

Investigations with the 'Individual Pollen Collector' and the 'Burkard trap' with reference to hay fever patients

RUTH M. LEUSCHNER and G. BOEHM*

Departement Forschung, Laborat. Dermatol./Allergol., Kantonsspital, Basel, and

**Herrengrabenweg 51, Basel, Switzerland*

(Received 28 March 1978; resubmitted for publication 9 June 1978; accepted for publication 15 September 1978)

Summary

Pollen collecting devices such as the 'Hirst' trap and the 'Burkard' apparatus provide information on average pollen content in the air during a certain time in a certain volume of air (e.g. 24 hr in 1 m³ air).

They give no idea, however, of the allergenic particles to which individual hay fever patients are exposed in the course of a day. An 'Individual Pollen Collector', attached to the patient's clothing, showed that the counts varied considerably in different persons in the same place. They differed—quantitatively and qualitatively—from the values with the 'Burkard' pollen and spore traps at two places in Switzerland. The slides from the 'Individual Pollen Collector' frequently show 'clouds' of certain kinds of pollen grains, which could be responsible for hay fever attacks in moderately sensitized subjects.

Introduction

Airborne pollen can be monitored by greatly varying methods. The allergologist would not only like to have a general idea of the pollen in the air but also to what pollen individual sensitized patients are being exposed. This is particularly true when the cause of the hypersensitivity is difficult to detect.

In Basel, a Burkard pollen-and-spore trap has been in continuous operation since 1969 (Fig. 1). The results obtained with this apparatus represent average values for 24 hr/day (Leuschner, 1974). The exposure of patients coming to the Basel Centre for Allergies from a radius of 20–50 km or more km may be very different from that of persons living in the city itself. Variations may even occur in individual districts of the city.

In 1964 Kailin constructed a special device to determine the exposure of individual patients during their daily activities. She was primarily interested in discovering to what degree patients were exposed to 'ragweed' pollen.

Correspondence: Dr Ruth M. Leuschner, Departement Forschung, Laborat. Dermatol./Allergol., Kantonsspital, Hebelstr. 20, CH-4031 Basel, Switzerland.

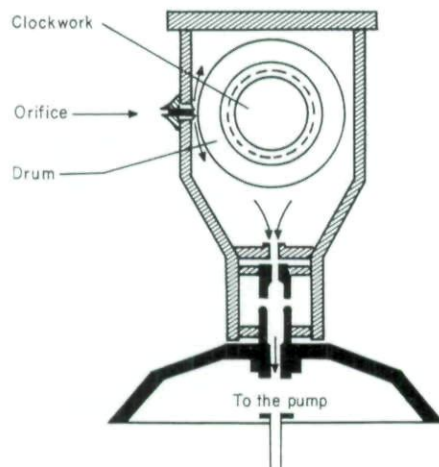


Fig. 1. Diagram of a Burkard pollen-and-spore trap after Stix (1971), modified. The clockwork rotates the drum 2 mm/hr. The air is sucked in through the orifice facing the wind. The particles are trapped on an adhesive tape wound round the drum which is changed weekly. (Described in Leuschner, 1974.) (▨) Movable part, mounted on ball-bearings which enable the apparatus to face the wind; (■) fixed part.

Materials and methods

In the preliminary investigations we realized that Kailin's design had to be modified. This was undertaken by one of us, G. Boehm (Leuschner & Boehm, 1977a).

We strove to imitate the shape of the nostrils, the inside of the nose, and the orbital cavity as far as possible

The opaque white plexiglass device is 82 mm long, 32 mm wide and 8 mm thick. An ordinary size slide (76 × 26 mm) is inserted at one end, and fastened with a spring

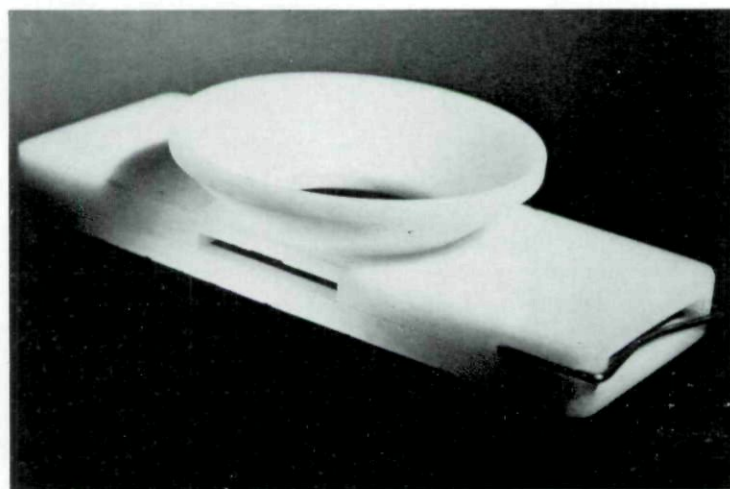


Fig. 2. The 'Individual Pollen Collector' after G. Boehm. The functional and attractive design of this device is the work of H. Müller, precision tool manufacturer, from the Institute of Pathology of the University of Basel.

(Fig. 2). The spring enables the investigator to change the slide easily without touching the adhesive surface. In the middle of the device a round funnel of 8 mm height is attached. Slits at the sides of the individual collector are clearly recognizable in Fig. 2. These openings have been provided on all four sides so that the incoming air can escape without difficulty. The projecting round plexiglass funnel protects the adhesive surface of the slide from accidental touching. Its shape also has an important 'collecting' function while the wearer is walking, cycling or facing winds. The actual area of the catchment surface beneath the inside opening of the funnel is about 3.15 cm^2 .

In the preliminary tests with the 'Individual Pollen Collector' ten different adhesive media were tried out, and Vaseline proved to be the most suitable.

The 'Individual Pollen Collector' has a safety-pin for fastening to the clothing, e.g. the jacket lapel. It is exposed to the air usually for 24, and less frequently for 48 hr. The device should lie or hang in the bedroom at night.

The particles caught on the adhesive layer are enclosed in Gelvatol without further preliminary treatment. A large cover-glass, e.g. of about $25 \times 55 \text{ mm}$, serves this purpose. The pollen grains and fungal spores can be determined qualitatively and quantitatively after 24 hr. The incoming air escapes through the side-slits and some pollen, fungal spores, and other particles settle some distance from the round opening. The specimens are examined microscopically and all pollen grains on the adhesive surface—about 12 cm^2 —counted.

The Burkard apparatus which works volumetrically and is in continuous operation, records the daily average present in 1 m^3 air. Nothing can, however, be said of the volume of air collected with the funnel of the individual sampler each day. It gathers very little if the wearer remains quiet and the surrounding air is at rest, e.g. inside a building or a car.

Results

The 'Individual Pollen Collector' (after G. Boehm) has been tested 160 times, mostly in Basel and its surroundings, a large number of times in Davos (see Table 4), and a few times in Geneva and other places.

Qualitatively the specimen with the individual device did not always differ greatly from those obtained with the Burkard traps in 1 m^3 air on the same day and in the same place. Certain kinds of pollen found in the individual collector in smaller or greater numbers may not appear in the Burkard apparatus on the same days (Table 4, Nos. 2, 4, 6, 8 and 18). The height of the device above the ground is probably an important factor. The Burkard trap is about 15 m up on a roof with its orifice always facing the wind, whereas the 'Individual Pollen Collector' is worn at a height of 1–1.60 m above ground level. Quite considerable quantitative differences can be observed between the two devices. By 'quantitative' we refer only to the ratios between the different kinds of pollen. The absolute values cannot be compared (see Table 4). For instance in Davos more grass pollen was collected frequently by an individual device than by the Burkard trap in 1 m^3 air on the same day (Table 4, Nos 3, 6, 7, 10 and 19). The amount of conifers then showed a higher ratio. Sometimes more weed pollen was found (Nos 3, 4, 6 and 8) than in the Burkard sampler.

The results with the 'Individual Pollen Collector' are striking because they show that the wearer is sometimes exposed to real 'swarms' of pollen. Gronemeyer (1967) showed that 3–5 pollen grains are sufficient to provoke a hay fever attack in a highly sensitive subject. 50 or more are required in a patient of average sensitivity. These

'swarms' or 'clouds' of pollen may therefore often cause attacks. Patient No. 4 in Table 4 found that she had itching of the nose and the eyes when her sampler had 212 pollen grains of composites partly as 'clouds'.

A patient may encounter such clouds of the same or other pollens—one after the other in a short time—while another may not. This was shown by the collectors worn by two students. In June 1977 they walked from Basel across the Jura to a small town in the middle country about 55–60 km away and both followed practically the same itinerary. The differences in species showed great variations (Table 1).

Table 1. Comparison of the results obtained with two students who each wore an 'Individual Pollen Collector' on a 55–60 km long walk from Basel lasting from 08.00 hours on 24 June till 13.30 hours on 25 June 1977

Pollen	Student A	Student B
Total pollen count	188	169
Wild grasses	103	79
Cereals	46	34
Nettle (<i>Urtica</i>)	14	3
Plantain (<i>Plantago</i>)	14	21

Another example in 1976 is of a collector worn on 4 April in Basel from the home to the work place (2 km each way) and again on 9 April for a walk outside the city. The numerous poplar pollens on 9 April come from two 'swarms' which settle very close to each other (Fig. 3) (Table 2).

Smaller 'clouds' of pollen grains from the horse chestnut are shown in Fig. 4. Quantitative comparisons may be only a question on determining the proportions of the different kinds of pollen on the adhesive strips of the Burkard trap and the 'Individual Pollen Collector' showing obvious differences (Tables 1–3).

The findings in a patient from Basel showed how staying in a certain place can

Table 2. Comparison of findings in two devices on two days in April 1976

Pollen	'Individual Pollen Collector'	Burkard apparatus
April 4 1976		
Total pollen count	394	204
Birch (<i>Betula</i>)	128	95
Hornbeam (<i>Carpinus</i>)	72	—
April 9 1976		
Total pollen count	514	145
Birch (<i>Betula</i>)	7	105
Poplar (<i>Populus</i>)	438	—
Hazel (<i>Corylus</i>)	18	—

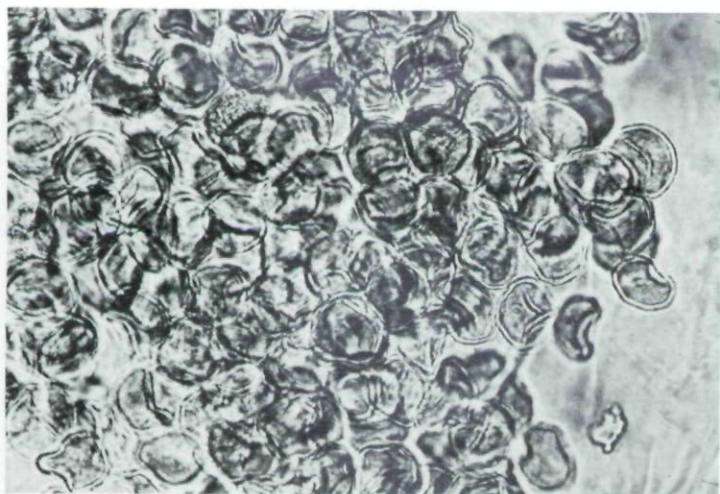


Fig. 3. Part of a large 'cloud' or 'swarm' of poplar (*Populus*) pollen. Sampled 9.4.76 with the 'Individual Pollen Collector' in the surroundings of Basel. (Magnification $\times 300$.)

affect the pollen count. On 26 and 27 March she wore an individual sampler outside the city for 48 hr, and there were unusually large numbers of pollens in her device even for this length of time. The Burkard apparatus in the city at the same time showed different ratios (Table 3).

The surrounding vegetation can be seen from Table 3. The patient was staying on a golf course in nearby Alsace (France). While ash (*Fraxinus*) and birch (*Betula*) pollen predominate in the Burkard trap samples from the city, a large number of hornbeam (*Carpinus*) pollen from the oak and hornbeam forest near the golf course were found in the individual collector.

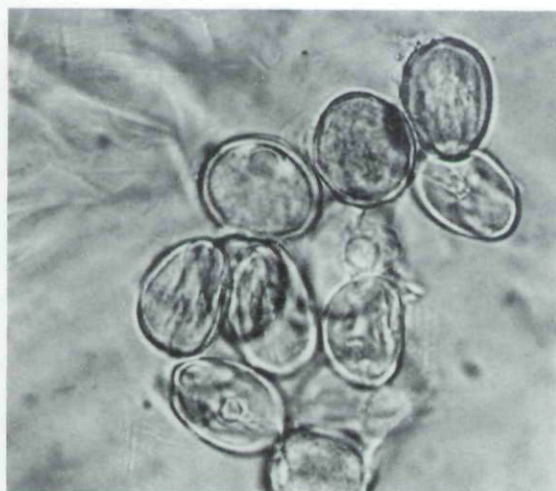


Fig. 4. Small 'cloud' of horse-chestnut (*Aesculus*) pollen. Sampled 2.6.77 with the 'Individual Pollen Collector' in the city of Basel. (Magnification $\times 800$.)

Table 3. Local differences between the values obtained with the 'Individual Pollen Collector' worn outside the city and the Burkard pollen-and-spore trap in the city. (We again stress that they are not intended to be compared quantitatively but to give a general idea only. See also the remarks on Table 4)

Pollen: (2 days— March 26 and 27)	'Individual Pollen Collector'	Burkard apparatus
Total pollen count	1951	950
Hornbeam (<i>Carpinus</i>)	1723	130
Ash (<i>Fraxinus</i>)	100	240
Birch (<i>Betula</i>)	95	410

Comments on Table 4 (Davos)

Meteorological data must be considered. A decrease in temperature and an increase in the relative humidity reduces the amount of pollen. The temperature and relative humidity and the daytime precipitation were read at 13.00 hours, since the patients only go for walks during the later part of the morning and early afternoon.

The volumetrically operated stationary Burkard apparatus works continuously day and night, while the portable pollen collector is not always out of doors and has also not been used continuously. Some data in July is therefore missing from Table 4 of Davos.

In some specimens from Davos, 'clouds' of pollen were found. The largest and densest were found in Nos 3, 4 and 7 (Table 4) on 1, 2 and 8 July (1977).

Pollen 'clouds'

The pollen recorded by the Burkard trap is considered to have a statistically fairly even distribution, probably due to turbulence and convection currents of the air far away from the source of the pollen grains. The closer to the source, the less even the distribution with possible occasional pollen 'clouds'.

It is not surprising that 'swarms' of pollen were sometimes found in the 'Individual Pollen Collector' when the wearer was near the pollen source. Occasionally, concentrations of pollen grains are also found on the adhesive surface of the Burkard trap, if the orifice is exposed to them. Such observations have been made in Basel with yew (*Taxus*), and birch (*Betula*). Specimens of these plants grow less than 10 m away from the trap. Generally speaking, the statistically fairly even distribution of pollen in the air referred to above occurs only at a distance from its source, and when this is not the case, the uneven distribution may presumably be made more uniform by the continuous action of the suction device.

Discussion

It is important to see to what pollen or pollens individual patients are exposed. A hay fever sufferer's working surroundings and his route to work each day should be considered. The walks taken by the patients during their treatment at Davos was known and could be compared (Table 4).

Rempe (1938) reported a thorough investigation of the dispersal of pollen by different air currents. He was unable to say whether a statistically uniform distribution

Table 4. Comparative numbers in investigations with the 'Individual Pollen Collector' and the Burkard Pollen-and-Spore Trap, Davos June-July 1976, with important meteorological data

Days	Pollen	'Individual Pollen Collector'	Burkard Trap	Remarks on exposure of the individual collector	Temperature at 13.00 hours (°C)	Precipitation 07.00-14.00 hours (mm)	Relative humidity at 13.00 hours (%)
(1) 25.6.76	Total pollen count	274	1040	Walk—mainly through forest	21.5	0	26
	Conifers (Coniferae)*	184	980				
	Grasses (Gramineae)	58	90				
	Sorrel (Rumex)	7	25				
	Plantain (Plantago)	5	20				
(2) 29.6.76	Total pollen count	87	170	Afternoon drive—mostly through forest	21.1	0.8	37
	Conifers (Coniferae)*	57	15				
	Grasses (Gramineae)	24	115				
	Nettle (Urtica)	—	25				
	Plantain (Plantago)	2	—				
(3) 1.7.76	Total pollen count	595	180	Comparatively long exposure on foot across meadows and through forest	22.4	0	34
	Conifers (Coniferae)*	28	80				
	Grasses (Gramineae)	135	55				
	Sorrel (Rumex)	28	15				
	Plantain (Plantago)	339†	5				
(4) 2.7.76	Total pollen count	306	201	Resting on hospital balcony and on meadow near outdoor swimming bath. Itching on the eyes and nose at both places	22.9	6.3	36
	Conifers (Coniferae)*	48	50				
	Grasses (Gramineae)	24	105				
	Composites (Compositae)	212†	—				
(5) 5.7.76	Total pollen count	88	910	Two short strolls, one in the morning, the other in the afternoon	22.4	0.3	34
	Conifers (Coniferae)*	11	610				
	Grasses (Gramineae)	58	220				
	Plantain (Plantago)	10	10				
	Composites (Compositae)	1	35				

(Continued overleaf)

Table 4. (cont.)

Days	Pollen	'Individual Pollen Collector'	Burkard Trap	Remarks on exposure of the individual collector	Temperature at 13.00 hours (°C)	Precipitation 07.00-14.00 hours (mm)	Relative humidity at 13.00 hours (%)
(6) 6.7.76	Total pollen count	93	35	Lying on roof terrace; walk and rest in hospital garden	20.8	3.2	38
	Conifers (Coniferae)*	20	10				
	Grasses (Gramineae)	47	20				
	Umbellifers (Umbelliferae)	—	5				
(7) 8.7.76	Plantain (Plantago)	8	—				
	Total pollen count	395	60	Rather long walk in alpine pastures. Meadows mown at hospital level	19.0	0	37
	Conifers (Coniferae)*	16	5				
	Grasses (Gramineae)	268	15				
(8) 9.7.76	Composites (Compositae)	88†	—				
	Total pollen count	84	65	Only about one hour outside in meadow area (mown)	16.5	0	50
	Conifers (Coniferae)*	12	10				
	Grasses (Gramineae)	48	35				
(9) 13.7.76	Nettle (Urtica)	4	5				
	Sorrel (Rumex)	11	5				
	Total pollen count	27	25	In the morning indoors and in the hospital garden; about 3 hr walking in the afternoon	15.1	0	63
	Conifers (Coniferae)*	15	15				
(10) 14.7.76	Grasses (Gramineae)	9	5				
	Total pollen count	65	40	Out of doors only in the afternoon—in meadows and forest	17.5	0	59
	Conifers (Coniferae)*	13	5				
	Grasses (Gramineae)	31	15				
(11) 15.7.76	Nettle (Urtica)	4	10				
	Total pollen count	218	50	Two extended walks to and across alpine pastures	21.3	0	43
	Conifers (Coniferae)*	11	5				
	Grasses (Gramineae)	188	25				
(12) 16.7.76	Total pollen count	66	125	Moderately long stroll in valley; meadows mown	24.3	0	31
	Conifers (Coniferae)*	17	10				
	Grasses (Gramineae)	39	80				
	Nettle (Urtica)	3	15				

(Continued overleaf)

Table 4. (cont.)

Days	Pollen	'Individual Pollen Collector'	Burkard Trap	Remarks on exposure of the individual collector	Temperature at 13.00 hours (°C)	Precipitation 07.00-14.00 hours (mm)	Relative humidity at 13.00 hours (%)
(13) 21.7.76	Total pollen count	2	—	Walk—in rain	13.0	5.3	64
(14) 22.7.76	Total pollen count	1	20	Walk—in rain	5.3	18.6	86
	Conifers (Coniferae)*	—	5				
	Grasses (Gramineae)	—	5				
	Nettle (Urtica)	1	5				
(15) 23.7.76	Total pollen count	12	10	Walk of 1½ hr duration—in valley	4.7	0.2	95
	Conifers (Coniferae)*	2	—				
	Grasses (Gramineae)	2	—				
	Nettle (Urtica)	2	5				
(16) 26.7.76	Total pollen count	4	10	Walk—in rain	5.5	10.7	91
(17) 27.7.76	Total pollen count	26	40	Short walk and stay indoors	12.0	1.2	71
	Conifers (Coniferae)*	6	—				
	Grasses (Gramineae)	12	15				
	Plantain (Plantago)	2	5				
	Nettle (Urtica)	4	20				
(18) 28.7.76	Total pollen count	10	15	Short walk and stay indoors	12.3	0	76
	Grasses (Gramineae)	4	10				
	Nettle (Urtica)	2	5				
(19) 30.7.76	Total pollen count	188	140	Walk—in direction of alpine pastures	18.2	0	43
	Conifers (Coniferae)*	2	5				
	Grasses (Gramineae)	178	90				
	Nettle (Urtica)	4	15				
	Plantain (Plantago)	—	25				

The absolute values should on no account be compared.

* Pine (*Pinus*) predominating, some Spruce (*Picea*) and Juniper (*Juniperus*); Larch (*Larix*) had already stopped flowering at that time.

† Particularly dense, frequent 'clouds' or 'swarms'.

existed at a certain distance from the source of the pollen, e.g. from woods. He assumed such a distribution but stressed that pollen can occur in varying concentrations at different heights.

The average values of pollen concentrations in the Burkard trap are related to the frequency and severity of hay fever attacks (Leuschner, 1974) (Table 1). One cannot, however, say that these attacks occur only when more than a certain quantity of allergenic pollen is present in the air. Symptoms may, for example, be provoked by pollen grains settling on the mucous membranes and on the conjunctivae in a more or less short succession when the concentration is not high in the air. 'Clouds' of pollen may also be involved so that exposed patients may have attacks even with low overall concentrations in the air.

Acknowledgments

We would like to extend our gratitude to Professor R. Schuppli, director of the Dermatological Department of the Basel Cantonal Hospital, for permission to conduct this investigation. Our special thanks go to Dr F. Wortmann, head of the Allergy Section, and to his collaborators, especially Dr Dorothea Somacal. We are likewise deeply indebted to Dr Chr. Virchow, Physician-in-Charge at the alpine hospital, 'Hochgebirgsklinik Davos-Wolfgang' in Davos, and his staff. He helped to choose the patients at his hospital who figure in Table 4 of this article.

Finally, we wish to express our gratitude to the 'Swiss National Foundation for the Advancement of Scientific Research' for the grants in aid to this project.

References

- GRONEMEYER, W. (1967) Pollenallergie. *Lehrbuch der klinischen Allergie* (eds K. Hansen and M. Werner), p. 167. Thieme, Stuttgart.
- KAILIN, E.W. (1964) Variations in ragweed pollen exposure in a metropolitan area. *Medical Annals of the District of Columbia*, **33**, 1.
- LEUSCHNER, R.M. (1974) Luftpollenbestimmung in Basel während der Jahre 1969 und 1970. (Mit Uebersicht über die Methoden und Ergebnisse von Luftpollenuntersuchungen.) *Verhandlungen der Naturforschenden Gesellschaft in Basel*, **84**, 521.
- LEUSCHNER, R.M. & BOEHM, G. (1977a) Ueber ein Pollenfängergerät für Einzelpersonen. (Vorläufige Mitteilung.) *Schweizerische medizinische Wochenschrift* **107**, 57.
- LEUSCHNER, R.M. & BOEHM, G. (1977b) Individual pollen collector for use of hay fever patients in comparison with the Burkard trap. *Grana*, **16**, 183.
- REMPE, H. (1938) Untersuchungen über die Verbreitung des Blütenstaubs durch Luftströmungen. *Planta*, **27**, 93.
- STIX, E. (1971) In: *Allergien durch Pollen und Sporen*. Mitteilung VI der Kommission zur Erforschung der Luftverunreinigung, p. 46. Deutsche Forschungsgemeinschaft, Bonn-Bad Godesberg.

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.