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NEWSLETTER of the INTERNATIONAL FEDERATION of PALYNOLOGICAL SOCIETIES

8th INTERNATIONAL PALYNOLOGICAL CONGRESS
(September 6-12, 1992)

WELCOME TO AIX-EN-PROVENCE

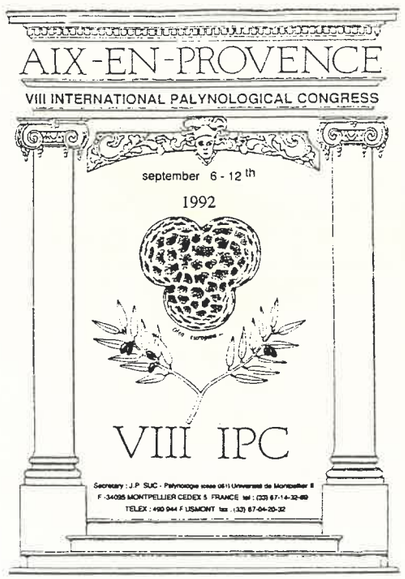
The Organizing Committee of the 8th International Palynological Congress will be pleased to welcome the delegates from the world palynological community to Aix-en-Provence. The utmost is being done to make this Congress both successful and enjoyable. Up to now, the main efforts of the Committee have been concentrated on arranging Symposia and trying to maintain reasonable registration fees.

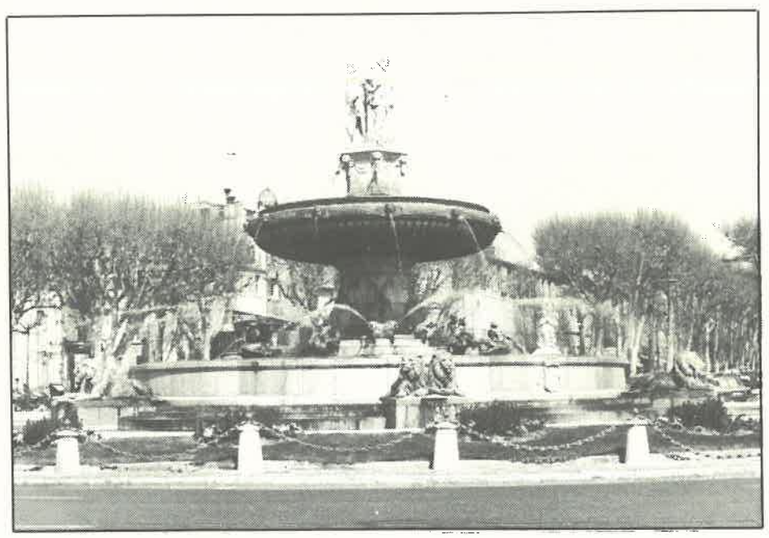
This special issue of *Palynos*, entirely devoted to topics related to the forthcoming 8th IPC, includes a "Review of Palynology in France," an "Introduction to Provence," and information concerning the scientific and social programs planned for the Congress.

In case you have failed to receive the 8th IPC Second Circular, please contact the Congress Secretary (Dr. **J-P Suc**, Université Montpellier II).

Our ambition is to offer you a pleasant and fruitful Congress--we eagerly await your arrival at Aix-en-Provence!

The 8th IPC Organizing Committee





Aix-en-Provence: the Rotonde square fountain

PALYNOLOGY IN FRANCE: AN HISTORICAL REVIEW AND CURRENT RESEARCH

In France, **M. Van Campo** established palynology as a basic scientific discipline with the publication of her thesis in 1950 on the phylogeny of the Abietaceae based on their pollen (Toulouse University). In 1959 she set up (in Paris at the *Muséum National d'Histoire Naturelle/EPHE*) the first palynology laboratory for the study of modern pollen; she developed research involving both morphology and pollen analysis, which she felt had to be considered together. In the same year she established at the Muséum the journal *Pollen et Spores*, which very quickly attained a high scientific level. Botanists and geologists alike worked in her laboratory to learn about and gain experience in pollen morphology, first in Paris and later at the University of Montpellier, where she moved in 1970.

MORPHOLOGY

Starting in 1959, numerous morphological studies were initiated and made an important contribution to our knowledge of variation in pollen characters of many taxonomic groups: Umbelliferae (**M.T. Cerceau-Larrival**, Toulouse), Mimosaceae (**P. Guinet**, Montpellier), Palmae (the lamented **G. Thanikaimoni**, Montpellier), Caesalpiniaceae (**S. Sénesse**, Montpellier), Celastraceae (**D. Lobreau-Callen**, Montpellier), Cycadales (**E. Masure**, Paris), Rubiaceae (**M. Kedam**, Paris), Rutaceae (**J. Millogo-Rasolodimby**, Paris), and Saxifragaceae (the lamented **M. Hideux**, Paris). At the same time, several atlases were produced, which gave a broad palynological knowledge of the flora of some tropical regions: African palynology (**M. Van Campo**), spores of Madagascar (**M.L. Tardieu-Blot**, Paris), Ethiopia and the savannas of Eastern Africa (**R. Bonnefille** and **G. Riollet**, Marseille), Ivory Coast (**J.P. Ybert**), medicinal plants of Rwanda (**M.T. Cerceau** and **M. Hideux**, Paris), Cameroon (**M. Salard-Cheboldaeff**, Paris), and Madagascar (**H. Straka**, Kiel).

The first work on ultrastructure, simultaneously on angiosperms, gymnosperms and pteridophytes, dates from 1965. These studies revealed previously unknown structures in the aperture of Ranales-Centrospermae, as well as certain types of tetrads (**F. Rolland**, Paris); made it possible to refine the terms used to describe the different spore or pollen wall layers in *Hepatica* (**J. Denizot**, Montpellier), Cycadales (**J.C. Audran**, Reims) and certain other gymnosperms (**M. Van Campo**); and showed the existence of an additional layer, the pseudoendospore, in the pteridophytes (**B. Lugardon**, Toulouse). Starting at that time, research on pollen wall ultrastructure expanded significantly in many taxonomic groups, showing new exine structures in the angiosperms (**M. Van Campo** and **B. Lugardon**; **B. Lugardon** and **A. Le Thomas**) and providing new data for the interpretation of the aperture, exine architecture and evolution, and the role of the various parts of the pollen wall in several groups: Annonaceae (**A. Le Thomas**, Paris), Mimosaceae (**P. Guinet**), Rosidae-Saxifragales (**M. Hideux**), Phaseoleae (**F. Stainier** and **F. Horvat**, Louvain-la-Neuve), Icacinaceae-Olacaceae and Malpighiaceae (**D. Lobreau-Callen**, Paris) and the pteridophytes (**B. Lugardon**).

As the methods for investigating pollen morphology and structure were being developed, French palynologists became interested in pollen ontogeny as a means of understanding the dynamics that result in the variation of pollen exine structure and of spore walls; sporophyte/gametophyte relations (**M. Hideux** and **M. Abadie**, **D. Robert**, Paris; **B. Lugardon**); and the role of meiosis in the placement of apertures (**K. Huyn**, Neufchatel). A model of sporopollenin biosynthesis was recently proposed by **M. Abadie** and **M. Hideux**, in collaboration with **J. Rowley**.

BIOLOGY

The biology and physiology of the male gametophyte have been examined from many perspectives during the last 15 years, most often by multidisciplinary groups. These studies have examined: the selective forces acting on pollen polymorphism and the morphological-developmental constraints in the stamen on the production of competitive gametophytes (**I. Till-Bottraud**); the sporophytic determinism that exists between the secretory layer and the young microspore has been analyzed in several Saxifragaceae and Umbelliferae (Paris); pollen-pistil interactions, incompatibility mechanisms, pollen viability and quality, elucidation of a male germinal unit, *in vitro* inter-gametic fertilization, and the characterization of isolated gametes *in vitro*, have all been the subject of research by **C. Dumas** and his team for over 10 years (Lyon); the control of pollen desiccation by lyophilisation or in a vacuum has made it possible to begin building a pollen bank (Paris) for genetic resources, the improvement of plants (Dijon) and for immuno-allergy work (Institute Pasteur).

AEROPALYNOLOGY AND MELISSOPALYNOLOGY

Aeropalynolgy has always been one of the primary areas of study at Montpellier. New methods of pollen capture and several new computer programs have been developed there (**P. Cour**, **R. Gros**). **P. Cour** has established a network to sample flux in wind-borne pollen along a transect from the polar circle to North Africa and in many other stations: Madagascar (**C. Rajeriarison**, **M. Ramavovololona**), Canada (**P. Richard**, **G. Cambon**), Reunion Island, and the Kerguelen Islands. The results have been brought together to comprise a computerized data bank. Particular attention has been placed on pollen content of the atmosphere and led to agronomic applications (**P. Cour**).

Medical aeropalynology began to develop at Marseille at the end of the 1950's. **J. Charpin** and his team established the first pollen calendars for several French towns; they identified allergenic taxa that are specific for the Mediterranean region; for some of them they discovered corresponding pollen antigens, and are still studying mold spores in urban, domestic, professional and hospital environments. More recently, **P.B. Michel**'s team at Montpellier improved the quantification of pollen calendars in collaboration with **P. Cour**'s group, and **M.R. Ikovic**'s team (Institute Pasteur, Paris) is engaged in the study of pollen allergen dispersal and sensitivity.

Melissopalynology began developing in France thanks to the work of **J. Louveaux** (1958, Paris) on honey bees, which provided considerable information on the pollen collected by this species, its nutritional characteristics, the relative importance of the different pollen sources present in the plant cover, and the pollination of cultivated plants. Applied work involving cultivated plants is well developed at Bures-sur-Yvette, Dijon and Lusignan, and recently computerization was used to develop a new method for characterizing honey (Marseille). The analysis of pollen collections is also being used as a bio-ecological tool in various regions such as Morocco (**F. Damblon**, Louvain-la-Neuve), tropical Africa (**D. Lobreau-Callen**, **A. Le Thomas**) and Madagascar (**L. Ramamonjisoa**).

PALAEOPALYNOLOGY

The earliest works dealing with geological palynology were not foreign to the previous IPC, since there are papers about the Permian of New South Wales by the two great French palaeobotanists, **P. Bertrand** and **B. Renault** (1894).

It is in the Coal Institute of Lille, which has long been directed by **P. Bertrand**, that, since the 1950's, anthracolotic formations from northern France have been the object of numerous palaeobotanical studies, taking into account spore morphology in the systematic analysis of fossil Filicineae groups (**P. Corsin-Danzé**, **J. Danzé**, **R. Coquel**, **J. P. Laveine**, **S. Loboziak**.)

Palynological investigations on the same formations, with more or less practical objectives, were initiated at the Laboratory of Palynology of the *Centre d'Etudes et de Recherches des Charbonnages de France* (CERCHAR) between the 1950's and 1960's (**B. Alpern**, **G. Lachkar**, **J.P. Liabeuf**).

At the *Bureau de Recherches Géologiques et Minières (BRGM)*–a national institution established at Orléans–palynology was acknowledged in 1965 with stratigraphic investigations aimed at mining applications (*Massif Central Infralias*, African Tertiary). Thereafter pollen and spore analysis, joined to the study of dinocysts, chitinozoa and acritarchs, and complemented by palynofacies analysis and organic petrography, enabled palynologists (**J.J. Chateauneuf**, **G. Farjanel** and **D. Fauconnier**) to solve problems relating to the age and depositional environment of sediments on almost all the continents and at all stratigraphic levels.

Still aiming at practical applications, petroleum research efficiently contributed to the evolution of French palynology. This was the case at the French Petroleum Institute (the lamented **M. Correia**, **B. de Jekhowsky**, **J. Taugourdeau-Lanz**), where active methodological research was carried out between 1960 and 1966–particularly in the field of quantification–and where "French Symposia abut Applied Palynology" were organized, leading to the creation of the A.P.L.F.

In 1950, TOTAL and the French Petroleum Company undertook the paleontological study of the vast Palaeozoic area of Sahara (Libya and Algeria) on the basis of spores and chitinozoa (**A. Combaz**, **G. Kieser**, **P. Millepied**, **P. Taugourdeau**). Since 1970 this time span has been extended to the Jurassic and the Tertiary with the study of petroleum fields in the North Sea (**Y. Carro**, **D. Michoux**), the main concern there being drilling supervision.

The team of Elf-Aquitaine followed in a similar course of investigations on the Paleozoic of both Australia and Canada (**P. Moreau** and **G. Peniguel**); studies were also carried out in the western part of Africa where the first angiosperm pollen was recorded (**B. Boltenhagen**, **S. Jardiné**, **P. Biens**, **A. Doerenkamp**, **O. Legoux**), as well as on stratotypes of the French Jurassic and Lower Cretaceous (**P. de Reineville**, **J.F. Raynaud**, **J.M. Moron**), Mesozoic and Cenozoic in the North Sea (**J. Ducazeaux**), and the Tertiary of Southeastern Asia where the "*révolution séquentille*" has had consequences in palynology (**C. Poumot**).

The ESSO REP biostratigraphy unit has been operational since the EXXON re-organization in 1987 with a staff of two palynologists (**N.S. Ioannides** and **P. Hochuli**). The major aspects of the work are biostratigraphy, sequence biostratigraphy and palaeoecology. The unit's expertise comprises a wide range of geological ages and covers extensive geographic areas such as Africa, Europe, North Sea, Barents Sea, Canada.

Among universities, three laboratories deserve special attention:

(1) At Strasbourg, between 1960 and 1986, under the direction of **J. Doubinger**, researches were made on pollen, spores, acritarchs, chitinozoa and dinocysts from Ordovician to Devonian sequences, from the Permo-Carboniferous (**R. Rauscher**) and from the Mesozoic–notably the Triassic–(**M.C. Adloff** and **L. Grauvogel-Stamm**). Simultaneously, Tertiary palynological studies were focussed on palaeoenvironments (**C. Sittler** and **M. Schuler**). Today, Mesozoic sequences (specially from the Jurassic) are being investigated (**R. Rauscher**, **M. Schuler**, **V. Huault**).

(2) At Rennes palynological researches started with the studies of **A. Philippot** about the "hystrichospheres" of Cretaceous silex (1941), of **S. Durand** about Cretaceous and Tertiary pollen (1949, 1960), and of **J. Deunff** about the acritarchs from the Palaeozoic (1961, 1966). Studies about acritarchs and chitinozoans from the Armorican Palaeozoic (**J.L. Henry**, **F. Paris** and **A. Le Herissé**) and about the Cretaceous and the Armorican Tertiary (**M.F. Ollivier-Pierre**) became, and still are, the main subjects.

(3) At the University of Paris VI, palynology has been part of the palaeobotanic research as early as 1970: **A. Moreau-Benoit** (Devonian of Europe and Africa), **J. Broutin** (Tethysian Permo-Carboniferous), **D. Pons** (Lower Cretaceous from Europe and South America), **J. Dejax** (Cretaceous from Africa and South America), **M. Salard-Cheboldaeff** (Cretaceous to Present from intertropical Africa). Biostratigraphy, palaeogeography and mainly the evolution of flora (particularly,

the rapid radiation of angiosperms) are the main lines of this research.

Some researchers have pursued personal researches in palaeopalynology since the middle of the 1960's: **J. Médus** (first at Montpellier and then at Marseille: Cretaceous [mainly] and Tertiary in the Iberian Peninsula and in southeastern France); **C. Caratini** and **C. Tissot** first at Bordeaux, and then at Pondichéry: Tertiary vegetation, especially mangroves in Africa and in the Indian Peninsula); **H. Méon** (Lyon: Neogene in the Rhône valley); **G. Lachkar** (European Palaeozoic); **C. Gruas-Cavagnetto** (Marseille, Paris, then Montpellier [mainly Cretaceous and Palaeogene of the Paris basin]); and **R. Jan du Chêne** (Genéve, then Ile Ife and Bordeaux: sequence palynostratigraphy).

PLEISTOCENE POLLEN ANALYSIS

Pleistocene pollen analysis has been very actively pursued in France for sixty years; its objective is to gain a better knowledge of vegetation, climate and human activity in recent times, in order to improve our understanding of present relationships between organisms and environments.

Close to those researches, and using a botanical approach, investigations about the Late Neogene and the Early Pleistocene were initiated in the 1960's at Paris and Rouen by **H. Elhai** (Massif Central and western France). Thereafter, these studies have been extensively pursued at Montpellier by the team of **J.P. Suc** (notably with **E. Bessais**, **M. Bessedik**, **N. Combourieu-Nebout**, **F. Diniz**, **S. Leroy** and **Z. Zheng**: origin of climate and Mediterranean vegetation) on the western Mediterranean border.

There are few works concerned with the study of present vegetation/pollen spectra relationships. However, in several thesis-works, an approach is made to this basic interpretation of pollen analysis results (**J.L. de Beaulieu**, **H. Laval**, **M. Reille** at Marseille, **G. Cambon** at Montpellier, **L. Visset** at Nantes).

Pollen analysis of the Middle and Upper Pleistocene and of the Holocene was introduced in France as early as 1927, with the work of two famous pioneers, **F. Firbas** and **G. Erdtman**, who together with a local botanist (**M. Denis**) undertook the analysis of the Massif Central peat-bogs.

During the 1930 decade this type of investigation, then conducted in several French regions, experienced a development at Strasbourg (**G.** and **C. Dubois**, **F. Firtion**, **G. Lemée**) before achieving a notable advance during the last World War, when the Strasbourg team moved to Clermont-Ferrand, as illustrated by numerous works by **G. Lemée** in the Massif Central (Between 1942 and 1956) and **J. Becker**'s thesis about the Alps (1942).

These researches were then continued with a new impetus and using more modern approaches: **N. Planchais** (first at Paris and then at Montpellier: Loire valley, Languedoc littoral); **G. Jalut** (first at Paris, then at Toulouse: Paris basin, and Pyrenees with **M. Mardonnès** and **V. Andrieu**); **H. Richard** (Besancon: Jura and Franche-Comté); **M.F. Huault** (Rouen: Seine valley); **M. Clet** (Caen: Normandy and Cotentin), and the team of Rennes (**M.Th. Morzadec**: pollen analysis, dinophyceae and variations in sea-levels), Brest (**D. Margerie**: environment of archaeological sites), and Nantes (**L. Visset**, **D. Voeltzel** and **J. Bernard**: Lower Loire valley and surrounding regions) and of Marseille (**J.L. De Beaulieu**, **J. Clerc**, **M. Couteaux**, **P. Guenet**, **J. Guiot**, **C. Goeury**, **H. Laval**, **J. Médus**, **A. Pons** and **M. Reille**: Corsica, French Alps, Provence, North Africa, Massif Central, Dauphiné and Pyrenees). The activity of the Marseille team concentrates mainly on the record of analysis of long sediment sequences, sometimes containing continuous records of the last five climatic cycles, and on the quantitative reconstruction of climates.

Pollen analysis of archaeological sediments was initiated by **A. Leroy-Gourhan** in the 1950's at the *Musée de l'Homme*, in Paris. It underwent a considerable development in France, as illustrated by the works of **M.M. Paquereau** (Bordeaux: Gironde), **J. Renault-Miskovsky** (Paris: particularly French Mediterranean region), **M. Girard** (Sophia Antipolis: Alps, Jura, Burgundy), **M.F. Diot-Foulquié** (Périgueux: southwestern France).

Following the works by **M. Strick-Rossignol** (Paris: eastern and central Mediterranean), pollen analysis of recent sea deposits began to develop in the 1960's with **J. Bernard**'s studies (Marseille: western Mediterranean), **J.L. Turon** (Bordeaux: North Atlantic), **E. Van Campo** (Montpellier, and then Marseille: Indian Ocean mainly), **A. Brun** (Paris: Gabès Gulf) and **A.M. Lézine** (Marseille and then Paris: Atlantic, offshore Africa).

As early as the 1940's, dinoflagellates have been investigated by **G. Deflandre** in his famous works about flint splinters; his material has been dated by **C. Foucher** (Reims). The biostratigraphy, the morphology and the evolution of dinoflagellates are being studied by **E. Masure** (Paris), while researches about living dinoflagellates are carried out at the Arago Laboratory of Banyuls/Mer.

In the fields of tropical palynology, researches in France are devoted to more or less distant countries: **R. Bonnefille**, **G. Riollet** and **A. Vincens** (*Laboratoire de Géologie du Quaternaire* at Marseille: pollen representation of present vegetation, lake and peat-bog sequences, climate reconstructions in eastern Africa), **J. Maley** (Montpellier: Lake Tchad and western Africa) and **P.Y. Ybert** (Bordeaux: Bolivia).

PALYNOLOGY IN SURROUNDING FRENCH-SPEAKING COUNTRIES

In Belgium, at Liège, the palaeobotanical tradition was generated at the very beginning of the 1960's with numerous systematic and stratigraphic works dealing with spores from the Palaeozoic, primarily the Devonian (**M. Streel**). These researches were complemented at the *Institut National des Industries Extractives* (INIEX: **R. Noël**). At Louvain-la-Neuve the team created by **W. Müllenders** (**B. Bastin**, **M. Coûteaux** when it first began, **J. Heim**, **A. Munaut**, **F. Damblon**) opened the way to an original methodology (vegetation-pollen rain relationships, correlations with phytosociological analyses,

intensive use of C_{14} for the study of the Late Glacial and Holocene in their country. In this laboratory, the lamented **G. Woillard** described in 1975-78 the first continuous continental record of the last climatic cycle (La Grande Pile, Vosges). In Belgium there are also researchers working at Gand (**C. Verbruggen**: Flanders Late Glacial) and at Bruxelles-Tervuren (**E. Roche**: Paleogene from Belgium and Pleistocene from eastern Africa).

A number of more or less isolated researchers from neighbouring countries have published (and are still publishing) in French, for instance **H. Straka** (Kiel, the author of "Palynologia Madagassica and Mascarenica": pollen analyses of peat-bogs in Madagascar and Mexico); **C. Janssen** (Utrecht: surface samples and peat-bog pollen analyses in the Vosges and the Massif Central); **S. Wegmüller** and **M. Welten** (Bern, clearances in the High Maurienne and in the Valais; **M.J. Gaillard-Lemdhal** (Lausanne, then Lund: Late Glacial and Postglacial vegetation in the "Moyen Pays" of French Switzerland, 1984); **M. Kedves** (Szeged, Hungary: Mesozoic), **M.Ch. Peñalba** (San Sebastian: Late Glacial and Holocene in northwestern Spain); **M. Dupré-Ollivier** (Valencia: Neolithic and human impact); **A. Ballouche** (Rabat: the Holocene in arid regions) and **B. Ben Tiba** (Chott Meriem, Tunisia: pollen rain and vegetation, Holocene history in Kroumiria).

Lastly, let us recall that the *Association des Palynologues de Langue Francaise (APLF)*, created in October 1967 at Marseille, and which comprises today 320 members from 33 countries, organizes every two years a symposium on various themes (palynology and continental drift, palynology and tropical environments, palynology and organic matter, for instance).

The great number of young participants, many of them newcomers, at the last biennal Symposium (Caen, September 1991) makes one optimistic about the future of palynology in France and in the neighbouring countries.

Annick **LE THOMAS** and Armand **PONS**.

ADDITIONAL INFORMATION ON THE CONGRESS

In order to attract public attention to the importance of palynology, lectures of general interest and a palynological exhibition have been planned at the Natural History Museum of Aix. This exhibition will present original letters between **Charles Darwin** and **Gaston De Saporta**, the paleobotanist who worked at Aix-en-Provence and initiated most of the modern paleobotanical researches, including palynology in the Mediterranean region.

As regards the Congress itself, General Sessions will be organized in parallel to Symposia. The General Sessions will involve all palynological fields and will be devoted to the general topics announced in the Second Circular and recalled hereunder. Following a world-wide consultation (see *Palynos*: 12, 2, 1989 and 13, 2, 1990), 26 Symposia and 2 Workshops have been planned. The papers presented during Symposia will be published, after acceptance, by international journals. Poster Sessions will be thematically arranged and presented so as to permit the largest audience. All the sessions will take place simultaneously in rooms close to one another.

As promised, a special effort has been made towards moderate registration fees, particularly for attending junior members, whose status has been considerably extended and who are exempted from accommodation reservation fees by the Tourism Office of Aix.

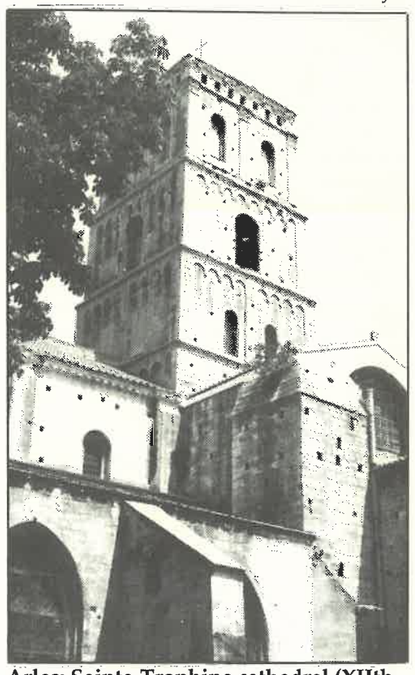
Numerous facilities and entertainments will be offered, for instance:

- a convenient Congress site with professional material;
- a guided tour of Aix;
- a Welcome Party with regional folk animation in a beautiful garden;
- introductory scientific lectures about the Mediterranean region;
- a Medieval and Renaissance music performance;
- Congress publications (abstract Volume, special issue of *Cahiers de Micropaléontologie* devoted to the Congress excursions and offered to all the attending members);
- photograph of the Congress participants;
- one full excursion day in Camargue, including a guided tour of Arles, a visit to a bird park, a lunch on the beach of Saintes-Maries de la Mer, a bull demonstration with games, dinner with gypsy songs and dances at Salins de Giraud;
- a Gala Party with a dance band (only the Gala Dinner is an extra charge);
- coffee breaks, Congress bag, etc....

In addition, the Organizing Committee hopes to be able to help some Eastern European and Third World scientists. They are invited to apply to the Congress Secretary when sending their registration form with abstract(s) and registration fees. The selection of those who will be offered financial assistance will be based on the originality and the quality of the research and results to be presented to the Congress.

As an illustration of works pursued in France and in the surrounding countries, ten excursions (two of them being planned both before and after the Congress) are proposed at reasonable cost.

Jean-Pierre **SUC**, Raymonde **BONNEFILLE**, Jacques-Louis **DE BEAULIEU**.



Arles: Sainte-Trophine cathedral (XIIth century)

INTRODUCTION TO PROVENCE

"Provence" is a historical entity, the extension of which varied since the Ligurian occupation (1,800-800 B.C.). It belongs to the present-day Provence-Alps-Côte d'Azur Region. Buttressed to the north by the Alpine "*Massif des écrins*", this region slopes gradually southwards across a patchwork of landscapes to the shore of the Mediterranean, between the Rhône delta and the Italian frontier (as illustrated on the cover of the 8th IPC Second Circular). These varied landscapes have been celebrated by famous poets and artists such as F. Mistral, H. Bosco, J. Giono and P. Cézanne or V. Van Gogh. "It is a complete whole, a microcosm of contrast and harmony," wrote Marie Mauron.

Map of Provence

Geology

The geological history of Provence is driven by important tectonic movements related to the convergence between African and European plates.

Except for the Southern Maures and Estérel massifs where endogenous rocks of Paleozoic age outcrop, Provence consists of marine sedimentary formations of Mesozoic and Cenozoic ages. The modern morphology of Provence results from the restructuring of these terrains during the Upper Cretaceous-Eocene and the Neogene.

Two major sedimentary episodes were linked to oceanographic events:

The first event corresponds to the opening of the Tethys Sea during the Triassic. During the Late Jurassic-Early Cretaceous time interval (i.e., during more than 50 My), Provence consisted of a large calcareous shallow platform with such specific facies as the Urgonian. Important tectonic movements uplifted the sedimentary cover, creating the main Provencal massifs: Ventoux, Sainte-Victoire and Sainte-Baume, in an east-west direction. This is the "Pyrénéo-Provencal" tectonic phase, partly caused by the intraplate collision between the European and Iberian cratons.

During the Neogene, the second sedimentary episode was directly related to the opening of the western Mediterranean basin (Ligurian Sea) resulting from the counterclockwise rotation of the Corsican and Sardinian blocks. Provencal reliefs were reactivated by the Late Miocene "Alpine" tectonic phase, which led to the formation of large subalpine folds and to the modern morphology of Alpine Provence.

During the so-called "Messinian Salinity Crisis," Provence was affected by an important phase of erosion, contemporaneous with the temporary desiccation of the Mediterranean Sea. The modern Mediterranean followed the flooding of the basin after the earliest Pliocene.

Climate

Provence's land relief and the sea play an important role in climate pattern. Maritime Provence enjoys a very agreeable climate with warm temperatures and little rain. It differs from Provence hinterland, where the latitude modifies the temperature considerably. But the dominant factor remains the extraordinary presence of the sun (more than 2,500 hours per year) in the region.

The Mediterranean climate is characterized by contrasting seasons: the summer drought lasts from June to the end of September, with rains no more than 70 mm and temperatures between 25 and 30ºC. Rain (sometimes as violent rainstorms) mainly occurs during autumn (from late September to late November) and spring (from March to May). The cold season is relatively mild, dry and often sunny.

The wind is an essential part of the Provencal climate; the most famous is the Mistral. This strong, dry and cold north-northwest draught sweeps down when the pressure is high over the mountains from the Massif Central to the Mediterranean, funneling through the narrow Rhône valley. It mainly blows during spring and winter. Besides the Mistral, two other winds should be mentioned: Marin, a southeast wind which bring rain, and Labech, a southwest wind which brings rainstorms.

Vegetation

In addition to its beautiful countryside, capped by a luminous sky, Provence possesses one of the most original natural habitats.

Panorama over Menton (Côte d'Azur)

All vegetation combined is closely dependent on climatic conditions. Flowering occurs as is normal elsewhere during the spring, and a second blossoming occurs in the autumn, lasting well into winter. The dormant period is during the summer when the heat only permits plants which are especially adapted to resist drought to grow: long tap roots, glazed leaves which reduce transpiration, bulbs which act as reservoirs of moisture and a protective perfumed vapor. During the summer, the dried-up plants of the underbrush, pine needles, and resins exuded by leaves and twigs are highly combustible. Consequently, the Provencal vegetation is particularly exposed to fires, which has two allies: drought and wind.

The olive tree and holm-oak demarcate the Mediterranean area as such, spotted with heaths. In Upper Provence the heaths disappear and are replaced by the forest cover (with downy oak, scots pine and beech) and the moors (with broom, lavender, boxwood). Other characteristic Provencal trees are the evergreen kermes or scrub oak, the maritime pine, the umbrella pine and the Aleppo pine, while in towns and villages the streets are shaded by plane trees.

Historical Heritage

Over the years, successive civilizations have left their stamp on the soil of Provence. Architectural landmarks abound. The Mausoleum at Saint-Rémy, the Roman theatres of Orange and Vaison, the amphitheatres of Arles, Nîmes and Fréjus, the Alpine Trophy of Augustus at La Turbie and the forgotten city of Glanum, attest to the "Grandeur that was Rome."

Expressions of Christian faith–the Romanesque churches and abbeys of Sénanque, Silvacane, Le Thoronet and Montmajour–impress visitors with the moving beauty of their sober lines.

The Medieval builders of the Gothic age left a rich legacy of religious architecture: the churches and cloisters such as Saint-Pierre's in Avignon, the Sainte-Baume basilica and the former Saint-Siffrein's cathedral in Carpentras. To them we owe a series of impressive secular buildings, the Popes's Palace in Avignon, one of France's most famous monuments, and the hilltop fortress of Les Baux, which overlooks the "*Val d'Enfer*". The hilltop villages scattered throughout the region, have a beguiling timelessness. Their narrow, shady streets are the very mark of Mediterranean lands.

Artists

The land of Provence has fostered and attracted artists of all kinds. Since the XV-XVIth centuries, the most famous of them came to the Holy See of Avignon (Villeneuve lès Avignon: "Coronation of the Virgin") and to Aix-en-Provence, where "Good King René" held his court ("Triptych of the Annunciation"). The XVII and XVIIIth centuries saw the development of baroque sculpture and architecture. The fountains, squares (*Quartier Mazarin*) and boulevards (*Cours Mirabeau*) that grace the center of Aix date from that period, as do the Old Charity Hospice and the Halles built by Pierre and Jean Puget in Marseille.

One can not visit Provence and not recall Van Gogh when in Arles or Saint-Rémy, Cézanne and Darius Milhau when in Aix, Corot and Ziem when in Martigues, Braque and Picasso when in Sorgues and Vauvenargues, and Le Corbusier when in Marseille, to name but a few.

And it is in Provence, at La Ciotat, that the Lumière brothers invented the cinema and in Marseille that Pagnol filmed his best works.

Literature

Provence is an ancient land. The Greek, the Roman and then the Occitanian civilizations never stopped influencing poets and writers.

The most famous poet, Frédéric Mistral, who expressed himself in Provencal, published in 1859 a twelve-cantos epic poem, "Mirèio," which enjoyed an immense success. Lamartine praised it and Charles Gounod made it into an opera in 1864. The Félibrige group of Occitanian poets and novelists included Alphonse Daudet and Charles Maurras among others. Born and raised there, Emile Zola found in Proven-

Marseille: the old port and Notre-Dame de la Garde basilica

cal village life the inspiration for some of his novels (the "Rougon-Macquart" series).

Contemporary Provencal writers have gained national recognition: Jean Giono from Manosque, Marcel Pagnol from Aubagne, René Barjavel from Nyons, and one of France's greatest poets: René Clair.

Lawrence Durrell, Graham Greene, F. Scott Fitzgerald, and H.G. Wells are among the English and American writers who at one time settled in Provence.

Handicrafts

Down through the ages, Provence has been a home for craftsmen. Many today continue their ancient trades. Established in the region's villages, they produce hand-made, traditional works: ceramics at Moustiers Sante-Marie, pottery at Villauris, glassware at Biot and Maurevieil, rugs and pipes at Cogolin, perfumes at Grasse, "santons" (clay figures for Christmas crèches) at Aubagne, etc.

Gastronomy and Wines

Provencal cuisine is second to none. Blends of garlic, olive oil, thyme, rosemary and basil give Provencal dishes unique flavour and character. The warm atmosphere of local restaurants sets the frame to appreciate the succulent specialities: *Daube*, a beef stew cooked in wine with herbs; *Bourride*, a whitefish dish served with a cream sauce; *Aïoli*, a garlic mayonnaise; *Pistou*, a vegetable soup with red beans flavoured with crushed basil and garlic; *Salade nicoise*, with black olives…and last but not least, the famous "*Bouillabaisse*", a fish stew made from Mediterranean rockfish flavoured with saffron.

The region is known for a wide selection of candies that are produced locally: Fruits confits from Apt and Nice; Calissons from Aix; Berlingots from Carpentras; Nougat from Sisteron…

The region's vineyards have a long-standing and well-earned reputation. The red wines of Gigondas and Châteauneuf du Pape are among the greatest in France. Lesser known, but worth of try, are the full bodied reds, delicately refreshing rosés and dry, fruity whites of Bandol, Cassis, Palette and Bellet and other "Côtes de Provence," all officially recognized labels.

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SPORES OF THE PTERIDOPHYTA. Alice F. Tryon & Bernard Lugardon. Springer-Verlag, New York (ISBN 0-387-97218-8); 648 pages, 2797 figures, 1990, US $98.00.

The incredibly intricate "hidden world" of pteridophyte spores is lavishly documented by scanning electron and transmission electron microscope micrographs in this fine volume by **Alice Tryon** and **Bernard Lugardon**. This book should be regarded as a companion to the beautifully-illustrated and informative *"Ferns and allied plants with special reference to tropical America"* (Tryon & Tryon, 1982); both are a must for pteridologists and palynologists. In the Tryon and Lugardon volume, spores of 252 genera of 35 families represented in the worlds' pteridophyte flora have been analysed and illustrated by high quality micrographs of their surface morphology and wall structure. In addition to providing generalised spore descriptions of each of the genera, there are supplementary comments on spore diversity within the genera, on spore morphologic/taxonomic relationships, and on the history of some of the genera as ascertained from the fossil record of comparable spores.

The work represents an integrated study directed towards elucidating systematic and evolutionary relationships of ferns and fern allies on the basis of spores. Using the classification system of **Tryon & Tryon** (1982), the genera are grouped into families; each family is prefaced by art-form silhouettes of foliage types representative of the family. Although controversy surrounds pteridophyte classification, spore morphology and structure provides some support for the sequences of families and genera utilised. The authors are commended for their synthesis of spore development and ultrastructure in the Introduction to the volume. This section represents an important bench mark for elucidating evolutionary trends within the pteridophytes based on character sets of their spores. One character that remains partially "hidden" in this work is that of exospore sculpture, which in most of the SEM micrographs is obscured or hidden by the perispore (or epispore in the water ferns). The inclusion of light microscope micrographs would have been valuable in detailing exospore sculpture, which represents an important comparative criterion where the perispore is lost through fossilisation or extraction processes. Nevertheless, the wealth of information and beautiful illustrations in the volume will provide the impetus for many to track down affinities of the myriads of spore taxa represented in the fossil record. Go to it paleopalynologists!

Tryon, R.M. & Tryon, A.F. 1982. *Ferns and allied plants with special reference to tropical America*, 857 pp. Springer-Verlag, New York.

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