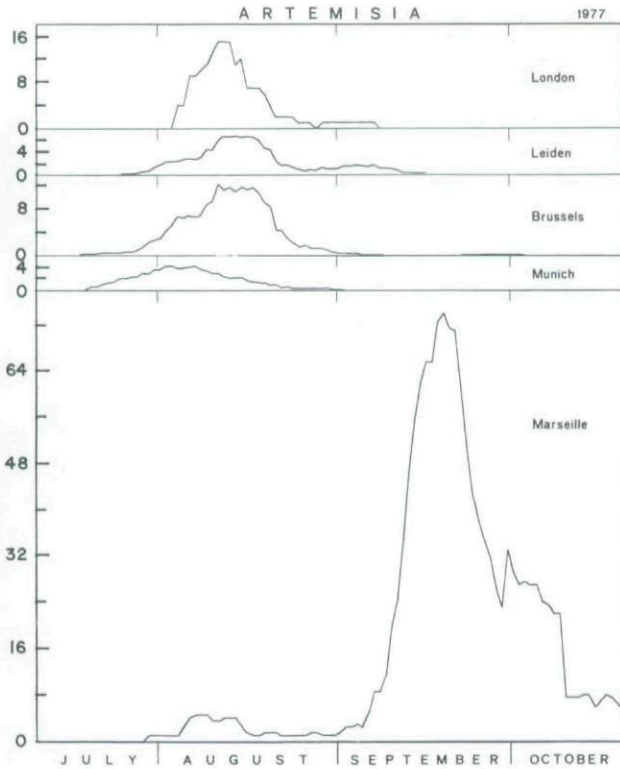


Fig. 8. Ten-day running means of daily pollen counts of *Artemisia*, per  $\text{m}^3$  of air, in 1977, at five European cities.

expected. He demonstrated (in cooperation with a palynologist) that the sample of *P. lanceolata* from which the extract was prepared contained from 3 to 5% grass pollen, and two other samples were contaminated with even more. Two samples were found to be free from contamination with grass pollen. It had been concluded earlier (Ellis & Dahl, 1947) that each pollen sample to be used for skin testing must first be checked on such contaminations.

*Chenopodiaceae*. The *Chenopod* pollen sampled at London, Leiden, Brussels and Munich originates from two genera, viz. *Chenopodium* and *Atriplex*.

Apart from observations on rare skin reactions, always combined with skin reactions to another pollen, mainly grass (e.g. Charpin *et al.*, 1962), there are two reports on allergies at least partly due to *Chenopodium* pollen (Homan, 1963; Gupta *et al.*, 1970). Homan stated that in any region where it is abundant, lamb's quarters (*Chenopodium*) should be considered a contributory factor in hay fever.

Although reported by Johnson (1963), the role of *Atriplex* pollen is probably negligible in causing pollinosis. Under occupational or agricultural circumstances pollen from the cultivated sugar beet *Beta vulgaris* may cause allergic complaints (Peck & Moffat, 1959; Ursing, 1968). *Beta vulgaris* is a biennial: the roots are harvested after the first year, when no flowering occurs. In the second year, it is allowed to flower for the production of seed. Sensitivity to pollen from sugar beet is most likely to occur

among professional plant breeders and people living in a seed-producing area. Whether or not there is any degree of cross-activity among *Chenopodium*, *Atriplex*, and *Beta* has not been established with certainty. Most authors (Peck & Moffat, 1959; Homan, 1963; Johnson, 1963; Ursing, 1968) suggest a cross-reactivity among the genera, while Gupta *et al.* (1970) are describing specificity of the allergenic extracts of the pollen even from various *Chenopodium* species. To the *Chenopodiaceae* pollen count at Marseilles, a number of other genera may contribute, such as *Salicornia*, *Salsola*, *Kochia*, and also *Amaranthus* of the *Amaranthaceae*. In urban areas, however, airborne pollen concentrations from these weeds are too low to cause pollinosis (Charpin *et al.*, 1962).

*Artemisia*. A number of authors consider the pollen of *Artemisia vulgaris* (mugwort), and of *Artemisia annua* (annual wormwood) for the mediterranean area, as the most important cause of pollinosis in late summer and autumn, not unfrequently seen in western continental Europe (Duchaine & Spapen, 1959; Charpin *et al.*, 1962; Voorhorst, 1965; Gueho *et al.*, 1970; Cornillon *et al.*, 1972; Soler *et al.*, 1973; Virchow *et al.*, 1976). An exception has to be made for the area near Lyon, where the local presence of *Ambrosia* spp. causes many cases of pollinosis in this time of the year (Touraine, Cornillon & Poumeyrol, 1965; Cornillon *et al.*, 1972).

Duchaine & Spapen (1959) in Belgium, found that 11% out of 171 patients with grass-pollen allergy suffered from allergy to *Artemisia* pollen.

Voorhorst (1965, 1971), in The Netherlands, estimated that 10% of all patients with pollinosis (mostly, but not exclusively allergic to grass pollen) suffered from their allergy to *Artemisia*. He considers *Artemisia* pollen second only to grass pollen in clinical significance in The Netherlands.

In France, Cornillon *et al.* (1972) observed skin reactivity to pollen of *Artemisia* in 14% of 864 patients suffering from various types of pollinosis. But the high frequency of allergy to *Ambrosia* in their patients obscured the clinical significance of *Artemisia*-pollen allergy.

Düngemann (1977, cited from Wachter, 1978) saw skin reactions in a frequency as high as 31% in 795 hay-fever patients in the Munich region.

The frequency of reasonably strong skin reactions (a flare of a diameter of 2.5 cm or more after testing with a 1 to 100,000 w/v diluted extract; *cf.* Voorhorst, Spijksma & Varekamp, 1969) observed in Leiden in the years 1976 and 1977, is presented in Table 1.

In general the clinical significance of any allergen may not be determined only by the frequency of skin reactions in a group of allergic people. Prevalence of the allergen source and quantity (or activity) of allergen per airborne particle are also decisive factors in this regard (Horak & Jäger, 1978).

As can be seen in the results of this report, among the summer-weeds pollen in western Europe that of *Artemisia* is sampled in the highest quantities, apart from *Urtica* (Charpin *et al.*, 1977).

In a 'preliminary list of equivalent allergen-extract concentrations', Voorhorst *et al.* (1969) estimate the specific allergen content of *Artemisia* pollen equal to that of the same weight of mixed grass pollen, but ten times higher than that of *Urtica* and *Rumex* pollen, and even thirty times higher than that of *Plantago* pollen.

Taking into account the relative weights and sizes of pollen grains (Brown & Irving, 1973), the allergen content of each individual *Artemisia* pollen grain can be estimated

**Table 1.** Frequency of skin reactions in out-patients of the department of Allergology, University Hospital, Leiden, in 1976 and 1977, after testing with diluted extracts from pollen of grasses (mixed) and of some summer weeds.

|                            |     |
|----------------------------|-----|
| All pollen types           | 390 |
| Grasses                    | 345 |
| <i>Urtica dioica</i>       | 4   |
| <i>Artemisia vulgaris</i>  | 20  |
| <i>Rumex crispus</i>       | 6   |
| <i>Rumex acetosella</i>    |     |
| <i>Rumex obtusifolius</i>  |     |
| <i>Plantago lanceolata</i> | 4   |
| <i>Atriplex</i> sp.        | 3   |

as one half to one third of a theoretical average grass-pollen grain, but, on the other hand, much more than that of any of the other summer weed pollen grains like *Urtica*, *Rumex*, *Plantago* and certainly also *Chenopodiaceae*.

### Conclusion

Based on the results of the counts of airborne pollen of the summer weeds, dealt with in this report, and considering the allergological observations by several authors cited above, it is concluded that the pollen of *Artemisia* is most likely to have real albeit limited clinical significance for pollinosis in late summer and autumn, particularly in a locality where much *Artemisia* can be found.

The pollen of *Rumex*, *Plantago* and *Chenopodiaceae* may have a contributory role in causing pollinosis only under exceptional conditions.

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