Table IV. Concentrations (μg/g) of ^{14}C Materials Found in Solubilized Tissue Samples, Hexane/Ether Extracts, and Methanol Extracts of Muscle and Head-Viscera of Largemouth Bass Exposed to a 1.0-μg/mL Solution of [^{14}C]TFM for 12 h and then Transferred to Lampricide-Free, Flowing Water for Up to 72 h

withdrawal interval, h	^{14}C tissue activity	^{14}C activity in hexane/ether extract	GC[a]	methanol extract	total extracted[b]
			Muscle		
0	0.862	0.331	0.352	0.492	0.823
4	0.228	0.102	0.079	0.225	0.327
8	0.014	0.048	0.007	0.090	0.138
12	ND	0.040	0.001	0.058	0.098
24	ND	0.025	0.001	0.026	0.051
48	ND	0.018	ND	0.024	0.042
72	ND	0.019	ND	0.021	0.040
			Head-Viscera		
0	1.878	0.555	0.481	1.061	1.616
4	0.816	0.286	0.118	0.742	1.028
8	1.567	0.247	0.080	1.460	1.707
12	0.540	0.139	0.040	0.451	0.590
24	2.530	0.411	0.176	1.519	1.930
48	0.788	0.172	0.067	0.348	0.520
72	0.487	0.160	0.056	0.608	0.768

[a] Gas chromatographic analyses were conducted on hexane/ether extracts (see Materials and Methods). [b] Total extracted = hexane-ether plus methanol extracts.

at 0, 12, and 24 h after withdrawal. The total amount of TFM in replicate samples extracted with HE followed by methanol was 30, 7, and 9% of the total radioactivity in the combined extracts. On the basis of these two experiments, we concluded that HE extracted most of the TFM from tissue.

Lech and Costrini (1972) found that fish liver is able to reduce TFM and acetylate the reduced form in vitro. Further studies would be required to determine if the radioactive materials we found, other than TFM, were reduced or N-acetylated, reduced TFM.

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Mothproofing Wool and Wool Blends with Permethrin

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Permethrin, a synthetic pyrethroid insecticide, can be applied to wool and wool-blend fabrics and yarn in the dye bath in a concentration of 0.003–0.005% and a wool–liquor ratio of 1:20 for 15 and 45 min at the boil with several dye types including acid premetalized, chrome, fiber reactive, acid leveling, and neutral premetalized. It was also found to be compatible with several flameproofing and shrinkproofing treatments for wool. Permethrin is absorbed nearly quantitatively by wool from many dye bath solutions. The described finishing treatments, which require only readily available equipment, appear easily adaptable to commercial use.

The excellent textile properties of wool are well-known. Nevertheless, wool has certain limitations. If it is not properly cared for, it is subject to laundering shrinkage and insect damage. Furthermore, although compared to other fabrics it is relatively resistant to ignition, it will burn. Thus it is more useful when it has been made resistant to

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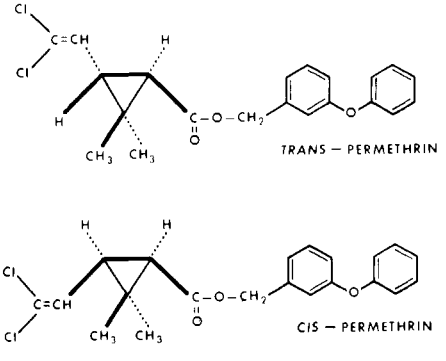

Figure 1. Structure of permethrin isomers.

Table I. Dye Bath Formulations

dye type / dye and chemicals	acid metalized: Vitrolan Yellow BE (Acid Yellow 54)[a]	chrome: Chrome Fast Blue GBX (CIBA; C.I. No. not found)[a]	fiber reactive: Lanasol Scarlet 2R (Reactive Red 78)[a]	acid leveling: Alizarine Sky Blue 5GLW (Acid Blue 232)[a]	neutral metalized: Supralan Yellow NR (Acid Yellow 121)[a]
Dye, 2% owF	0.6 g	0.6 g	0.6 g	0.6 g	0.6 g
Na_2SO_4, 10%	3.0 g	3.0 g	3.0 g	3.0 g	3.0 g
$(NH_4)_2SO_4$, 4%		1.2 g	1.2 g	1.2 g	1.2 g
$K_2Cr_2O_7$, 1.0%		0.3 g			
H_2SO_4, 10%	8 cm^3				
acetic acid, 10%			5 cm^3	5 cm^3	
albegal B[b]	0.3 g	0.3 g	0.3 g	0.3 g	0.3 g

[a] "Color Index" (1975) names are given in parentheses. [b] A polyglycol ether derivative used as dyeing assistant and leveling agent (CIBA-GEIGY).

Table II. Permethrin Distribution between Wool and Dye Bath in the Presence of Various Dyes (Calculations Based on Average of Four Analyses)

dye type[a] and dye	permethrin in bath: time at boil, min	permethrin in bath: intended concn, % by wt	permethrin in bath: amount indicated by analyses, % by wt	permethrin recovered: on wool, % by wt	permethrin recovered: in spentbath, % by wt	total recovery, %
AL-Alizarine Sky Blue 5 GLW.	15	0.003	0.0030	0.048	0.00041	90.72
(C.I. Acid Blue 232)	15	0.005	0.0048	0.081	0.00078	92.93
	45	0.003	0.0031	0.058	0.00001	93.80
	45	0.005	0.0051	0.095	0.00001	93.25
C-Omega Chrome Fast Blue GBX.	15	0.003	0.0029	0.052	0.00001	89.93
conc. (Sandoz; C.I. Number not found)	15	0.005	0.0051	0.090	0.00011	89.33
Omega Chrome Brown 2R conc.	45	0.003	0.0029	0.051	0.00001	88.20
(C.I. Mordant Brown 33)	45	0.005	0.0049	0.089	0.00001	90.93
NP-Supralan Yellow NR	15	0.003	0.0028	0.050	0.00039	100.00
(C.I. Acid Yellow 121)	15	0.005	0.0050	0.083	0.00057	88.88
Irgalan Red 2GL	45	0.003	0.0029	0.052	0.00001	89.92
(C.I. Acid Red 211)	45	0.005	0.0048	0.088	0.00001	91.79
FR-Lanasol Scarlet 2R	15	0.003	0.0030	0.054	0.00001	86.93
(C.I. Reactive Red 78)	15	0.005	0.0051	0.102	0.00001	100.11
Lanasol Red B	45	0.003	0.0029	0.054	0.00001	93.37
(C.I. Reactive Red 65)	45	0.005	0.0045	0.079	0.00001	87.93
AP-Vitrolan Yellow BE	15	0.003	0.0029	0.060	0.00001	103.71
(C.I. Acid Yellow 54)	15	0.005	0.0049	0.100	0.00001	102.16
AP-Neolan Blue 2R	45	0.003	0.0029	0.0543	0.00001	91.68
	45	0.005	0.0049	0.091	0.00001	92.99

[a] AL, acid leveling; C, chrome; NP, neutral premetalized; FR, fiber reactive; AP, acid premetalized.

Table III. Insect Resistance of Fabrics Dyed in the Presence of Permethrin

dye type and dye	time at boil, min	concn in bath,[a] % by wt	excrement per larva, mg
AL-Alizarine Sky Blue 5GLW	15	0.003	0.12
(C.I. Acid Blue 232)	15	0.005	0.13
	45	0.003	0.11
	45	0.005	0.14
C-Chrome Fast Blue GBX conc.	15	0.003	0.15
(CIBA; C.I. No. not found)	15	0.005	0.13
Irgalan Red 2GL	45	0.003	0.13
(C.I. Acid Red 211)	45	0.005	0.11
FR-Lanasol Scarlet 2R	15	0.003	0.10
(C.I. Reactive Red 78)	15	0.005	0.10
Lanasol Red B	45	0.003	0.08
(C.I. Reactive Red 65)	45	0.005	0.08
AP-Vitrolan Yellow BE	15	0.003	0.07
(C.I. Acid Yellow 54)	15	0.005	0.07
	45	0.003	0.09
	45	0.005	0.12
None			2.66

[a] Results of 14-day feeding tests with black carpet beetle larvae (CSMA, 1971).

Table IV. Permethrin Uptake on Shrink-Resistant and Flame-Resistant Wool

treatment	permethrin in bath, % by wt: intended concn	permethrin in bath, % by wt: amount indicated by analysis	permethrin recovered, % by wt: on wool	permethrin recovered, % by wt: in bath	total recov., %
chlorine hercosett + permethrin	0.003	0.0025	0.044	0.00073	109.93
	0.005	0.0041	0.072	0.00091	
potassium fluorozirconate + permethrin	0.003	0.0024	0.048	0.00002	100.63
	0.005	0.0047	0.083	0.00002	88.62
DCCA[a] + potassium hexafluorotitanate + permethrin	0.003	0.0026	0.049	0.00004	101.22
	0.005	0.0045	0.083	0.00007	93.41

[a] DCCA, dichlorocyanuric acid.

Table V. Insect Resistance of Shrink-Resistant and Flame-Resistant Wool Fabrics Treated with Permethrin[a]

treatment	bath concn, % by wt	permethrin residue after, % by wt: 0 washings	permethrin residue after, % by wt: 3 washings	excrement per larva, mg: 0 washings	excrement per larva, mg: 3 washings
chlorine hercosett + permethrin	0.003	0.044	0.016	0.12	0.15
	0.005	0.072	0.029	0.09	0.12
potassium fluorozirconate + permethrin	0.003	0.048	0.030	0.10	0.11
	0.005	0.083	0.052	0.10	0.11
DCCA[b] + potassium hexafluorotitanate + permethrin	0.003	0.049	0.036	0.12	0.12
	0.005	0.083	0.055	0.10	0.11
			Controls		
chlorine hercosett		<0.0002	<0.0002	2.61	0.60
potassium fluorozirconate		<0.0002	<0.0002	0.14	0.30
DCCA[b] + potassium hexafluorotitanate		<0.0002	<0.0002	0.14	2.03
Savannah moth test cloth		<0.0002		2.67	

[a] Results of 14-day feeding tests with black carpet beetle larvae (CSMA, 1971). [b] DCCA, dichlorocyanuric acid.

Table VI. Insect Resistance of Wool Fabric Treated with TBPA[a] and Permethrin[b]

treatment	excrement per larva, mg	residue of permethrin on wool, % by wt
untreated control	2.32	0.0006
dyed control	1.20	0.0001
8% (OWF)[c] TBPA control	0.82	0.0006
16% (OWF)[c] TBPA control	0.77	0.0006
acid-premetalized dye + 8% (OWF)[b] TBPA	0.64	0.0001
acid-premetalized dye + permethrin (0.005%)	0.11	0.091
TBPA + permethrin (0.005%)	0.10	0.083

[a] TBPA, tetrabromophthalic anhydride. [b] Results of 14-day feeding tests with black carpet beetle larvae (CSMA, 1971). [c] OWF, percentage based on weight of fabric.

laundering shrinkage, insects, and fire. Studies to develop finishing treatments for wool and wool blends to overcome these limitations clearly show that a combined, multipurpose treatment applied in a normally used commercial process is feasible. Such a multipurpose treatment has the best chance of being adopted by the textile industry. Dyeing is a particularly logical finishing step for combining with other wet finishing treatments. In this paper we evaluate the compatibility of the relatively new, highly effective candidate mothproofing agent, permethrin, with several dye types with wool treated to resist ignition and shrinkage and wool-blend fabrics and yarns.

MATERIALS AND METHODS

Dye Bath Procedure. Compositions of the dye bath solutions are shown in Table I. Permethrin (FMC 33297, *m*-phenoxybenzyl *cis,trans*-(±)-3-(2,2-dichloroethyl)-2,2-dimethylcyclopropanecarboxylate, Figure 1, as a 38.9% stock solution of both isomers in about equal concentration) was diluted with water to 30 or 50 mg/L. The samples (30 g of wool fabric) were treated with permethrin in a normal dyebath containing the necessary dye assistants but without dye. For each 30 g of wool, 700 mL of dyebath (nominal 1:20 wool–liquor ratio) was prepared with permethrin; a 50-mL sample was taken for analysis before adding the wool. Permethrin and dye were applied to the wool at the same time; i.e., the dye and permethrin were dispersed in the bath together. The bath with wool was then heated to the boil and boiled for the indicated time. After the treatment, a sample of 100 mL was taken for analysis for permethrin. The total volume prepared for each dye bath, 700 mL, allowed for the initial 50-mL sample and about 50-mL loss due to evaporation. "Color Index" (1976) names, when known, of all dyes are included in parentheses in the tables.

Permethrin Analysis. Permethrin contents of treating baths and residual solutions and of wool were determined by a gas chromatographic procedure (Bry and Lang, 1976).

Mothproofing Test. Biological tests were made with black carpet beetle larvae according to the Chemical Specialties Manufacturers Association (CSMA, 1971) excrement weight test procedure.

Table VII. Insect Resistance of Wool Fabrics Treated for Combined Resistance Also to Shrinkage and Ignition

treatment	excrement per larva, mg	residue of permethrin on wool, % by wt
ozone treated + TBPA[b] (8% OWF)[c] + acid-leveling dye	0.56	0.0004
ozone treated + TBPA[b] (8% OWF)[c] + permethrin (0.005%)	0.10	0.073
wurset treated + acid-leveling dye + TBPA[b]	0.43	0.0004
wurset shrinkproof + acid-leveling dye + TBPA[b] + permethrin (0.005% OWF)	0.13	0.080
polysiloxane treated	2.34	0.0006
permethrin (0.005%) on polysiloxane treated, dry cleaned	0.06	0.094
permethrin (0.005%) on polysiloxane treated, 75 min accelerator wash	0.06	
untreated control	2.11	0.0001

[a] Permethrin was applied under dye-bath conditions to wool fabric previously treated with flame- and shrink-proofing compounds as indicated. [b] TBPA, tetrabromophthalic anhydride. [c] OWF, percentage based on weight of fabric.

Table VIII. Permethrin Uptakes and CSMA[a] 14-Day Feeding Tests on Wool Yarn and Blends

type of yarn	permethrin in bath, % by wt: intended concn	permethrin in bath, % by wt: by analysis	permethrin recovered, % by wt: on wool	permethrin recovered, % by wt: in afterbath	excrement per larva, mg
100% wool knitting yarn	0.003	0.0019	0.042	0.0004	0.16
	0.005	0.0028	0.073	0.0005	0.13
100% wool carpet yarn	0.001	0.0010	0.015	0.0002	0.11
	0.003	0.0030	0.053	0.0001	0.10
	0.005	0.0036	0.069	0.0012	0.13
50% wool/50% Dacron	0.005	0.0047	0.078	0.0003	0.14
50% wool/50% cotton	0.003	0.0003	0.031	0.0001	0.11
100% wool	0.003	0.0007	0.021	0.0001	0.07
			Controls		
100% wool knitting yarn			<0.0002		2.69
100% wool carpet yarn			<0.0002		0.61
50% wool/50% Dacron			<0.0002		0.89
50% wool/50% cotton			0.0023		1.02
100% wool			<0.0002		2.63

[a] Chemical Specialties Manufacturers Association.

Table IX. Insect Resistance of Various Wool and Blended Fabrics Treated with Permethrin[a]

fabric	bath concn, % wt of fabric	excrement/larva, mg: untreated	excrement/larva, mg: treated
76/24 wool/acrylic,	0.003		0.14
grey plaid	0.005	2.67	0.15
55/35/10 wool/Dacron/	0.003		0.15
mohair, red plaid	0.005	4.78	0.16
65/35 polyester wool,	0.003		0.13
green plaid	0.005	1.15	0.14
70/30 wool/nylon,	0.003		0.13
maroon plaid	0.005	3.03	0.14
55/45 Dacron polyester/	0.003		0.15
wool, light yellow	0.005	1.42	0.14
50/50 wool/nylon, dark	0.003		0.16
red upholstery	0.005	0.99	0.14
65/35 wool nylon	0.005	3.12	0.12
50/50 wool/Dacron	0.005	3.99	0.11
50/50 wool/cotton	0.005	2.53	0.11
55/45 wool/cordelan	0.005	2.58	0.11
100% wool	0.005	2.95, 3.41	0.11

[a] Results of 14-day feeding tests with black carpet beetle larvae (CSMA, 1971).

Black carpet beetle larvae were allowed to feed on samples at the Stored Products Insects Research and Development Division, U.S. Department of Agriculture, Savannah, GA. Treated and untreated samples (0.5 g) were exposed to the larvae 14 days and excrement weights were measured. Wool is considered satisfactorily resistant if the average quantity of excrement per larva is not over 0.5 mg, provided no single value is over 0.6 mg and the

Table X. Uniformity of Permethrin Distribution on Treated Fabrics[a]

fabric	sample no.	permethrin residue, % by wt (+SD)[b]
65/35 wool/nylon	1	0.084
	2	0.085
	3	0.086
	4	0.090
	av	0.086 ± 0.003
50/50 wool/Dacron	1	0.090
	2	0.087
	3	0.095
	4	0.127
	av	0.100 ± 0.018
50/50 wool/cotton	1	0.070
	2	0.072
	3	0.079
	4	0.076
	av	0.074 ± 0.004
55/45 wool/cordelan	1	0.088
	2	0.089
	3	0.094
	4	0.087
	av	0.090 ± 0.003
100% wool	1	0.089
	2	0.083
	3	0.083
	4	0.089
	av	0.086 ± 0.003

[a] Chemical analyses of four subsamples of various wool and wool-blend fabrics treated with 0.005% permethrin. [b] SD, standard deviation.

Table XI. Recovery of Permethrin from Various Dyed Wool Fabrics Exposed to Light[a]

dye type[b] and dye	permethrin on wool after exposure to indicated standard fading hours (SFH),[c] % by wt				
	0 SFH	20 SFH	40 SFH	60 SFH	80 SFH
C-Omega Chrome Brilliant Blue B (C.I. Mordant Blue 1)	0.079		0.060	0.045	
M-Xylene Milling Yellow 3 GL (C.I. Acid Yellow 75)	0.081		0.070	0.058	
FR-Intracron Orange WG (C.I. Reactive Orange 29)	0.074			0.062	0.032
AP-Neolan Blue 2R (C.I. Acid Blue 158)	0.070		0.048	0.029	
NP-Irgalan Rubine RL (C.I. Acid Violet 75)	0.074			0.057	0.044
permethrin alone (no dye)	0.075	0.064		0.046	0.039

[a] AATCC Standard Test 16A (1964). Atlas Fade-Ometer Model FDA-RC, Atlas Electric Devices Company, Chicago, Ill. [b] C, chrome; M, milling; FR, fiber reactive; AP, acid premetalized; NP, neutral premetalized. [c] Residues on all untreated controls were <0.0003% by weight.

value for the untreated control is over 1.5 mg.

Flameproofing Treatment. Application of the flame-retardant tetrabromophthalic anhydride (TBPA) to wool was carried out in a dye bath as previously described (Friedman, 1978; Friedman et al, 1974).

Treatments to Control Shrinkage. Ozonized wool cloth was prepared by Thorsen and Landwehr (1975). A wollen worsted cloth with a polyurea finish (WURSET) was prepared by Pardo et al. (1975).

Polysiloxane shrink-resistant wool was prepared as follows: A 3.5-g all-wool swatch in 21 mL of a 14% Polysiloxane Emulsion obtained from Th. Goldschmidt AG, Chemische Fabriken, Essen, West Germany, was treated for 1 min at room temperature. The fabric was squeezed through pad rolls set at 40 psi to give a 60% wet weight pick-up. The samples were air-dried overnight in an forced-air oven at 250 °F for 2 h. The weight add-on was 9%.

The following wool fabrics, supplied by the Wool Bureau, Inc., Long Island, NY, were included in this study. Knitted yellow-gold fabric, chlorine-Hercosett treated in top form and dyed in the piece (Holt, 1975); woven 14 oz/yd worsted blue serge fabric treated for flame resistance with potassium fluorozirconate (Benisek, 1975); woven 14-oz worsted dark-blue serge fabric treated for shrink resistance with dichlorocyanuric acid (DCCA) (Holt, 1975) and for flame resistance with potassium hexafluorotitanate (Benisek, 1975). In addition, 65/35 wool/Nylon, 50/50 wool/Dacron, 50/50 wool/cotton, and 55/45 wool/Cordelan fabrics were prepared in our Fabric Processing Laboratory. Other wool blends were purchased.

DISCUSSION

Clothes moths and carpet beetles readily attack and damage wool-containing apparel, upholstery, and carpeting. To increase the durability of wool products and to help the consumer, mothproofing such products is desirable. Because the Environmental Protection Agency has banned the highly effective mothproofing agent dieldrin, a safe, effective, and economical alternative is needed. The synthetic pyrethroid insecticide permethrin has been shown to be more effective than DDT as an insecticide (Berkovitch, 1974). The compound is relatively nontoxic when ingested by mammals. The acute oral LD_{50} to rats is greater than 2000 mg/kg (Bry et al., 1976). Furthermore, it is nonmutagenic in the Ames test with *Salmonella typhimurium* with or without a liver metabolizing system in vitro (Metker et al., 1978; cf. also MacGregor and Friedman, 1977). For these reasons, permethrin is being widely evaluated as a potential agricultural insecticide (Hunt and Gilbert, 1977). Recent studies (Bry and Lang, 1976; Bry et al., 1976; Carter and Duffield, 1976; 1977; Duffield, 1977) disclose that it is also a highly effective mothproofing agent for wool.

This study was undertaken to assess the compatibility of permethrin with various dye types, to develop optimum conditions for applying permethrin to wool and wool blends, fabrics and yarns, to determine the compatibility of permethrin with flameproofing and shrinkproofing treatments, and to establish the extent of binding and distribution of permethrin to wool and wool blends. Our results show that the amount of permethrin absorbed by wool in the presence of dye varied somewhat with the dye type. From less than 1 to about 13% of the permethrin was present in residual dyeing liquors. Additional studies in which permethrin was extracted from various places on the fabric and quantitatively determined by gas chromatography indicate that the treatment gives an even (level) distribution of permethrin.

Results of 14-day CSMA feeding tests with black carpet beetle larvae, summarized in Table II–IX show the following: (a) Application of a 0.003–0.005% permethrin solution to wool (wool–liquor ratio, 1:20) gives a permethrin residue in wool that ranges from 0.04–0.09% by weight. (b) Since test specifications for satisfactory protection require an excrement per larva value of less than 0.5 mg and no single value over 0.6 mg, all treatments effectively protected wool fabric against carpet beetle larval feeding. (c) The dyes used offer little or no protection by themselves. The excrement per larva for the control without dye or permethrin was 2.88 mg, compared to a range of values from 1.49 to 2.36 mg for dyed fabrics without permethrin.

Feeding test results for permethrin-treated, flame-resistant, and shrink-resistant wool fabrics are given in Tables IV–VII. These results show five things. (a) Permethrin is compatible with wool that has been treated for flame resistance with tetrabromophthalic anhydride, potassium hexafluorozirconate, or hexafluorotitanate. Indeed, the TBPA, titanate, or zirconate treatments without permethrin impart significant mothproofing. (b) Shrinkproofing treatments based on ozone, polyurea, polysiloxane, chlorine-resin (Hercosett), and DCCA also appear compatible with permethrin (Tables IV–VII). (c) Permethrin can be applied under dye bath conditions to yarns, including wool hand-knitting and carpet yarns and blended yarns with Dacron or cotton (Tables VIII–X). (d) Permethrin effectively mothproofs various wool blend fabrics including wool/acrylic, wool/Cordelan, wool/cotton, wool/Dacron, wool/Nylon, and wool/polyester

(Table IX). (e) Exposure of dyed, permethrin-treated wool fabric to light in a Fade-O-Meter causes slow but measurable degradation of permethrin in the wool (Table XI). These results suggest that exposure of permethrin-treated wool to sunlight over long periods will lead to measurable degradation of permethrin. This slow loss is expected to have little practical effect, but deserves further study; cf. Holmstead and Casida (1978).

In conclusion, this study demonstrates that it is possible to impart multibenefit finishing treatments to wool to give products that are moth, flame, and shrink resistant. We believe these multipurpose finishes merit consideration for commercial use.

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Comparison by Twelve Laboratories of the Odor Qualities of Nine Chemicals Sniffed from the Bottle and as Gas–Liquid Chromatography Effluents

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Twelve laboratories carried on a collaborative study to compare the odors of nine pure chemicals as sniffed from the bottle and as gas–liquid chromatography (GLC) effluents at three different concentrations. Odor intensities varied according to known psychophysical functions. There was some confusion between odors of sequentially eluted odorants, but it was not great and it could be reduced by improvements in design of GLC splitter ports, suggestions for which are made. Many of the problems of contamination of one odorant with another are the same involving mass spectrometric identification. The recognizability of an odor was not greatly impaired when the odorant was delivered from a GLC effluent port as compared with sniffing the pure compound. Although 126 judges generated 136 descriptor terms for the nine chemicals, the terms could be classified into 22 groups and there was good agreement among the 12 laboratories involved.

Much of the information we have about the odor and taste qualities of chemicals—including several poisonous ones—came to be because early chemists used their senses of odor and taste as analytical instruments. The practice has fallen into disuse except for two kinds of chemists. The traditional perfumer or flavorist still uses his nose and remarkable memory to catalogue hundreds of compounds and often to identify the source of components of a mixture. Gas chromatographers constitute the other group. They frequently "sniff" compounds as they emerge from a gas–liquid chromatography column to evaluate their odor qualities and sometimes use sensory analysis as an aid in identification. There are questions whether the odor qualities of a compound are the same when sniffed from a bottle or a perfumer's stick and as a hot vapor coming from a GLC instrument. Furthermore, there are questions

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