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THE SIGNIFICANCE OF TESTING AND HYPOSENSITIZATION WITH SEVERAL GRASS POLLENS FOR HAY FEVER

By

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In the temperate zones there are considered to be, as is well known, three different hay fever seasons: a spring period, when hay fever is caused by tree pollen; a period at the height of summer, when the cause is grass pollen; and finally, a late summer or autumn period, when the cause is pollen from plants of the family Compositae.

In Europe the second group is the most common. In Scandinavia, according to *Bruun & Hagerman* (1964), and others, 80-90 per cent of all pollinoses consist of grass pollen allergies. Grasses, including rye, are wind-pollinated, and therefore release large numbers of small light, pollen grains—which is always the case when a plant plays a significant part in causing hay fever. Exceptions to this are, however, wheat, oats and barley, which are self-pollinating (they “bloom inside closed ears”) and therefore release no pollen, or only an insignificant amount.

In Sweden there are more than 100 species of grasses, the most common of which are listed in Tables 10 and 11. Of these grasses, usually only Timothy grass (*Phleum pratense*) and the common reed (*Phragmites communis*) are included in the commonly-used standard series for intracutaneous testing (*Allergen Vitrum*, 1960 Ref. nr. 31) in this country. Support for this is provided by Freeman, who as early as 1911 demonstrated that cross-sensitization between different grass pollens occurs. He considered that an extract of Timothy

pollen alone should be sufficient for using in intracutaneous tests and hyposensitization of grass pollen allergies. *Bray* (1937), *Juhlin-Dannfeldt* (1944), *Fitzgerald & Sherman* (1949) and *Frankland* (1955) came to the same conclusion.

There have, however, emerged a number of facts, particularly in recent years, which seem to throw doubt on this opinion. Thus *Bruun & Schwartz* (1947) found that most, but not all, grass pollen allergic persons had a positive intracutaneous test for Timothy. *Hoet et al.* (1952) demonstrated that the three different plant pollens they studied, including one grass pollen—Timothy—, contained a mosaic characteristic to each pollen of several antigens. *Wodehouse* (1948) also found that pollen antigens have a mosaic structure and that a common major antigen exists, which is specific for closely-related species, such as certain grasses—but that in addition pollen contains several only partly specific antigens, which are also capable of producing clinical symptoms. *Frick et al.* (1960) demonstrated that pollen from the species red-top grass (*Agrostis alba/stolonifera*)—common in Scandinavia—contains some allergens similar to those in Timothy pollen, but some that are quite different. By means of exhaustive immunoelectrophoretic studies *Rosa Augustin & Barbara Hayward* (1962) found that Cocksfoot (*Dactylis glomerata*) and Timothy pollen each contain an at least partially-similar principal (major) antigen. Timothy pollen also contains two other principal “twin” antigens, which are specific to Timothy. They proved that Timothy and Cocksfoot pollens each contain about 10 minor antigens besides, some of them probably identical, others immunologically different. *Rosa Augustin* (1959 a, b, c) also found that 9 other British grass pollens have several antigenic determinants in common with Timothy and Cocksfoot pollen. However, individual antigens in these 9 pollens which have no counterpart in Timothy and Cocksfoot pollen could not be discovered by using the author’s methods.

The results of these investigations lend scant support to the belief that for diagnosis and treatment the allergens in only

one grass pollen, Timothy, should cover the whole field of grass pollen allergies. To cover such a wide field, one can reasonably say that several grass pollens should be used, so that a greater number of allergens common to the grasses will be represented.

After two years' allergological work in the north of Sweden, we formed the impression that the results of hyposensitization of grass pollinosis patients with Timothy pollen (and in certain cases also reed pollen) as the only allergen, were relatively poor compared with results reported from other places.

Thus the Danes, *Bruun & Schwartz* (1947), report an 88 per cent improvement in cases of specific hyposensitization of pollinoses. It must, however, be noted that instead of Timothy only, a compound extract of three different grass pollens has been used for a long time in Denmark.

Because of the experiences mentioned above, we included from 1962 onwards 6 further grass pollens, as a matter of routine, in the intracutaneous tests: Cocksfoot (*Dactylis glomerata*), Yorkshire Fog (*Holcus lanatus*), June grass (*Poa pratensis*), Meadow foxtail (*Alopecurus pratensis*), Meadow fescue (*Festuca pratensis*) and Rye (*Secale cereale*) pollens. For the skin test we used a dilution of 1/1000 (1 ml = 1000 Noon units), and in the process compared the diameter of the test reaction with that of histamine 1/10,000; the histamine reaction was given the value ++. First we did a prick test, and if the test reaction was less than that of histamine, intradermal test was done. A positive skin test was then verified, when possible, by a provocation test, usually by means of a nasal spray in a dilution of 1/100, sometimes instead by a conjunctival test (dilution 1/1,000, possibly 1/100) and in the case of pollen asthma by an inhalation test (dilution 1/100,000 down to 1/100).

From more than 2,000 patients we have so far tested with the above-mentioned pollens, we selected at random 100 cases of hay fever with typical anamneses, *i. e.* with symptoms at the height of summer. We took only cases that had

TABLE 1

Intradermal Tests of 100 Hay Fever Patients (not Hyposensitized).

Pollen	Average skin reaction	Number of patients	Pos. %	Neg. %
Timothy	++ (+) (2,3)	100	95	5
Cocksfoot	++ (+) (2,2)	100	98	2
Yorkshire Fog	+++ (2,8)	100	97	3
June grass	+++ (2,8)	100	97	3
Meadow Foxtail	++ (+) (2,5)	100	100	0
Meadow fescue	++ (+) (2,5)	48	96	4
Rye	++ (+) (2,5)	100	95	5
Histamine	++ (2,0)			

not undergone hyposensitization earlier. From Table 1 it can be seen that there were strong average reactions to all the grass pollens in 95–100 per cent of the cases. It can also be seen that 5 patients of the 100 had a completely negative intradermal test for Timothy, but were on the other hand manifestly allergic to several of the other grasses. These 5 cases of grass pollen allergies would not have been discovered if in the skin tests only Timothy pollen had been used.

Table 2 shows the strength of test reactions in a typical case. Table 3 shows one of the 5 cases with a negative Timothy reaction. From Table 4 it can be seen that there was fairly good correspondence between skin tests and provocation tests.

TABLE 2

Pollen	Skin reaction
Timothy	+++
Cocksfoot	+++ (+)
Yorkshire Fog	++++
June grass	+++++
Meadow foxtail	++
Meadow fescue	+++++
Rye	+
Histamine	++

TABLE 3

Pollen	Skin reaction
Timothy	neg
Cocksfoot	+++
Yorkshire Fog	++
June grass	++
Meadow foxtail	+++
Rye	+++
Histamine	++

TABLE 4

Correspondence between Skin Reactions and Provocation Tests (Usually by Nasal Spray) with Grass Pollen. 100 Hay Fever Cases.

Ic-tests	Provocation pos.	Provocation neg.	Number of provocations
(+) —+	33 (56 %)	26 (44 %)	59
+(+) —++	87 (73 %)	33 (27 %)	120
++(+) —++++	76 (86 %)	12 (14 %)	88
≥++++(+)	23 (96 %)	1 (4 %)	24

Total number of provocation tests: 291.

In the patients with mildly positive skin tests, the provocation tests were positive in over a half of the cases; in the patients with strongly positive intradermal tests, the provocation tests were almost 100 per cent positive.

Since 1962 quite a large number of patients have been hyposensitized with these 6 grass pollens. Of particular interest is a group of 33 hay fever cases who were earlier hyposensitized with Timothy pollen as the only grass species; from 1962 to spring 1966 we gave them a new test (called here intracutaneous test nr. 2), and they were later hyposensitized with the aforesaid grass pollens. It is thus possible to compare in the same patients the results of Timothy-hyposensitization (called here hyposens. nr. 1) with our more comprehensive grass pollen hyposensitization (hyposens. nr. 2). All 33 patients had rhinitis and conjunctivitis symptoms from mid- or

late June until early or mid-August. Their symptoms were aggravated by more intensive contact with grass pollen, when 21 of them, *i.e.* 63 per cent, developed varying degrees of asthma—we also included those who had very mild pollen asthma. Some of them had asthma almost continuously during the whole grass pollen season. Of other atopic conditions, atopic dermatitis occurred in 13 cases, of which 3 showed clear correlation with grass pollen.

TABLE 5
Ic-Test 2 (after Hyposensitization with Timothy Pollen). 33 Cases.

Pollen	Average skin reaction	Number of patients tested	Pos.	Neg.
Timothy	+(+)	1,7	30	83%
			25	17%
Cocksfoot	+++(+)	3,3	33	100%
Yorkshire Fog	+++	2,9	33	100%
June grass	++(+)	2,6	33	100%
Meadow foxtail	+++	2,8	33	100%
Meadow fescue	++++	3,9	9	100%
Rye	++	2,2	30	87%
			26	13%
Histamine	++	2,0		4

Average skin reaction for timothy:

Ic-test 1: ++(+), 2,7 24 patients.

Ic-test 2: +(+) 1,3 24 patients.

In Table 5 a summary has been made of the strength of the average reactions in ic-test nr. 2, that is after the first hyposensitization with Timothy pollen only. It can be seen that skin reaction of approximately similar strength occurred in approximately the same high frequency as for the earlier-named 100 cases, except in the case of Timothy. In ic-test nr. 1 the Timothy test was positive in all 33 cases. In the case of the 24 patients in whom we were able to establish the strength of the Timothy test by means of ic-test nr. 1, this Timothy

reaction on average showed a noticeable decrease (as can be seen at the foot of Table 5) in ic-test nr. 2, after Timothy-hyposensitization took place. Such a lessening of skin reaction can usually be noted after a specific hypo-sensitization and, as is well known, is believed to be caused by blocking antibodies. In 5 cases, *i.e.* in 17 per cent, the decrease in reaction went so far that ic-test nr. 2 with Timothy pollen was completely negative. On the other hand, skin reactions and provocation tests for several of the other grass pollens were clearly positive in these 5 patients. These cases of grass pollen allergy would have been missed if the supplementary grass pollens had not been used.

Table 6 reveals that every patient undergoing hypsens. 2 was treated with an average of 5 grass pollens, though only 21 of 33 cases with Timothy.

TABLE 6
Grass Pollen Included in Hyposensitization 2. 33 Cases.

		%
Timothy	21	64
Cocksfoot	31	94
Yorkshire Fog	32	97
June grass	32	97
Meadow foxtail	33	100
Meadow fescue*	8	24
Rye	20	61

Number of grass pollens per patient: 5 (average).

* This pollen has not always been available.

The provocation tests with grass pollen are represented in Table 7 and show, even in these 33 cases, good correspondence with the skin tests. A provocation test with Timothy was used in 9 cases, of which 5 gave a negative result—positive, however, in the case of other grass pollens.

To judge from anamneses, intracutaneous tests and provocation tests equally, it thus seemed that hypsens. nr. 1 with Timothy pollen had to a certain degree been successful with

regard to Timothy. On the other hand, allergies to the other grass species tested did not seem noticeably affected by Timothy-hyposensitization.

Table 8 shows the result of hyposensitization on hay fever symptoms. After hyposens. nr. 1 with Timothy pollen only, it can be seen that 54 per cent of the cases showed some improvement, but only 12 per cent were noticeably improved or completely cured. After hyposens. nr. 2 with additional grass pollens, all the cases improved, while 94 per cent showed a clinically good result—noticeable or complete improvement.

TABLE 7

Correspondence Between Skin Reactions and Provocation Tests (Usually by Nasal Spray) with 7 Grass Pollens (see Table 1). 33 Cases.

Ic-test 2	Provocation pos.	Provocation neg.	Number of tests
(+) —+	6 (55 %)	5 (45 %)	11
+(+) —++	16 (76 %)	5 (24 %)	21
++(+) —+++	16 (94 %)	1 (6 %)	17
≥++++(+)	6 (100 %)	0 (0 %)	6

Total number of provocations: 55.

TABLE 8

Effect on Hay Fever Symptoms of Hyposensitization 1 and 2. 33 Cases.

Degree of improvement	Hyposens. 1 (timothy only)	Hyposens. 2 (several grass pollens)
Complete (or almost)	0	11 = 33 %
Noticeable improved	4 = 12 %	20 = 61 %
Somewhat improved	11 = 33 %	2 = 6 %
A trace of improvement	3 = 9 %	0
No improvement	0	15 = 46 %
<i>Total number improved:</i>	18 = 54 %	33 = 100 %

The low improvement figures after hyposens. nr. 1 with Timothy pollen can perhaps to some extent be explained by the fact that we selected only those patients who had previously undergone such treatment before they received hyposens. nr. 2.

Of course the majority were not satisfied with their first treatment. Some of them had noticeably improved, however, but gradually grew worse again after the maintenance treatment had ended. Even if the improvement figures after hyposensitization with Timothy pollen are a little too low to be true in general, the fact remains, however, that considerably better result on the same patient material was obtained with our more comprehensive grass pollen treatment.

Of the 21 grass pollen asthma cases, 15 or 71 per cent were completely or almost cured of their pollen asthma after our hyposensitization nr. 2. Finally, of the 3 cases of atopic dermatitis, 1 was completely cured of eczema after treatment with several grass pollens. He had earlier suffered from eczema only during the grass pollen season.

Table 9 shows the strength of the maintenance doses, which in most cases were 1/100–1/10,000, on average about 1/1,000. Patients receive a maintenance dose once a month for, in most cases, 3 years.

TABLE 9
Strength of Maintenance Doses. 33 Cases.

	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	Unknown strength
Hyposens. 1	8	17	2	0	1	5
Hyposens. 2	3	13	11	3	0	3

During the last 6 months we have tested several hundred atopic patients with 4 more grass species besides the 8 previously mentioned. Of these, in skin and provocation tests on grass pollinosis patients, Rye-grass (*Lolium perenne*) usually produces about as strong a reaction as the grass pollens included in our investigation. Reactions to Red fescue (*Festuca*

rubra) are usually moderate, while only slight or non-existent in the case of Fine Bent (*Agrostis tenuis*) and Lyme-grass (*Elymus arenarius*). Thus Rye-grass pollen would seem to have a very high allergen potency (high antigenicity).

We have also tested some patients with Tufted hair-grass (*Deschampsia caespitosa*), Wavy hair-grass (*Deschampsia flexuosa*) and Sweet vernal grass (*Anthoxanthum odoratum*) pollens. It seems that these pollens too have a relatively high antigenicity.

TABLE 10
Wind-Pollinated Grasses in Northern Sweden.

<i>Common</i>	<i>Less common—fairly common</i>
<i>Phragmites communis</i>	<i>Phalaris arundinacea</i>
→ <i>Anthoxanthum odoratum</i>	<i>Hierochloë odorata</i>
<i>Phleum pratense</i>	<i>Phleum alpinum</i>
→ <i>Agrostis stolonifera</i>	<i>Alopecurus aequalis</i>
<i>Agrostis tenuis</i>	<i>Alopecurus geniculatus</i>
<i>Calamagrostis neglecta</i>	<i>Alopecurus pratensis</i>
<i>Calamagrostis purpurea</i>	<i>Agrostis canina</i>
→ <i>Deschampsia caespitosa</i>	<i>Melica nutans</i>
→ <i>Deschampsia flexuosa</i>	<i>Dactylis glomerata</i>
<i>Molinia coerulea</i>	<i>Poa nemoralis</i>
<i>Poa annua</i>	<i>Poa pratensis</i>
<i>Festuca ovina</i>	<i>Poa trivialis</i>
<i>Festuca rubra</i>	<i>Festuca pratensis</i>
→ <i>Agropyron repens</i>	<i>Nardus stricta</i>
<i>Elymus arenarius</i>	<i>Agropyron caninum</i>
15	15
Total: 30	

In Table 10 we have listed the common and fairly common wind-pollinated grass species in the north of Sweden, according to *Eric Hultén* (1950) and *Nils Hylander* (1953). The grass species used in our investigation are spaced. Table 11 gives a similar list for the south of Sweden.

It should be possible to make an even better selection for

TABLE 11
Wind-Pollinated Grasses in Southern Sweden.

Common	Less common—fairly common
<i>Phragmites communis</i>	<i>Phalaris arundinacea</i>
→ <i>Anthoxanthum odoratum</i>	<i>Calamagrostis canescens</i>
<i>Phleum pratense</i>	<i>Calamagrostis epigeios</i>
<i>Alopecurus geniculatus</i>	<i>Holcus lanatus</i>
<i>Alopecurus pratensis</i>	→ <i>Arrhenatherum elatius</i>
<i>Agrostis canina</i>	<i>Avena pratensis</i>
→ <i>Agrostis stolonifera</i>	<i>Melica nutans</i>
<i>Agrostis tenuis</i>	<i>Poa compressa</i>
<i>Calamagrostis arundinacea</i>	→ <i>Lolium perenne</i>
<i>Aperaspica venti</i>	<i>Bromus secalinus</i>
→ <i>Deschampsia caespitosa</i>	<i>Agropyron caninum</i>
→ <i>Deschampsia flexuosa</i>	
<i>Avena pubescens</i>	
<i>Siglingia decumbens</i>	
<i>Molinia coerulea</i>	
<i>Briza media</i>	
<i>Dactylis glomerata</i>	
<i>Poa annua</i>	
<i>Poa nemoralis</i>	
<i>Poa pratensis</i>	
<i>Poa trivialis</i>	
<i>Glyceria fluitans</i>	
<i>Festuca ovina</i>	
<i>Festuca pratensis</i>	
<i>Festuca rubra</i>	
<i>Nardus stricta</i>	
<i>Bromus mollis</i>	
→ <i>Agropyron repens</i>	
<i>Elymus arenarius</i>	
<i>Secale cereale</i>	
30	11
Total: 41	

allergological diagnosis and treatment than the 8 grass species spaced in Tables 10 and 11.

Taking into account the grass species' geographical distribution and degree of frequency (*Hultén 1950, Hagsand et al.*

1960, *Hylander* 1966, *Halling* 1967), also American (Ref. no. 32), English (Ref. no. 33) and our own experience of different grass pollens' allergen potency, we arrived at certain modifications in our selection.

The said 8 grass species should be supplemented with 5 more: Sweet vernal grass (*Anthoxanthum odoratum*), Red-top grass (*Agrostis stolonifera/alba*), Tufted hair-grass (*Deschampsia caespitosa*), Wavy hair-grass (*Deschampsia flexuosa*) and Common couch (*Agropyron repens*). (These supplementary grass species are marked with arrows in Tables 10 and 11). These 13 grass species should, for the south of Sweden, be supplemented with 2 more: False oat (*Arrhenatherum elatius*) and Rye-grass (*Lolium perenne*). We attempted thus to include at least 1 member of the most common genera (= the first part of the Latin name). The most common grass species in the whole country are, according to *Hylander* (1966), Tufted hair-grass and Wavy hair-grass, which are relatively tall grasses with large panicles, often growing alone, without other grass species, the first in neglected damp fields and meadows, the second in dry forest clearings and on moorland. Patients often themselves say that these very grasses must cause their hay fever. Of all 15 grass species, most grow in built up areas as cultivated grass, in for example pastures, meadows and lawns. For the north of Sweden, rye and Yorkshire Fog can be excluded. One arrives then at a selection of 11 grass species applicable to the whole of Sweden, and 4 more grasses for the south of Sweden. (See conclusions). On the whole this selection probably is valid also for the rest of Scandinavia.

For the time being, we intend to continue our investigations as before testing with a wider selection of separate grass pollens, then carrying out hyposensitization with a special allergen-compound for each patient. This is without doubt the best method. From the practical point of view it is clearly simplest to use compound extracts with 3-5 pollens in each—though there is, of course, a risk that an allergic person undergoing hyposensitization with such an extract may be treated with a

pollen he is not allergic to. According to *Wodehouse* (1947), among others, and *Fitzgerald et al.* (1949), a positive skin test may then be induced, but without the development of any clinical symptoms.

CONCLUSIONS

1. It is not sufficient to test and hyposensitize grass pollinosis with only Timothy pollen. A considerably better result is achieved if an additional six common grass species are used.

2. By means of allergen testing with these grasses the existence can be shown of grass pollinosis which otherwise would not have been discovered.

3. Taking into account the grasses' distribution and frequency, and our own and others' experience of the allergen potency of different grasses, the following grass pollens would seem, where Sweden is concerned, to be a suitable selection for allergological diagnosis and treatment:

1. Common reed (*Phragmites communis*).
2. Sweet vernal grass (*Anthoxanthum odoratum*).
3. Timothy grass (*Phleum pratensis*).
4. Redtop grass (*Agrostis stolonifera/alba*).
5. Tufted hair-grass (*Deschampsia caespitosa*).
6. Wavy hair-grass (*Deschampsia flexuosa*).
7. Common couch (*Agropyron repens*).
8. Meadow foxtail (*Alopecurus pratensis*).
9. Cocksfoot (*Dactylis glomerata*).
10. June grass (*Poa pratensis*).
11. Meadow fescue (*Festuca pratensis*).

For the south of Sweden, 4 additional grass pollens should be included:

12. Rye (*Secale cereale*).
13. Yorkshire Fog (*Holcus lanatus*).
14. False oat (*Arrhenatherum elatius*).
15. Rye-grass (*Lolium perenne*).

This list may in the future be reduced when one knows more about cross-sensitivity between these grasses.

An examination of the literature on the properties of grass pollen antigens supports the conclusions of our investigations.

SUMMARY

33 cases of hay fever during the height of summer had previously been tested and hyposensitized with Timothy as the only grass pollen. Of these, 54 per cent showed some improvement, but only 4 cases (12 per cent) were noticeably better or completely cured. New skin and provocation tests with additional 6 common grass species showed manifest allergies to most of these grass pollens. After further hyposensitization with an average of 5 grass pollens, all the cases improved, and 31 (94 per cent) were noticeably better or completely cured.

By means of skin and provocation tests with the said grass species on 100 grass pollinosis patients (not hyposensitized), grass pollen allergies were discovered in 5 cases with a negative Timothy reaction.

A selection of 15 grasses is proposed for allergological diagnosis and treatment, where Sweden is concerned.

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REFERENCES

1. *Andrup, O.*: Hayfever in Norway. Det norske Vid.-Akad. Skr. No. 5, 1945.
2. *Augustin, R.*: Grass pollen allergens. I. Immunology 2, 1-18, 1959 a.
3. *Augustin, R.*: Grass pollen allergens. II. Immunology 2, 148-169, 1959 b.
4. *Augustin, R.*: Grass pollen allergens. III. Immunology, 2, 230-251, 1959 c.
5. *Augustin, R.*: Acta allergol. 15, 83-85, 1960.
6. *Augustin, R.*: Acta allergol. 16, 473-495, 1961.
7. *Augustin, R. & Hayward, B. J.*: Immunology 3, 45-73, 1960.
8. *Augustin, R. & Hayward, B. J.*: Immunology 5, 424-460, 1962.

9. *Bray, G. W.*: Recent Advances of Allergy. Churchill Ltd., London, 1937.
10. *Bruun, E.*: Nord. Med. 28, 2581, 1945.
11. *Bruun, E.*: Ugeskrift for Laeger 116, 1386, 1954.
12. *Bruun, E. & Hagerman, G.*: Lärobok i Allergologi. Munksgaard, Copenhagen, 1964.
13. *Bruun, E. & Schwartz, M.*: Ugeskrift for Laeger 109, 243-253, 1947.
14. *Fitzgerald, J. D. L. & Sherman, W. B.*: J. Allergy 20, 286-291, 1949.
15. *Frankland, A. W.*: Int. Arch. Allergy 6, 45-52, 1955.
16. *Frankland, A. W. & Augustin, R.*: Clin. Sci. 23, 95-102, 1962.
17. *Freeman, J.*: Lancet 2, 814, 1911.
18. *Frick, O. L., Gyenes, L. & Schon, A. H.*: J. Allergy 31, 216-231, 1960.
19. *Hagsand, E. & Thörn, K-G.*: Norrländsk vallodling. Almquist & Wiksell, Uppsala, 1960.
20. *Halling, S.*: Personal communication, 1967.
21. *Hoet, J. J., Mynors, L. S., Coombs, R. R. A., Bell, S. & Milner, F. H.*: Acta allergol. 5, 239-254, 1952.
22. *Hultén, E.*: Atlas över växternas utbredning i Norden. Generalstabens litog. anst. förl. Stockholm, 1950.
23. *Hylander, N.*: Nordisk kärlväxtflora. Almquist & Wiksell, Stockholm, 1953.
24. *Hylander, N.*: Personal communication, 1967.
25. *Juhlin-Dannfelt, C.*: Nordisk Med. 20, 2328, 1943.
26. *Juhlin-Dannfelt, C.*: Nordisk Med. 21, 540, 1944 a.
27. *Juhlin-Dannfelt, C.*: Nordisk Med. 24, 1836, 1944 b.
28. *Kragh, J.*: Ugeskrift for Laeger 98, 294-295, 1936.
29. *Wodehouse, R. P.*: Ann. Allergy 5, 558, 1947.
30. *Wodehouse, R. P.*: Ann. Allergy 6, 358-377, 1948.
31. Allergen Vitrum för diagnostik och behandling. Stockholm 1960.
32. Simplified techniques in allergy, Hollister-Stier Laboratories, Philadelphia.
33. The Bencard Manual of Allergy, C.L. Bencard LTD., London 1956.

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