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A FACTOR ANALYSIS OF CORRESPONDENCES APPLIED TO RING WIDTHS

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ABSTRACT

The factor analysis of correspondences has been applied to variations as a function of time of the ring widths of the Aleppo pine *(Pinus halepensis* Mill.) in the French Mediterranean region. This study, involving rings corresponding to 36 years of growth, demonstrates that a general climatic factor (factor 1) intervenes, as well as the constraint of external factors vis-a-vis individual reactions (factor 2).

Numerous factors govern ring width. The factor analysis of correspondences enables the demonstration that an important factor is the rain which falls during the vegetation period preceding the summer drought. The importance of the rainfall factor is conditioned by the date at which the average minimum daily temperature exceeds +4°C, as well as by the distribution of rain during the period in question and by the multiplying effect of the climate of the preceding year. The important effect of unusually low average minimum daily temperatures during the month of February is also stressed.

L'analyse factorielle des correspondances appliquée aux variations de l'épaisseur des cernes du pin d'Alep (*Pinus halepensis* Mill.) au cours du temps, dans la région méditerranéenne française, met en évidence l'intervention d'un facteur climatique de portée générale (facteur 1) et la contrainte des facteurs externes vis-à-vis des réactions individuelles (facteur 2).

Parmi les facteurs intervenant dans la détermination de l'épaisseur du cerne, l'analyse factorielle des correspondances permet de dégager la prééminence des précipitations de la période de végétation antérieure à la sécheresse estivale dont l'intervention est conditionnée par la date de l'établissement de températures minimales moyennes supérieures à +4°C, par la propre répartition de ces précipitations dans la période considérée et par l'écho multiplicateur des conditions climatiques de l'année précédente. L'action considérable des températures minimales moyennes exceptionnellement basses de février est aussi soulignée.

Es wurde ein Verfahren der Faktorenanalyse auf die in Abhängigkeit von der Zeit veränderlichen Jahrringbreiten der Aleppo-Kiefer (*Pinus halepensis* Mill.) aus dem französischen Mittelmeergebiet angewandt. Die Untersuchung von 36 Jahresringen zeigt, daß ein allgemeiner Klimafaktor (Faktor 1) ebenso wie weitere externe Faktoren gegenüber individuellen Reaktionen (Faktor 2) in die Jahrringbildung eingreifen.

Unter den zahlreichen Faktoren, die auf die Jahrringbreite einwirken, haben sich die in der Vegetationszeit vor der Sommerdürre fallenden Niederschläge als wichtig erwiesen. Ihre Bedeutung hängt von dem Zeitpunkt ab an dem die minimalen Tagestemperaturen im Durchschnitt +4°C übersteigen, ferner von der Verteilung der Niederschläge während der in Frage stehenden Periode sowie von der Wirkung des Vorjahresklimas. Die beträchtliche Bedeutung ungewöhnlich niedriger Minimumtemperaturen im Februar wird ebenfalls betont.

INTRODUCTION

The variations of ring widths of a given lignified species depend on intrinsic factors such as trunk form (Lück et al. 1970) or age (Ans 1973), as well as extrinsic climatic or ecological factors (Fritts 1962, 1965, 1966; Fritts et al. 1965 a, b; Serre et al. 1966; Borel and Serre 1969).

When investigating the relationships between ring width and directly measured or estimated external factors, stepwise multiple regression analyses are usually employed. The ring widths are the dependent variables (predictands, Fritts 1974) and the extrinsic factors are the independent variables (predictors, Fritts 1974). The already high performance of the stepwise multiple regression analysis has recently been improved by the introduction of the principal component analysis of the predictors such as precipitation and temperature (Fritts 1971, 1974; Fritts et al. 1971; LaMarche and Stockton 1974); the orthogonal property of the eigenvectors fully satisfies the assumption of non-correlation among the independent variables of the regression (Fritts 1974).

The present report deals with a factor analysis of correspondences (Benzecri et al.1973) applied only to ring width as a function of time, and also with the interpretation of the variations of the width which can be drawn from its results (Serre 1973). The method was subsequently used with the same material to study the role of intrinsic factors. It demonstrates perfectly the process of dependence between the width of successive rings (Ans 1976) already noted elsewhere (Serre 1973).

MATERIALS AND METHODS

The analysis was performed on the data gathered from the Aleppo pine (*Pinus halepensis* Mill.) growing in the region of Marseille, France. Twenty-four trees at the same site, in four age categories (60, 80, 100 and 140 years) were chosen. Three cores were taken from each tree, at 120° angles from each other (Serre 1973). The pines were carefully crossdated in order to detect any anomaly in ring chronology and the ring widths were measured to 0.01 mm under a microscope. Thirty-six rings per core were retained for study, corresponding to the years 1932 to 1967. The analysis was performed on 2,484 data (69 x 36) since only 69 of 72 cores were utilized.

The factor analysis of correspondences (Escofier-Cordier 1965; Benzecri et al. 1973) applies to the cases where, in a natural or experimental context, two sets (individuals : I and variables : J) or more are in relation whatever the nature of these sets may be. This sort of analysis can be considered as a particular case of the principal component analysis, but is distinguished from the latter by the use of the chi square statistic which supposes the utilization of the profile of the points rather than their actual values. Thus the "size" effect is attenuated in the comparison of individuals or of variables (Briane et al. 1974).

The chi square statistic gives such a symmetry to the clouds of points representing the sets *I* and *J* that at each factorial axis of the cloud of individuals (I) there corresponds a factorial axis of the cloud of variables (J) of the same eigenvalue. Thus it is possible to represent simultaneously individuals and variables on the plane defined by the axes which render maximum the moment of inertia of the clouds. The projection on the axes of the points representing *I* and *J* facilitates interpretation of these axes.

DATA PROCESSING

The analysis of correspondences was not performed directly on the 36 actual measured ring widths in view of several unsuccessful trials, but rather was effected on the annual frequency table of six width classes (Table 1).

In order to minimize the parasite influence arising from the individual factor and from age, the ring widths were first normalized. Each ring width of a core was divided

Table 1. Annual frequencies of ring-width classes during the 36 years studied.

	Width-classes (I)					
Years (J)	1	2	3	4	5	6
1967	17.0	31.0	16.0	4.0	.0	1.0
1966	7.0	18.0	23.0	13.0	5.0	3.0
1965	30.0	17.0	12.0	4.0	4.0	2.0
1964	3.0	11.0	8.0	20.0	15.0	12.0
1963	2.0	7.0	6.0	6.0	21.0	27.0
1962	6.0	11.0	15.0	20.0	12.0	5.0
1961	8.0	6.0	5.0	10.0	15.0	25.0
1960	17.0	7.0	11.0	6.0	12.0	16.0
1959	17.0	18.0	9.0	8.0	11.0	6.0
1958	26.0	23.0	6.0	5.0	7.0	2.0
1957	54.0	7.0	3.0	5.0	.0	.0
1956	66.0	3.0	.0	.0	.0	.0
1955	3.0	27.0	22.0	13.0	2.0	2.0
1954	3.0	9.0	25.0	23.0	6.0	3.0
1953	22.0	27.0	13.0	6.0	.0	1.0
1952	2.0	10.0	18.0	20.0	15.0	4.0
1951	3.0	16.0	18.0	13.0	13.0	6.0
1950	16.0	30.0	20.0	2.0	1.0	.0
1949	4.0	21.0	23.0	15.0	4.0	2.0
1948	.0	5.0	6.0	20.0	26.0	12.0
1947	15.0	20.0	23.0	7.0	3.0	1.0
1946	25.0	24.0	11.0	7.0	1.0	1.0
1945	48.0	16.0	5.0	.0	.0	.0
1944	1.0	6.0	18.0	18.0	18.0	8.0
1943	2.0	11.0	13.0	28.0	11.0	4.0
1942	.0	2.0	18.0	18.0	21.0	10.0
1941	.0	.0	5.0	15.0	25.0	24.0
1940	.0	.0	5.0	14.0	22.0	28.0
1939	3.0	.0	4.0	11.0	25.0	26.0
1938	.0	.0	8.0	5.0	23.0	33.0
1937	.0	2.0	7.0	17.0	18.0	25.0
1936	.0	.0	2.0	8.0	19.0	40.0
1935	.0	5.0	11.0	11.0	18.0	24.0
1934	4.0	13.0	13.0	15.0	13.0	11.0
1933	10.0	8.0	6.0	13.0	18.0	14.0
1932	.0	3.0	6.0	14.0	10.0	36.0

by the sum of the ring widths analysed on that core and the normalized ring widths as a whole were distributed among six classes of equal size. The normal ring widths of each core were then expressed by these classes. Finally, the annual frequency table of the 6 classes analysed (Table 1) was constructed: class 1 comprises the narrowest rings, class 6 the widest.

RESULTS

During the analysis, we retained only the first two axes (Table 2) which account for 62.11 and 26.59%, respectively, of the total inertia of the whole cluster of data points. We sought the significance of these axes by projecting on each of them the points of the two sets, width classes (I) and years (J) (Figure 1). The significance is based on the study of the relative proximity of the points of the two sets and also on the opposition of the extremes of each of the axes.

Significance of axis 1

The points of the "width classes" set are projected on the first axis in an orderly manner (Figure 1). Class 3 is near the origin, classes 1 (very thin) and 6 (very thick) are opposed in relation to class 3.

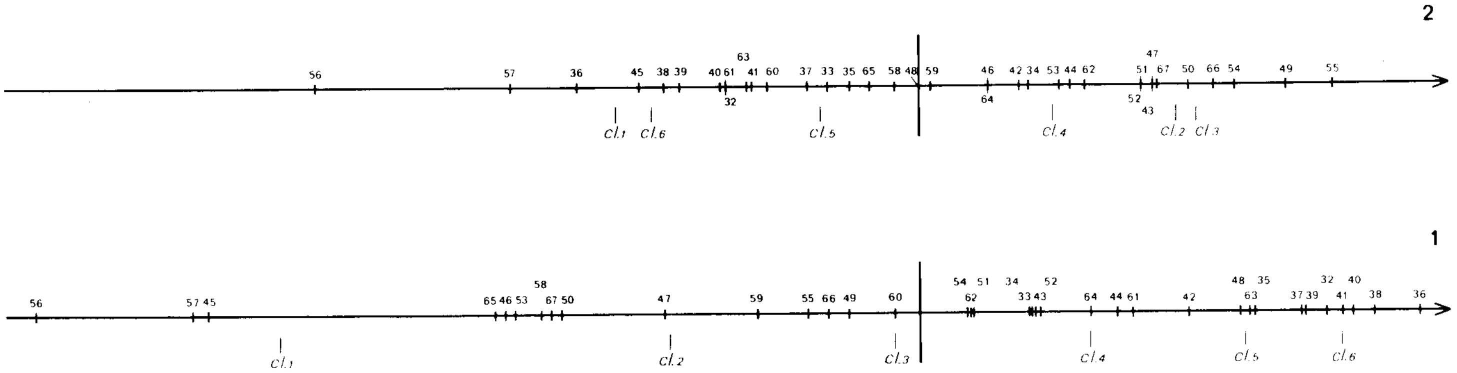

Figure 1. Projections of the points of the years and width-class sets on factor axes1 and 2.

Table 2. Absolute contributions of the points of the width classes and years to the eigen value of the factor axes 1 and 2 retained for analysis.

Factor axes		1	2	Factor axes		1	2
Eigen value		0.501	0.214	Eigen value		0.501	0.214
Percentage		62.11	26.59	Percentage		62.11	26.59
Absolute contributions:				Absolute contributions:			
(I)	Cl 1	647.37	146.657	(J)	1952	3.653	13.087
	Cl 2	101.451	107.030		1951	.727	12.987
	Cl 3	1.111	121.062		1950	34.579	19.251
	Cl 4	47.310	28.485		1949	1.550	35.293
	Cl 5	168.927	14.949		1948	26.776	.003
	Cl 6	278.709	114.679		1947	17.709	14.045
(J)	1967	35.954	14.836		1946	46.008	1.302
	1966	2.242	22.635		1945	134.516	21.237
	1965	48.619	.821		1944	10.432	5.817
	1964	7.946	1.199		1943	3.597	14.364
	1963	28.365	8.195		1942	19.221	2.612
	1962	.667	7.402		1941	47.370	7.798
	1961	11.848	10.374		1940	49.805	10.625
	1960	.176	6.406		1939	39.722	15.561
	1959	7.385	.038		1938	53.579	17.514
	1958	38.329	.174		1937	38.325	3.616
	1957	139.507	44.438		1936	65.404	31.179
	1956	204.129	96.311		1935	29.360	1.477
	1955	3.463	45.028		1934	3.061	3.248
	1954	.603	26.015		1933	3.251	2.447
	1953	43.313	5.127		1932	43.674	10.396

The points of the "years" set are apparently randomly distributed along the axis; 1936 and 1956 are on opposite sides of the origin. Knowing that these two years represent pronounced climatic particularities (Serre 1976a, Tables 3 and 4), the first factor can be interpreted as *climatic*.

In order to know in detail the climatic characteristics corresponding to the well opposed nature of width classes 1 and 6, an analysis was performed of the groups of years situated on the extreme left and the extreme right of the axis. Rainfall and temperature data for these years were obtained from the Observatory at Marseille, located 8 km from the pine site. They were considered separately or together for variable length periods (Tables 3 and 4), as a function of the results acquired during a prior analysis of the relationships between annual growth and the pattern of climatic records (Serre 1973, 1976a, b).

The analysis of these groups of years leads to the following findings:

1. The opposition of the two groups does not arise in an obvious manner from the total annual rainfall nor from the average annual temperature;

2. The annual rainfall-average annual temperature ratio (P/T), which constitutes an expression of average annual hygrometry, does not furnish any better explanation for their opposition;

3. Rainfall during the vegetation period preceding the summer drought (from about March to July for the species and region considered) is not totally satisfying either. It is certain, however, that this precipitation affects the distribution of the two groups of years but there are also one or several other associated factors.

The prior detailed analysis of the growth of the pine used in the present study (Serre 1973, 1976a, b) has shown that growth conditions during the years preceding

Table 3. Minimum average temperatures (ºC) recorded by the Observatory at Marseille between 1932 and 1967.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1967	4,2	6,1	8,3	8,8	12,9	15,0	19,6	18,4	15,2	13,6	9,6	2,7
1966	4,1	8,2	6,1	10,3	13,0	16,8	17,0	16,7	16,0	14,3	5,5	5,3
1965	4,3	1,0	6,5	8,5	12,3	15,6	17,1	16,8	13,9	14,1	8,3	6,1
1964	3,9	5,7	6,6	9,6	13,9	17,3	18,8	18,1	16,9	10,5	8,5	4,8
1963	1,4	1,5	6,4	9,3	11,5	15,7	19,3	17,0	15,3	11,4	10,6	4,7
1962	6,2	3,9	4,5	9,0	11,2	15,2	17,7	17,4	15,2	12,7	6,2	2,2
1961	4,2	6,9	5,8	11,6	12,4	16,2	18,2	16,8	17,5	13,0	8,0	6,2
1960	3,4	5,8	8,3	8,0	13,3	16,9	17,6	17,1	13,7	11,9	8,4	4,1
1959	4,0	5,4	9,1	9,2	12,7	15,7	18,6	17,7	16,3	12,2	7,2	6,1
1958	3,8	5,3	4,8	7,2	13,4	15,0	17,3	18,2	16,8	12,2	8,2	6,4
1957	2,8	7,1	7,9	8,6	10,9	15,2	17,7	17,1	13,9	11,3	8,4	4,8
1956	5,8	-4,2	6,3	8,2	12,6	13,6	16,9	17,6	16,8	9,9	5,1	3,9
1955	7,4	5,0	5,6	7,9	11,9	15,3	18,2	17,5	14,4	9,7	9,2	7,1
1954	1,6	2,9	7,1	8,0	11,1	15,8	16,1	16,1	15,2	11,1	8,5	6,1
1953	0,6	1,4	5,5	9,4	13,1	14,7	17,7	17,7	15,8	12,6	7,8	8,8
1952	1,7	1,6	8,2	10,0	12,7	17,5	19,7	18,3	14,0	11,6	6,5	4,7
1951	4,4	4,8	5,5	8,0	11,1	15,4	17,3	17,7	16,1	11,9	9,8	5,4
1950	3,5	5,9	5,8	7,1	12,7	16,9	19,9	18,7	14,5	10,9	7,3	1,6
1949	3,2	2,9	3,5	9,1	10,9	14,6	17,6	17,2	17,9	13,0	6,2	5,9
1948	5,4	5,0	6,9	9,1	13,1	14,8	15,1	17,0	13,7	11,2	6,8	5,5
1947	0,7	3,2	7,2	8,1	13,0	16,0	18,2	18,3	15,0	12,4	8,1	2,2
1946	3,6	4,8	5,8	9,9	12,1	14,1	16,9	17,2	14,4	10,7	6,5	2,5
1945	-0,8	4,9	5,7	9,0	11,9	15,9	17,9	16,7	14,7	11,2	6,1	4,0
1944	2,3	1,4	3,1	9,5	11,1	14,3	16,6	18,8	15,1	8,8	6,7	3,4
1943	4,6	4,1	6,8	8,6	12,0	14,6	17,5	17,2	16,3	13,7	6,2	5,6
1942	-0,1	0,0	7,8	9,2	11,5	15,7	16,8	16,9	15,6	11,8	5,3	4,3
1941	1,8	4,2	5,9	6,2	9,0	14,4	17,3	15,5	12,1	9,5	6,2	1,2
1940	0,4	4,7	5,7	8,1	11,6	14,3	15,7	15,9	14,5	10,2	6,8	1,9
1939	5,3	2,8	3,5	9,1	9,7	14,1	16,0	16,4	13,7	11,3	8,7	3,8
1938	2,2	2,4	5,6	5,3	9,8	14,5	16,5	16,3	14,1	10,7	8,9	4,2
1937	5,9	6,7	5,4	8,2	12,0	16,6	16,5	16,1	14,2	11,1	6,3	2,7
1936	6,5	5,0	6,4	7,9	11,1	14,2	16,8	16,1	15,5	6,7	7,2	3,9
1935	0,5	3,9	4,6	7,7	10,1	15,3	17,8	15,9	14,7	10,1	8,0	4,3
1934	2,2	1,4	5,8	8,8	12,2	14,8	17,4	15,7	13,5	9,5	5,3	6,6
1933	2,4	3,5	6,2	7,6	11,7	13,2	16,6	17,3	15,5	12,0	5,8	1,3
1932	3,6	-0,4	5,6	7,0	10,4	13,7	15,3	18,1	17,4	10,5	7,7	8,8

Table 4. Rainfall (mm) recorded by the Observatory at Marseille between 1932 and 1967.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1967	13	21	13	31	9	30	0	18	46	10	75	13	279
1966	47	109	2	76	26	15	8	30	44	150	87	17	611
1965	45	21	69	1	4	22	38	56	103	87	32	54	532
1964	39	97	87	21	18	11	9	42	35	38	45	74	516
1963	55	109	29	64	8	69	11	66	231	63	54	77	835
1962	23	86	20	23	11	47	0	1	37	55	155	49	507
1961	35	18	0	102	50	2	0	5	125	138	194	24	693
1960	44	83	83	12	2	14	9	72	62	171	91	72	715
1959	4	24	33	53	49	6	1	36	89	183	51	230	759
1958	20	2	36	50	13	13	30	67	95	78	54	121	579
1957	29	50	16	125	75	80	19	64	4	24	61	189	736
1956	58	52	113	57	22	41	58	16	69	42	70	8	606
1955	117	47	17	8	13	61	1	46	11	84	38	38	483
1954	35	88	43	37	96	14	17	10	16	13	84	52	505
1953	17	11	1	21	24	115	4	13	160	121	14	92	593
1952	52	18	12	49	69	4	1	27	60	26	34	87	439
1951	82	81	108	23	70	44	0	20	65	204	219	29	945
1950	13	57	54	28	16	1	0	27	31	75	16	105	423
1949	33	6	11	47	95	4	16	11	74	59	154	70	580
1948	118	19	73	85	81	33	0	24	93	113	9	36	684
1947	33	79	67	2	21	1	8	88	84	132	43	57	615
1946	52	10	99	78	57	4	0	32	8	42	93	34	509
1945	15	18	16	4	16	3	0	16	14	74	50	96	322
1944	8	44	0	39	22	14	51	9	59	150	20	20	436
1943	31	8	23	7	64	1	1	32	45	131	190	130	663
1942	49	44	42	49	3	26	2	19	59	136	17	135	581
1941	174	65	39	48	58	25	12	52	166	21	189	20	869
1940	34	18	20	63	93	131	11	28	19	149	23	44	633
1939	51	43	10	86	22	4	27	71	49	50	54	150	617
1938	30	23	12	5	296	10	3	9	158	72	95	79	792
1937	75	33	99	111	29	21	3	46	23	63	65	44	612
1936	145	40	146	75	65	74	3	0	4	22	20	67	661
1935	6	18	128	16	90	1	1	45	0	103	280	81	769
1934	10	13	23	132	4	9	0	16	7	125	141	97	577
1933	41	24	45	16	18	44	0	0	174	66	154	107	689
1932	135	6	38	53	47	54	141	76	274	27	75	92	1018

the formation of a given ring intervene in the formation of that ring and that their action is combined with that of rainfall during the vegetation period preceding the summer drought. The influence of the preceding year (and even of several others) on the width of a given ring is known and generally approached by considering either the meteorological data for that year and the width of the corresponding ring (Fritts 1962, 1971; Fritts et al. 1965b, 1971), or the type of liaison between the width of consecutive rings (Ans 1976). That rainfall has been considered and "the growth conditions during the previous year" have been introduced in the search for factors which could lead to a given width class by means of the ring width of that previous year.

The problem we faced was the means of expressing rainfall data of the current year and ring width of the previous year in comparable terms in order to determine the mode of combination of these factors. Each of these parameters was normalized. The average annual ring width was expressed on the basis of the average width of all the rings and the rainfall of the vegetation period preceding the summer drought of a given year was expressed on the basis of the corresponding average figure for the 36 years analyzed. These two values were combined by multiplication. The values obtained for each of the two extreme groups of years on the first axis give the most faithful image of the distribution of the years on the axis considering their contribution to the eigen value of the axis (Table 2). The years located to the left of the origin present the lowest values of the product, those situated to the right the highest values.

The existence of three exceptions for the data located to the left of the origin (1953, 1956, 1965) led us to more closely examine the meteorological characteristics of each of these years (Tables 3 and 4). The following could be further defined:

1. The very low minimum temperatures of February are implicated in the formation of very narrow rings or even in their nonformation. Although 1956 was normal from the point of view of rainfall, it was exceptionally cold in February: the minimum monthly average temperature at Marseille was -4°C, as opposed to + 3.5°C for the years 1922-1971 (Serre 1976a). In addition, such temperatures can plainly be located anatomically because they lead to the formation of frost cells (Monange 1961; Parker 1963; Serre et al. 1966; Glerum and Farrar 1966).

2. The *useful* quantities of rain during the vegetation period preceding the summer drought depend on the minimum February temperatures. In the Aleppo pine, cambial reactivation occurs about one month following the establishment of average daily minimum temperatures greater than + 4°C (Serre 1976a). When February temperatures are lower than this required threshold, rainfall during March does not appear to count among the useful quantity of precipitation.

3. Considering the growth conditions of the previous year, the relationship between the useful rainfall during the vegetation period preceding the summer drought and the width of a given (especially a narrow) ring depends on the relative importance of rainfall at the beginning and the end of this period. The relationship is direct when there is more rainfall at the beginning than at the end of this period but can be aberrant when the reverse is true (1953, 1965). This finding is consistent with the distinction, made during the analysis of the annual growth pattern of the Aleppo pine (Serre 1976a), between rain falling at the beginning of the vegetation period preceding the summer drought (March, April, beginning of May) which is related to the value of maximal acceleration of cambial activity, and rain falling at the end of this period (end of May, June and July) which prolongs the variable part of the phase of high cambial activity (Serre 1976a, b).

We also considered the product of the expressions of the previous growth conditions and of the annual rainfall, or of the ratio P/T, where P is the annual rainfall and T is the average annual temperature; these products gave no better approach to the distribution of points along the axis than that just discussed. When January and February rainfalls were added to that occuring during the vegetation period preceding the summer drought, the proposed interpretation was not improved either.

Factor 1, which integrates both the climatic conditions (rainfall and temperature) of the year preceding the formation of the ring and those of a part (March to July) of the year of its formation, is a "general interest" factor (Benzecri et al. 1973), as expected from the type of analysis utilized.

Significance of axis 2

Contrary to what is seen on axis 1, the two extreme clases 1 and 6 of the width classes set are close together on one side of the axis and oppose classes 2 and 3 (Figure 1).

The distribution of the points of the years set around classes 1 and 6 is an exact reproduction of that which was observed on axis 1 for class 6 but only partially so for class 1.

The years 1956, 1957, 1936, 1945 and 1938 on one hand, and 1955, 1949, 1954, 1966 and 1960 on the other hand, present, among the points of the set "years", the highest absolute contribution to the eigen value of the axis (Figure 1, Table 2). The opposition of these two groups of years is expressed in the following observations:

1. According to Table 1, the distribution of width classes frequencies is highly asymmetrical for the left-hand group of years and is symmetrical for the right-hand group.

2. At the two extremes of the axis, 1956 opposes 1955. The dominant climatic element of 1956 was the exceptional cold of February (Table 3); *all* the rings from this year are *very narrow* and are distributed almost exclusively in one class. In opposition is 1955 where the growth conditions of the previous year (evaluated as we have just explained) and rainfall of the vegetation period preceding the summer drought were average (Table 4); *all* the rings from this year are of *varying width* and are distributed among *all* the classes. The years which, by their absolute contribution to the eigenvalue of the axis, are close to those at both extremes of the axis exhibit, as them, dominant characteristics (left-hand group) or average characteristics (right-hand group) concerning the factors discussed for axis 1.

Axis 2, therefore, translates the external factor-provoked constraint on the tree: in the presence of a strong constraint (favorable or unfavorable) the response of all the individuals is uniform, resulting in the observed uniformity of classes; when the constraint is weak, the response of each tree becomes a function of its own nature, resulting in the variety of classes observed.

The class 4 ring widths are the closest to the average width of all the rings examined (Serre 1973); it is interesting to note that the minimum intervention of factor 2 is translated as classes inferior to the average (Figure 1).

CONCLUSIONS

The factor analysis of correspondences applied to the study of tree-ring width variations as a function of time emphasizes the role of climatic factors.

Because of the significance of the initial two factor axes, which extract 88% of the total inertia of the points considered, we could demonstrate the multiplying action of the growth conditions during the year preceding the formation of a ring towards the rainfall of the vegetation period preceding the summer drought. In addition, we could demonstrate the effects of climatic constraint and thereby the conditions of maximum manifestation of individual idiosyncrasy.

Such results show that the factor analysis or correspondences can be used for any analysis of ring width, either alone or as a preliminary study to more extensive research concerning the causes of these variations.

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