Physiology. — *"About Odour-affinity, based on experiments of* J. HERMANIDES. By Prof. H. ZWAARDEMAKER.

(Communicated in the meeting of May 29, 1909).

In the physiological laboratory at Utrecht Mr. HERMANIDES prepares a dissertation about the constants of olfactometers used in qualitative measurement of odour [1]). The latter are nine in number. The odorous matter consists as much as possible of pure substances, taken up by paraffinum liquidum, with the exception of muscon, which is divided in myristine-acid. In the measurements first of all the weakest observable stimulus is fixed for each olfactometer separately. In order to compare the results that Mr. HERMANIDES arrived at, with those of other observers we give in the subjoined table a review of minimum values of stimuli. Each figure represents the mean out of 10 observations.

MINIMA PERCEPTIBILIA
in cm.

	Z_1	Z_2	N	K	H_5	v. d. H. L. abnormal odour-syst.[2])	$H\alpha$
Isoamylacetate ½%	0.23	0.2	0.3	0.245	0.3	0.34	0.4
Nitrobenzol 5 % .	0.03	0.03	0.03	0.02	0.02	0.007	0.03
Terpineol 2.5% . .	1.10	1.10	2.0	2.90	1.3	>7.00	1.2
Muscon 0.627% . .	0.15	0.15	0.3		0.2	1.45	0.3
Aethylbisulfide 1°/ooo	0.015	0.015	0.005	0.004	0.012	0.28	0.02
Guajacol 1°/oo . . .	0.30	0.30	0.25	0 50	0.5	2.30	0.6
Valerian acid 1°/ooo	0.03	0.03	0.02	0.02	0.04	0.05	0.04
Pyridine 1°/oo. . . .	0.02	0.02	0 02	0.023	0.03	2.25	0.03
Skatol 1°/oo.	0.002	0.003		0.0003	0.002	0.000043	0.003

The names of the observers whose initials are given at the head of the columns, are: ZWAARDEMAKER, NOYONS, KUBO, HERMANIDES, VAN DER HOEVEN LEONHARD, HERINGA. The mean error in the observations of Mr. HERMANIDES was very satisfactory, viz.:

1) See Meeting 28 Sept. 1907.

2) At the same time abnormal trichromate, as to sense of colour; compare Onderz. Physiol. Lab. Utrecht (5), Deel. 8, p. 394.

for the isoamylacetate-olfactometer		16 %
„ „ nitrobenzol-	„	40 „
„ „ terpineol-	„	20 „
„ „ muscon-	„	24 „
„ „ aethylbisulfide-	„	10 „
„ „ guajacol-	„	20 „
„ „ valerianacid-	„	18 „
„ „ pyridine-	„	12 „
„ „ scatol-	„	23 „

Expressed in absolute measure the minimum perceptibile of HERMANIDES answers to:

for	isoamylacetate	9.10^{-6}	grammes per Liter of air
„	nitrobenzol	412.10^{-7}	„ „ „ „ „
„	terpineol	185.10^{-6}	„ „ „ „ „
„	aethylbisulfide	3.10^{-7}	„ „ „ „ „
„	guajacol	37.10^{-7}	„ „ „ „ „
„	valerian acid	21.10^{-7}	„ „ „ „ „
„	pyridine	1625.10^{-7}	„ „ „ „ „
„	scatol	35.10^{-8}	„ „ „ „ „

Mr. HERMANIDES has joined together his 9 standard odours in all possible combinations and tried a compensation. By alternately rendering one of the two stimuli weaker or stronger he determined the quantitative proportion, for which the blended odour either entirely disappeared, or approached to zero in the double olfactometer, first in case of unilateral, afterwards also with bilateral supply. That the blended odour approached to zero, was assumed to be the case, when in the combination only an extremely weak indefinite odour was observed. The whole number of combinations each of 2 odours examined in this way amounted to 72. Each mixture repeating itself twice in unilateral observation, 36 combinations were thus formed. The proportional numbers met with for these, are taken together in the subjoined table, whilst the table taken from my first communication regarding odour-affinity, to render a comparison possible, has been placed by its side. The odour-stimuli are expressed in olfactions and each time the proportion $\frac{p}{q}$ is given, in which for each combination the quantities had been mixed.

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PROPORTIONAL NUMBERS OF THE STIMULI COMPENSATING EACH OTHER.

ZWAARDEMAKER.

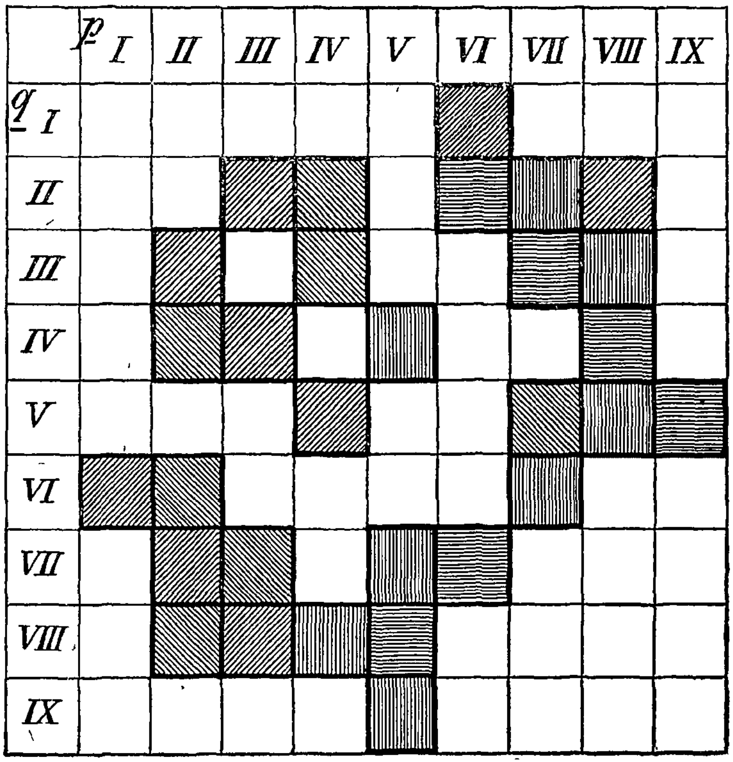
q \ p	I	II	III	IV	V	VI	VII	VIII	IX
I		2.2	0.76	16	4.1	0.33	107	0.28	375
II	0.44		0.73	2.3	9	1.53	30	0.33	83
III	1.32	1.37		8	14	1	20	2	8
IV	0.06	0 43	0.12		1	0 03	0.33	0.83	5
V	0.24	0.11	0.07	1		0.06	0.82	0.31	44
VI	3	0.65	1	33	18		33	63	1400
VII	0 01	0 03	0.05	3	1.2	0.03		0.25	0.08
VIII	3.6	3	0.5	1.2	3.2	0.02	4		2.4
IX	0.003	0.012	0.125	0.2	0.023	0.001	12	0.42	

HERMANIDES.

q \ p	I	II	III	IV	V	VI	VII	VIII	IX
I		1.18	0.26	5.26	1.25	0.5	15.07	0.16	18
II	0 85		0.45	1.24	0.54	1.64	70.4	0.25	5.2
III	3 88	2.22		5.5	2.22	2.94	16	1.74	22.86
IV	0.19	0 81	0.18		0.44	0.37	1.61	1.82	24
V	0.8	1.87	0.45	2.27		0.52	1.72	0.54	27.03
VI	2	0.61	0.34	2.69	1.92		28.57	0.67	18.52
VII	0.063	0.0126	0.062	0.62	0.58	0.035		0.036	3.2
VIII	6.45	3.99	0.58	0.55	1.85	1.5	27.39		23.26
IX	0.055	0.19	0.04	0.042	0.037	0.054	0.31	0.043	

In order to give a survey of the proportional numbers in which the two observers agree and in which they differ, the cases in which there is agreement within the limits of the probable errors, are expressed in the subjoined field of squares.

Cases in which the proportional number $\frac{p}{q}$ does not differ in *Z* and *Hs*, within the limits of the probable errors.



A definite order in these agreements is not to be perceived as yet.

We have tried to discover whether a greater agreement might perhaps be obtained, if instead of the proportion of the olfaction-values those of the logarithms of the olfaction-values were taken. The subjoined tables account for this.

If in these tables the values are looked up that in the tables to the right and left are about the same, it soon appears that no manner of regularity can be observed.

Hereupon Mr. Hermanides has tried a vectorial representation of

PROPORTIONAL NUMBERS OF THE LOGARITHMS OF STIMULI COMPENSATING EACH OTHER

The Table gives the value of $\frac{\log p}{\log q}$.

ZWAARDEMAKER.

log q \ log p	I	II	III	IV	V	VI	VII	VIII	IX
I		1 25	0.85	12 5	2 27	∞	5 88	0 67	5.26
II	0.8		0.86	1 35	1 79	1.15	2 5	0 78	2 44
III	1 18	1.16		2.27	2 38	1	3 57	1 32	1.69
IV	0 08	0.74	0 44		1 01	0	0.7	0.94	1 54
V	0 44	0 56	0.42	0.99		0.33	0.96	0 8	1.41
VI	0	0 87	1	∞	3 08		∞	3 09	0
VII	0.17	0.4	0 28	1.43	1.04	0		0.74	0 56
VIII	1.5	1 28	0.76	1.06	1.25	0.11	1 35		1 18
IX	0.19	0.41	0.49	0 65	0 71	∞	1 79	0.85	

HERMANIDES.

log q \ log p	I	II	III	IV	V	VI	VII	VIII	IX
I		1 09	0 41	2.94	1.11	0.63	2.44	0 47	1.96
II	0 92		0.67	1 09	1 64	1 19	4 54	0.68	1.35
III	2 43	1.49		3.45	1 49	1 89	15 15	1.28	2.63
IV	0 34	0.92	0.29		0 64	0.52	1.23	1.32	2.38
V	0.9	0 61	0.67	1.55		0.78	1 18	0.84	2
VI	1.58	0 84	0 53	1 91	1 28		10	0.85	2 08
VII	0.41	0.22	0.066	0.81	0.85	0.1		0.38	1 25
VIII	2.14	1.47	0.78	0 76	1 19	1 18	2 66		1.82
IX	0 51	0 74	0 38	0 42	0.30	0.48	0.8	0 55	

the results of his observations. Whereas at the time, among the 252 possible combinations, I myself had found only one system [1]) in which three odours, considered as vectors, could be joined together, HERMANIDES succeeded in finding three such systems.

The system of ZWAARDEMAKER was that of terpineol, aethylbisulfide and guajacol in the proportion 1:18:1 and as such not be construed; the systems of HERMANIDES appear to be:

A. isoamylacetate, guajacol and valerian-acid in the proportion 2 : 1 : 29.

B. nitrobenzol, aethylbisulfide and pyridine in the proportion 1.9 : 1 : 0.5.

C. guajacol, pyridine and scatol in the proportion 1.5 : 1 : 24.

On account of the relative rarity of such constellations and the want of agreement between the system of ZWAARDEMAKER and those of HERMANIDES no further inferences can, at least provisionally, be drawn from this.

An important fact, however, is that in the further work some identities between vectors for both of us conjointly have been found. The subjoined table accounts for this.

TABLE of the coinciding of two vectors with respect to two others, both for Z and for Hs.

Vectors becoming identical	Vectors whose position is given beforehand
isoamylacetate and guajacol	valerian acid and scatol
aethylbisulphide and valerian acid	guajacol and pyridine
valerian acid and scatol	isoamylacetate and terpineol
valerian acid and scatol	isoamylacetate and guajacol

Also the reciprocity between the proportion of isoamylacetate and guajacol on the one side and valerian-acid and scatol on the other, previously observed by me, has been found back by HERMANIDES, as a look at the table may show.

Likewise manifold identity. For four vectors it occurred, just as with me, only once and that for the odours:

[1]) Through an error in the calculation, Proceedings Vol. XVI, p. 187 note, the only possible combination of three vectors in my system has been erroneously given. The unique constellation is that of Terpineol, Aethylbisulfide and Guajacol. Inferences were not drawn then, nor are they tried now.

isoamylacetate
terpineol
guajacol
pyridine

Placed as vectors over against the odours valerian acid and scatol, likewise thought as vectors.

In that constellation, as we see, we meet with pyridine, in contradistinction to nitrobenzol in my case. If we leave this element, which is different, aside and if we take into consideration only what they have in common, we are in a position, in both my odour-system and that of HERMANIDES, to put two groups of odours over against one another.

Group A.	*Group B.*
isoamylacetate	valerian acid
terpineol	scatol
guajacol	

In these two groups terpineol and guajacol, on the ground of the reciprocity mentioned just now, stand in the same proportion to each other as valerian acid and scatol.

Cases of odour-compensations, showing both for Z and Hs about the same proportions.

Odour-compensations	Z	Hs	Ha
Isoamylacetate : Guajacol	3	2	5.7
Nitrobenzol : Terpineol	1.37	2.22	28
Nitrobenzol : Muskon	0.43	0.81	0.29
Nitrobenzol : Guajacol	0.65	0.61	49
Nitrobenzol : Valerian acid	0.03	0.013	0.8
Nitrobenzol : Pyridine	3	3.99	10.0
Terpineol : Muskon	0.12	0.18	0.05
Terpineol : Valerian acid	0.050	0.062	0.026
Terpineol : Pyridine	0 50	0.58	0.093
Muskon : Aethylbisulfide	1.0	2.27	0.15
Muskon : Pyridine	1.2	0.55	0.16
Aethylbisulfide : Valerian acid	1.2	0.58	0.13
Aethylbisulfide : Pyridine	3.2	1.85	0.45
Aethylbisulfide : Scatol	0.023	0.037	0.036
Guajacol : Valerian acid	0.030	0 035	0.013

We have been in a position to cause the combinations in which we agree, to be examined by a third person, Mr. H. Heringa, assistant at the laboratory. In order to make a comparison possible, the cases meant are put here side by side.

Of the proportional numbers in column 4 (Ha) three deviate very little from the corresponding values in column 2 (Z) and 3 (Hs), viz. terpineol to valerian acid, aethylbisulfide to scatol, guajacol to valerian acid (strictly speaking it is only aethylbisulfide to scatol that remains within the limits of the probable errors; the others are, speaking roughly, in agreement with each other).

If we connect this with the division into two ordinary groups *A* and *B*, we are led to single out from the nine standard-groups three groups, whose action upon the normal olfactory organ is presumably characteristic and in general equal for different persons (at least three observers got about the same quantitative proportions, when trying these three odours in combinations).

They are the odours:

From group A.	*From group B.*
terpineol	valerian acid
guajacol	

It is to be recommended for the present to continue the investigation with these three odours, for it has been these three materials, chemically sharply defined, which have exercised a quantitatively agreeing influence on the sensorial complex of three observers, mutually quite independent of each other. Therefore it may be assumed that the action of these odours, apart from the accidental psychological appreciation, within the limit of the probable errors and based upon the physiological organisation, possesses a sharply outlined nature and a very definite degree of intensity.

About the results of the bilateral combination of odours I hope I shall be able to offer a communication later on, when the three odours, which usually act in the same way, shall have been investigated on this point by more observers.