POLLEN: A SURVEY

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FRG

A. CAILLAS (1958) is apparently the first to have written a popular book on collection, properties, and uses of the pollen yielded by flowers.

Research on pollens and their collection by pollen traps had been obviously done previously to the publication of CAILLAS' book.

At Laboratoire de Recherches Apicoles at Bures-sur-Yvette, CHAUVIN has initiated the dietetic use of pollen.

Pollen production – the amount in excess of the bee colonies' requirements – has however been approached at the present scale only since 1950s.

Pollen supply is still quite low.

The quality of pollens available varies, being dependent on:

- the flower plant;
- how it is handled by the beekeeper, the conditions under which it is collected by pollen traps;
- packaging;
- storage.

1. Chemical composition of pollen

The pollen grain is a complex element, consisting of a nucleus – the male inherited part, protoplasm, and an extremely resistant sporodermis.

1.1. The sporodermis is only a small part of the pollen grain, but its composition and morphological structure are of a great practical importance. First, it protects the contents of the pollen grain under extreme conditions. Second, it is useful to palynologists in identifying the type of pollen – because of its different morphological structure.

According to STRASSBURGER the sporodermis of angiosperms is similar in principle to that of gymnosperms but in the former differentiation is greater.

The sporodermis consists of several layers whose composition and structure varies from one another.

From the inside to the outside: the protoplast (plasma body) lies next to intine which is slightly stable chemically and physically and consists of many pectins. But the contents of the pollen grain is actually protected by the exine which consists of several layers. The inner layer is the nexine, whose structure is lamellar and consists of 2-3 layers. The outer layer is the foot layer and belongs to the sexine around it.

The sexine includes the oil substances – constituents of the resins in pollen.

The pollens of most plants pollinated by animals are sticky. Openings (apertures) in the exine generally exist, through which the intine often emerges. BARBIER reported that the exine consists of polymerides with high molecular weight, with the following formulas:

$$C_{90}H_{142}O_{27} - C_{90}H_{142}O_{25} - C_{80}H_{144}O_{24} - C_{90}H_{139}O_{26}$$

Its general composition is: 10-15% cellulose, 10% xylene fraction, and 55-65% lipids, and varies in different species, genera, and families.

According to STRASSBURGER, the exine mainly consists of terpenes. Lately, it has been assumed that it results from the oxidative polymerazation of carotenoids and of carotenoid esters.

As already stated, the exine is a very stable substance. Tests made by myself showed that exine is not altered after being boiled in an alkaline solution and then soaked into a mixture of sulphuric acid and acetic anhydride. Under normal conditions, the exine would not be altered *in vitro* by chloropepsin – even after 96 hours, and it would not swell either.

BARBIER reported that the exine consists of over 50% lipids and that these are likely to be split by the lipase in the digestive tract. This process could be important in relation to the access of the proteolytic enzymes to the contents of the pollen grain.

MARTINHO reported on his investigation of how are pollens digested by *Melipona quadrifasciata* and *Apis mellifera,* both on live bees and *in vitro.*

He found that, both in *Melipona* and *Apis,* the sugar content in the honey sac differs from that in the ventriculus. Because of this difference, the pores of the exine open readily thus providing for access of the proteolytic enzymes to the intine. Digestion proper hence consists of the hydroizolation and washing of the proteins of the intine. The exine remains intact. The combined effect of the osmotic pressure (50% sugar content in the honey sac and 19% in the ventriculus) and of the proteolytic enzymes results in a synergic effect which increases digestibility to a greater extent than the added effects of each of them (MARTINHO's results are the same as the data reported earlier by HEJTMANEK).

These two studies might prove useful in the research on the digestibility of pollens in the human body.

1.1.1. The freshly collected pollen has a 30% warer content, which makes its storage hardly possible.

Following microbiological investigations, AGUAR MONTERDE found that the pollens collected by bees contain a bacteriostatic principle which does not exist in the hand-collected pollens. It must be the same glucose oxidase which is present in honey.

Apparently, the natural bacteriostatic principle cannot prevent alteration – by mould, for example – of pollen by itself alone; therefore, bees add lactic acid bacteria to their pollen stores. In common practice, the moisture content of pollens is reduced to 8-9% by drying it up to 70 ^{O}C. As a result, the dried pollens are more or less digestible, which means more or less active.

As suggested by the author, the Hungaronektar Company in Budapest has stored pollen in honey, without previously drying it. In a sample, pollen accounted for 15% of the total amount. The sample was kept at room temperature, and no alteration was found to take place until mid December. Microscopic examination showed that the pollen grains in the sample are swollen. The results of the bacteriological assay are given in Table 1.1., and are partially similar to those reported following bacteriological assays of dried pollens.

Table 1.1

Bacteriological assay of a honey sample including 15% pollen

Total number of aerobia		at the surface	in depth
	- nutritive agar-agar	1,860	8,250
	- gelose lactose	630 (no acidification)	450 (no acidification)
Streptococci		absent	absent
Lactic acid bacteria		absent	absent
Enterobacilli		absent	absent
Salmonellas (after enriching)		absent	absent
Haemolytic staphylococci		absent	absent
B. cereus		absent	absent (but other sporulated aerobia developed)
Sulphite-reducing clostridia		absent	absent (but other aerobia developed)
Fungi/yeasts cultured immediately after enriching		absent yeasts and one mould colony	absent yeasts

1.2. Overall composition

Data about the composition of pollens are given in tables 1.2.1., 1.2.2., 1.2.3., and 1.2.4. All refer to dried mixed pollens from Hungary, and to their overall composition.

According to DVORZHAK the protein content of pollen is comparable to a certain extent to that in dried legumes, just as its digestibility.

The content of free aminoacids is low: proline – 1.050 %; the content of glutamic acid is very low, and a comparative assessment of the aminoacid content of pollen and that of legumes is limited because of the aminoacids with sulphur.

The fact content – 11 % on average – is higher than in most legume (except soy bean). The content of free fatty acids is substantial – about 55 % (C18 : 2 added to C 18 :3). The content of the A, C, E, and P vitamins are above the average. That of B_1 is almost double than in meat and liver, and the content of B_2 and of nicotinic acid is comparable to those in some animal products. The oligoelements content stands at the average value, while the content of Cu and Pb are above the average.

Table 1.2.1

Physiologically important pollen components (reported by Dvorzhak)

Nutritive principles	%
Dry matter	83.0
Lipids	11.2
Albumins	23.0
Sugars:	
total as invert sugar	35.6
glucose	14.3
fructose	19.4
Ash	2.4
Lipids (as lecitine)	1.65
Phytosterol	1.56
Other	13.2
Fatty acids:	
C_{14} : 0	3.7
C_{16} : 0	23.7
C_{16} : 1	4.1
C_{18} : 0	4.3
C_{18} : 1	9.0
C_{18} : 2	17.2
C_{18} : 3	38.0

Table 1.2.2

Free amino acids	mg in 100 g	% of total albumines
Alanine	30	7.0
Arginine	22	4.8
Asparagine	traces	9.7
Cystine	-	0.88
Phenylalanine	-	5.3
Glycine	-	9.2
Glutamic acid	-	5.3
Histidine	traces	2.6
Leucine	-	15.8
Lysine	10	5.8
Methionine	-	0.88
Proline	1050	10.6
Serine	15	5.7
Tyrosine	22	4.6
Threonine	-	5.1
Valine	45	6.2

Table 1.2.3

Physiologically important pollen components (reported by Dvorzhak)

Vitamins	mg in 100 g
Total carotene	17.6
β-carotene	0.6
E	3.2
C	30.0
P – Rutin	60.0
Quercitin	2.5
Biotin	0.0063
B_1	0.84
B_2	0.54
Niancin	4.80
Pantothenic acid	0.32
Folic acid	0.30

Table 1.2.4

Minerals	
Inorganic phosphorus	mg/100 g 194
Potassium	mg/100 g 400
Natrium	mg/100 g 28
Calcium	mg/100 g 178
Magnesium	mg/100 g 94
Copper	ppm 10.5
Zinc	ppm 75.7
Chromium	ppm 0.24
Manganese	ppm 0.0072
Cobalt	ppm 0.127
Molybdena	ppm 0.137
Lead	ppm 0.72

The content of inorganic phosphorous is surprisingly high, being exceeded only by that of potassium. The term “inorganic phosphorous” would indicate that the phosphorous content was determined in ash. But it should actually be the phosphorous as a constituent of nucleic acids. The relatively high sugar content in pollens collected by bees reported by DVORZHAK and other authors comes from the nectar which bees add when making the pollen pellets.

Table 1.2.5 (BOSSI and RICCIARDELLI D’ALBORE) give the composition of 29 Italian pollens collected by bees – in Umbria, Latium, and Abruzzi. The 29 mixed pollens were manually sorted, and then their geographic and botanical origins were determined. The figures in table 1.2.5 are essentially different from those in table 1.2.2.

RICCIARDELLI D’ALBORE found, just as DVORZHAK, that the free proline content exceeds that of all the other amino acids.

The protein content (according to KJELDAHL Nx6.25) of the pollens investigated ranged between 15.01 % (*Tussilago farfara*) and 36.73 % (*Echium vulgare*), the average being 24.23% and comparable to that found by DVORZHAK (23 %).

The values reported by BOSI and RICCIARDELLI D’ALBORE also varied in different species, but were quite uniform within plant families. This finding is certainly important for the further chemical study of pollens. The two authors point out that the content of free amino acids is essentially different from that reported by other authors.

They assume that this difference is due to the proteolytic processes induced by bees, giving as an example the *Quercus robus* pollens which, when collected by hand have a 2.02 g content of free amino acids (in 100 g dry matter), while when collected by bees the amount of free amino acids in them stands at 5.11 g.

Table 1.2.5

Average amino acid content determined in 29 Italian honey samples

	Free amino acids				Amino acids in proteins %	
	g/100 g pollen		%			
	Average	(minim-maximum)	Average	(minim-maximum)	Average	(minim-maximum)
Alanine	0.110	0.48-0.274	2.64	1.20-4.80	5.38	3.91-7.91
Valine	0.039	0.011-0.120	0.99	0.22-3.53	6.91	4.06-11.17
Glycine	0.032	0.013-0.063	0.76	0.33-1.37	4.81	3.67-5.80
Iso-leucine	0.017	0.006-0.065	0.43	0.11-1.94	7.00	4.11-12.43
Leucine	0.094	0.004-0.661	1.73	0.10-10.15	9.06	6.73-11.42
Proline	2.962	0.820-4.898	65.75	47.90-77.85	6.21	4.80-9.49
Thereonine	0.013	0-0.37	5.28	0-0.72	5.28	1.03-7.53
Serine	0.073	0.008-0.191	1.96	0.18-7.44	4.95	0.60-8.91
β-amino-butyric acid	0.083	0.022-0.244	2.02	0.55-4.82	-	-
Methionine	0.047	0.010-0.320	1.06	0.15-5.81	1.17	0.13-2.41
Hydroxiproline	0.058	0.003-0.204	1.42	0.09-5.90	0.89	0.14-3.16
Phenylalanine	0.025	0.004-0.093	0.59	0.09-2.19	5.94	5.00-7.36
Asparagine	0.414	0.114-2.002	9.04	1.93-40.18	12.57	10.06-14.32
Glutamic acid	0.187	0.038-0.620	4.07	0.49-12.11	12.18	10.37-15.78
Tyrosine	0.040	0.008-0.072	1.00	0.19-2.13	3.69	1.94-6.90
Lysine	0.043	0.008-0.115	1.14	0.20-3.15	7.70	4.14-13.63
Tryptophan	0.008	0.002-0.015	0.30	0.16-0.45	0.18	0.14-0.30
Arginine	0.200	0-0.729			5.35	0.06-9.83
(Cystine) 2	0.012	0-0.072	4.48	0-11.78	0.51	0-3.02
β -alanine	0.016	0.004-0.028	0.46	0.08-0.99		
Histidine					0.98	0.17-3.17
Total g/100 g	4.464	1.523-6.845				
Free amino acids						
Proteins x 100	18.43	6.06-31.53				
Proteins %					24.23	15.01-36.73

The fact that the content of various amiso acids varies greately is important in appreciating pollens, and the authors exemplify it:

Echium vulgare – very high content of asparagine: 2 g (average 0.41 g);

Galega officinalis – high content of α-alanine, proline, β-amino butyric acid, phenylalanine, and lysine;

Erica scoparia – high content of leucine and proline;

Zea mays – low content of leucine, but the highest content of proline (77.8 %);

Salix caprea – has the highest content of valine, lysine, and tyrosine of all pollens;

Prunus communis – high content of arginine and low content of *iso*-leucine;

Quercus robur – relatively high content of glutamic acid, glycine, and tyrosine;

Castanea sativa – the content of methionine, thereonine, proline, and β-amino butyric acid are higher than the average values.

The authors conclude that the average values of the protein-amino acid content in pollen and royal jelly are quite similar. But the content of free amino acids in pollen is different from that in royal jelly.

On the basis of BOSI and RICCIARDELLI D'ALBORE findings, TALPAY found that of decisive importance in determining the chemical composition of pollens is the free amino-acid-protein content ratio, fact also confirmed by the findings of SIMIDCHEV.

2. Physiological effect of pollens

Extensive investigation is conducted at present of this matter, especially in the Soviet Union and east European countries. But researchers in Italy, France and Sweden are also working on it. The effect of pollen was first reported by beekeepers who noted that the pollen freshly collected by bees was efficient in weakly conditions – in 30 g doses/day.

The author of this paper knows the results of clinical investigations in this respect, made in Hungary. They were initiated by Hungaronektar, and were conducted in several clinics in Budapest, both on patients and rats.

2.1. The tests described here were intended to determine the acute toxicity of pollens. They were made at the research hospital at Kecskemét, Bács-Kiskun county (Hungary) under the supervision of D. KISS and R. FARAGO.

Sixty male white rats – Wistar strain, reared at the Faculty of Medicine in Szeged (Hungary) were used. Three groups were made at random:

1. *Control groups* (n=2x5 rats)
1.1. Fed on usual rat food
1.2. Fed on rat food and 4 ml distilled water – *per os* with a probe.

2. *Test groups* (n=4x10)
Fed on normal rat food and gradually increased doses of pollen in distilled water 1 : 1, *per os*, with a probe.

3. *Test group* (n=10 rats)
100 g pollen collected by bees and water *ad libitum* were supplied to the 10 rats daily. Pollen consumption was checked daily.
The results of the tests are given in table 2.1.1.

Table 2.1.1

Test results

Test group	Food administered	No. of test animals	Amount of pollen in food	Death rate	Weight (g)		Weight gain (g)
					At the beginning of tests	At the end of tests	
1.1	Usual rat food	5	-	-	224±5.2	240±6.8	+16±4.4
1.2	Usual rat food + 4.0 ml distilled water	5	-	-	227±6.5	242±6.7	+15±5.0
2.1	Usual food + pollen	10	2.25	-	227±7.9	245±8.0	+18±4.9
2.2	Usual food + pollen	10	4.5	-	223±7.5	224±7.8	+21±4.8
2.3	Usual food + pollen	10	9.0	-	224±8.0	246±8.5	+22±5.0
2.4	Usual food + pollen	10	18.0	-	220±7.4	250±8.5	+30±4.8
3	Pollen alone	10	38.2	-	230±8.5	248±8.7	+18±5.1

Observations on the behaviour of rats were taken throughout the tests. The data recorded were processed by STUDENT Test “t” (calculus of variations).
The data given in the table show that supplementary feeding with pollens has positive effects inducing increase in weight, which was significant only in the test group 2.4 (+30±4.8 g). The average pollen consumption was determined in the test group 3 and was found to be of 38.2 g/kg.
The behaviour of animals was normal, no change being recorded in their motility during the test. After the tests, the rats were slaughtered and dissected. No significant changes were recorded at the macroscopic examination. The two workers found no toxic effect in rats due to the pollen collected by bees.
The increase in weight of the test animals is a positive element. The two workers pointed out that the daily amount of pollen consumed by beekeepers accounts for only about 1.3 % of the highest dose supplied during the tests.
2.2. With the assistance of L. GUBACSI (Kecskemét, Hungary), the two workers extended the test to 8 weeks. Male white rats of CFY (LATI) strain were used.
The 1st group (n=10), 2.2.2., was the control group; usual rat food was given, and water *ad libitum*.
The 2nd group (n=10) was fed on pollen and water *ad libitum*.
During the 8-week test rats were not disturbed but for weighing once a week.
After the test, the rats were anesthetized with ether, and blood samples were taken from their tails. Then, they were slaughtered and histological examination made. The results are given in table 2.2.1.
The results of biological assays are given in table 2.2.2.

Table 2.2.1

	At the beginning of tests	Test weeks							
		1	2	3	4	5	6	7	8
Weight in g	141.5	176.5	217.0	232.0	265.7	290.0	295.0	299.0	300.1
x±s	±4.1	±5.2	±4.9	±6.2	±7.1	±7.6	±8.8	±8.1	±10.1
Weight in g	138.2	175.5	232.3	256.5	245.3	227.9	211.4	208.2	201.3
x±s	±3.9	±4.3	±6.0	±6.4	±6.1	±6.2	±5.8	±5.8	±5.4
p	-	-	-	1%	-	1%	-	-	-
Difference (g)	-3.3	-1.0	+15.3	+24.5	-18.4	-62.1	-83.6	-90.8	-99.8
x±s	±2.2	±2.4	±3.9	±4.1	±5.2	±5.0	+4.3	+5.3	+5.6

p = probability of treatment inefficiency; s = straggling range of results; x = arithmetic mean

Table 2.2.2

	SGPT (U)	LDH mU/ml	LDH ratio	HN mg/100 g
	x±s	x±s	x±s	x±s
First test group	89.8	815.3	0.975	20.3
	±26.3	±296	±0.02	±4.3
Second test group	231.2	515.0	0.884	29.2
	±36.2	±127.7	±0.11	±3.0
p	1%	5%	5%	1%

U = units; mU = milliunits; s = straggling range of results; x = arithmetic mean; p = probability of treatment inefficiency

Biological assays covered determination of serum transaminase (SGPT) – according to REITMANN-TRAUCHEL, of lactodehydrogenase (LDH) – according to WROBLEWSKY, of LDH level (LDH-p) – according to BASBON et al., and of the nitrogen content of uric acid (HN) – according to GRABENER.

The daily pollen consumption/individual rat was 38.2 g/kg, just as during previous tests.

The increase in weight of the test groups was more marked in the second week and significantly greater in the third week as compared to the control group, while in the fourth week this positive effect was more marked in the control group.

The authors consider that this is due to the fact that pollen first stimulates weight increase because of the active substances it contains. But obviously, pollen is not sufficient as food for rats. When rats were fed on pollen alone, an undesired decline in the weight increase rate was recorded in the fifth week.

The authors specified that the data given in table 2.2.2. resulted from blood samples taken from rats anesthetized with ether. That is why they are not the same as those in relevant literature, both for control and test groups. But the authors used the same method of blood sampling for the test groups and consequently the values obtained are comparable.

In determining the LDH and LDH level, no significant differences between the two test groups were recorded.

But the SGPT and HN values differed significantly.

The results of the biological assays are not yet sufficient for elucidating the cause of this difference. With pollen alone as food, disorder in the function of kidneys and that of the liver was however recorded.

Subsequent tests showed that this is not due to a toxic effect of pollens, but to the negative phenomenon mentioned above.

2.3. The results of previous tests led the authors to assume a possible antitoxic effect of pollens and made further tests.

Seventy GFY (LATI) male rats were used, in which disorder in the liver function was induced by carbon tetrachloride (CCl_4). The methods described by R.O. RECHAGEL (1976), P.K. DAS (1974), and SZELENYI (1972) were used.

The results obtained are given in table 2.3.1.

The 1st and 3rd groups were larger than the other groups; this was necessary because tests had to last until cirrhosis appeared. Every week a test animal was slaughtered for histological examination. The results of the tests were assessed both by biochemical analysis of blood serum as in the previous tests, and by histological examination of the liver.

After the tests were over, all rats were slaughtered for histological examination of their livers.

Table 2.3.1

Test group	No.	Treatment	Type and amount of food
Control	20	1st-4th week: 2x0.05 ml edible oil/100 g weight/week, subcutaneously 5th-8th week: 3x0.1 ml edible oil/100 g weight/week, subcutaneously	Usual rat food and water *ad libitum*
Third	20	1st-4th week: 2x0.05 ml of 1 : 1 mixture of CCl_4 and edible oil/100 g weight/week, substaneously	Usual rat food and water *ad libitum*
Fourth	10	Same as in the third test group	Usual rat food and water *ad libitum* and 1 g of pollen/100 g weight, in the morning
Fifth	10	Same as in the third test group	Usual rat food and water *ad libitum* and 4 g pollen/ 100 g weight, in the morning
Sixth	10	Same as in the third test group	Usual rat food and water *ad libitum* and 4 g pollen and 0.3 g royal jelly/100 g weight, in the morning

SGPT values for the control group and the 3rd test group are given in table 2.3.2.

In the 3rd test group, SGPT values were 10-11 times higher than in the control groups.

Table 2.3.3. gives the overall results of biochemical analyses, and the weight of test groups at the end of the 8-week tests. Results were processed by statistic methods.

Table 2.3.2

Tests groups	Test weeks						
	2	3	4	5	6	7	8
	SGPT units						
Third	29	38	94	110	140	320	550
First	35	49	71	63	69	78	49

Table 2.3.3

Tests groups	1st	3rd	4th	5th	6th
SGPT units	89.7	488.9	430	124.3	86.2
x±s	±26	±206	±235	±57	±20.2
LDH in mU/ml	818.3	1247.2	426.7	632	634
x±s	±296	±118.6	±96.6	±80.5	±211.5
LDH ratio	0.975	1.498	1.144	1.114	1.190
x±s	±0.02	±0.06	±0.13	±0.09	±0.05
Weight (g)	301.1	307.5	303	306.1	295.8
x±s	±10.1	±8.6	±9.0	±8.9	±11.2

The test animals tolerated the treatment quite well; none died although the stage of liver cirrhosis was advanced indeed. The results of biochemical assays of the 1st (control) group and the 3rd (test) group were significantly different.

Significant differences were also recorded between the 1st and 4th groups with respect to SGPT values, just as between the 3rd and 5th, and between the 3rd and 4th groups.

The results obtained show that pollen has no toxic effect on rats. Noteworthy is that great amounts of pollen suppressed the pathologic development of the enzyme activity.

Histological examinations were made by J. LESZNYAK and G. KOVACS. After the tests were over, the rats were slaughtered and preparations of liver were made according to the methods described in literature. Typical microscopic pictures were photographed by the authors.

In the 1st group the liver tissue was found to be healthy, except just a few cases. The authors point out that the liver of control animals was healthy and uninjured.

In the 3rd group the authors found continuous changes in the liver, with serious changes being recorded in all animals at the end of the tests, the most serious ones being in the liver tissue.

Differences were found to exist between the 4th and 3rd groups at histological examination: in the 4th group the damage was more extensive also affecting the biliary system.

The general condition of the 5th group was considerably better than that of the 3rd and 4th groups.

Here are the conclusions of LESZNYAK and KOVACS following the extensive histological examinations.

The test method used for determining the antitoxic effect of pollens was the right one.

Treatment with CCl_4 caused more or less substantial alteration of the liver tissues.

Liver cirrhosis cannot be prevented with even the highest doses of pollens, but its development can be substantially delayed. But during the tests, one could not find out whether the further development of cirrhosis could be suppressed.

Similar results were reported by the Romanian authors M. IALOMIȚEANU, C.L. HRISTEA, C. BUTOIANU, and Lucia ONIȚIU at the XXth International Congress of APIMONDIA, Bucharest, August 1965.

At the “Prof. V. Babeş” clinical hospital in Bucharest, the authors treated a number of patients with affections of liver parenchyma with 25 g pollen mixed with honey, daily. In 30-45 days they found that the protein balance had been restored (serum electrophoresis), and also a considerable improvement in the patients’ condition. The pollen was well tolerated, with no allergenic effects.

2.4. The Swedish scientists G. JONSSON – of the Urology Clinic of the Upsala University reported successful results in the treatment of prostatitis with pollen (preparations with pollen).

The latter has treated a number of patients with pollen preparations for many years, and in some cases he has not used the classical therapeutical methods. What is remarkable is that he obtained successful results, with no secondary effects being recorded.

2.5. In concluding, worth mentioning are a number of papers presented at the 25th Internacional Congress of APIMONDIA, 1975.

G. CALCAIANU and F. COSMA (Romania) reported possibilities of treating puberty and adolescence disorders with bee products. Experiments were made on 67, 15 to 18-year old teenagers.

The authors recorded the clinical symptoms which appear in the months of “biological crisis”. Special heed was paid to the neurophysical and tropic, as well as neuro-vegetative, vaso-motor and sensori-motor disorders in the pupils. By electromiographic tests (ALAJOUANINE et al.) excessive neuro-muscular excitability was recorded. In addition to the clinical and laboratory results, also considered were the behaviour of pupils at home and at school.

The authors concluded that serious behavioural disorders could be prevented by treatment with honey, pollen and royal jelly.

E. GHEORGHIEVA and V. VASILIEV (Bulgaria) reported data concerning the effect of pollen in hyperlipaemia caused by arteriosclerosis in 60 older people.

One spoon of pollen was administered to them twice a day before meals, for 30 days. The lipids, total cholesterol, triglycerides, free fatty acids, and the lipoprotein spectrum in serum were determined.

The results of biochemical analyses showed a definite tendency of decline in the cholesterol, β-lipoprotein and albumin levels.

The authors recorded an increase in number of the α-and β-globulin in serum. They concluded that treatment with pollen leads to a general improvement of the atheromatous process. The same authors reported on the treatment with pollen of 40 patients with cerebral arteriosclerosis.

Just as in their other experiment, 2 spoons of pollen were administered daily before meals. A favourable effect was recorded in cases of adynamic neurasthenic disorders. The sleep, memory, and physical condition of patients improved.

The results of the biochemical analyses showed this time too that pollen has good effects.

The authors recommend general use of pollen therapy in the treatment of arteriosclerosis.

3. R. CHAUVIN (Station de Recherches Apicoles du Ministère de l'Agriculture, Paris, France), who pioneered the research in this respect, summarises the physiological and clinic effect of pollens on test animals as follows :

3.1. When administered in adequate doses to mice, they grew substantially faster. The effect was not due to the vitamins in pollen – as their food contained all the necessary vitamins -, but to a better processing of the food.

An increase in the number of white and red blood cells was also recorded.

Smaller doses of pollen administered for a longer period (one year) increased the fertility of test animals by 70% as compared to the controls.

CHAUVIN assumes that this is due to an effect of pollen on the hypophisis.

According to CHAUVIN, for man pollen is important for the normal function of his organs. His assumption was confirmed by subsequent experiments which were already described in this paper.

CHAUVIN reported a positive effect of pollen in diarrhoea and constipation, as well as in obesity and setbacks.

G. VORWOHL (Landesanstalt für Bienenkunde, Hohenheim) communicated a general effect of pollens on estrogens. CHAUVIN has also recorded such an effect. This effect was ascertained – by the ovulation of the test animals – during the experiments made by SALAJAN and BALTAN.

CHAUVIN assumes the effect of pollen on estrogens to be due to its relatively high content of phytosterols.

As it is known, chemically the estrogens are sterols. Considering the high stereospecificity of sterols in general and in particular of the sex hormones, this effect is not likely to be direct.

Although the estrogens are female sex hormones, CHAUVIN has recorded no interruption in spermatogenesis during tests made on animals.

According to the above mentioned, it seems that the effect of increasing sexual vigour – attributed by laymen to pollen – does not actually exist. The error is likely to be due to the fact that pollens are carriers of the plant male genetic code.

On the other hand, both beekeepers and the above mentioned authors have often noted an invigorating effect; characteristic of all pollens is a high phosphorus content (nucleic acid).

3.3. In conclusion, several observations concerning the allergenic effect of pollens:

Hay fever – the most widely occurring allergy caused by pollen is due to the pollen of anemophilous plants.

Such pollens stick to the bees by accident, because bees collect pollen only from entomophilous plants.

Whether, following *per os* administration of pollens allergies appear, they are likely to be due to the chitin particles from the shell of acarine mites. Such impurities must not exist in properly collected and sorted pollens.

4. In 1970, a book – "Therapeutical Values in the Bee Hive", by E. HEROLD was published. It is a through review of the information about the physiological effect of pollens, but no critical scientific appreciation is made.