concentration) on measured 'equilibrium' dissociation constants. The solution to the rate equation can also provide insight into several apparently paradoxical phenomena, including the observation that the degree of approach to equilibrium within a given time is not always a monotonically increasing function of ligand concentration[2].
To facilitate estimation of the times required for the attainment of equilibrium under a variety of conditions we offer in table 1 a short summary of solutions to the rate equation for various useful combinations of the relevant variables B_{max}, S_o and K_d (i.e. k_d/k_a). The initial condition is simply that $B_{sp}=0$ at $t=0$, and the solution is presented as a table of pairs of numbers representing the time (in h) required for B_{sp} to attain 80% and 95% of the equilibrium value. The times were generated (by a very simple Fortran program) for $k_a = 10^5\ M^{-1}\ min^{-1}$. For other values of k_a one simply multiplies the tabulated values by 10^5 and divides the resulting product by k_a. In table 2 we provide estimates of the fraction of binding sites occupied and the fraction of the total ligand bound at equilibrium under the same hypothetical conditions as in table 1. (These percentages apply to all values of k_a.)

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Locomotor behavior in relation to octopamine levels in the ant *Lasius niger*

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Summary. The heads and bodies of hyperactive and hypoactive ants, selected on the basis of motor activity, were tested for their octopamine content. The level was found to be significantly higher in hyperactive animals. A possible involvement of octopamine in locomotor behavior is discussed.

Since highly sensitive and specific determination techniques[1-4] for the non-catecholic amine octopamine have been developed, it has been found in a wide range of vertebrates and invertebrates (see reviews by Robertson and Juorio[5] and by Robertson[6]). This amine is found to be associated with behavior in the rat[7,8] and in the locust *Locusta migratoria*[9]. In these 2 animals, high octopamine levels are associated with avoidance conditioning[8] and with the solitary phase status, respectively[9]. These observations suggested a correlation between the amine and the animal's activity, and led us to study the octopamine levels in ants in parallel with their degree of activity.
Methods. 40 worker individuals from *Lasius niger* were selected on the basis of locomotor activity[10]. This activity, in constant fluctuation, is estimated by the frequency of similar scores (or activity levels) given by the number of circular tracks run in 1 h in repeated tests. Thus animals were separated into groups of hypermotors or hypomotors.
Locomotor activity is characterized by a coefficient (k_a) computed from the indices (0 to 6) attributed to different levels of activity and noted at the tops of each column (table 1).
The coefficient k_a is the quotient of the sum S (sum of the products of the indices 'i' and the corresponding frequencies 'fi') by the total number of tests N. Example for the individual A:

$$k_a = \frac{S\,(2\times 1)+(3\times 3)+(4\times 9)+(5\times 5)+(6\times 6)}{24} = 4.5$$

This coefficient permits us to consider different levels of activity: very high, high, median, low, and very low. Animals used for this work were selected on a severe criterium with a coefficient ka higher than 4.42 (very high) for individuals named 'hyperactive' and lower than 1.42 (very low) for those considered as 'hypoactive' (table 2).
The animals were killed immediately after locomotor testing and heads and bodies were separately kept frozen at −70 °C. Tissues were analyzed within a week for their octopamine content according to the method described by Molinoff and Axelrod[1] as modified by David[4].
Tissues were homogenized with a Potter homogeniser in 10 vol. of tris-HCl buffer 0.05 M (PH 8.6) containing 1 mM pargyline. Extracts were kept in a boiling water bath for 5 min and centrifuged for 5 min at 20,000×g; 150 µl of supernatant were incubated at 37 °C with 37.5 µl of PNMT (phenyl-ethanolamine N-methyl-transferase) partially purified according to Saelens et al.[11], and 0.04 nmole of $[^3H]$-

Table 1. Example of locomotor activity levels in the ant *Lasius niger*

Activity level	→ 15	16–49	50–89	90–129	130–169	170–189	190 →	Activity coefficient
Index	0	1	2	3	4	5	6	k_a
Animal								
A	0	0	1	3	9	5	6	4.50 very high
B	0	0	1	4	12	3	0	3.85 high
C	0	4	12	6	2	0	0	2.25 low
D	6	8	5	5	0	0	0	1.37 very low

SAM ([^{3}H]-S-adenosyl-methionine) from CEA Saclay, 13.5 Ci/mmole in 60 µl of tris-HCl buffer 0.05 M (pH 8.6). After 45 min incubation, the reaction was stopped by the addition of 200 µl of 0.5 M borate buffer (pH 11) saturated with sodium chloride and containing *p*-synephrine, norphenylephrine and N-methylphenylethanolamine (1 µg each). N-methylated amines were extracted with 5 ml ethylacetate and centrifuged for 5 min at 10,000×g. After reaction with dansylchloride, the 3 methylated amines were separated using the different and consecutive chromatographic systems[3]. The radioactivity was found to be associated (> 90%) with *p*-octopamine.

Results. As depicted in table 3, the *p*-octopamine levels are significantly higher in heads and bodies from hyperactive animals as compared to hypoactive ants. This difference was more significant in the heads (1.58 and 3.83) than in the bodies (0.67 and 1.32).

Discussion. Endocrine glandular activity and metabolic needs in animals are known to be closely related[12]. Moreover, it has been shown that glandular cells of the retrocerebral system of hyperactive workers contain numerous dense granules and large dense bodies[13]. Those large dense bodies may contain octopamine, as has already been postulated for insects[14]. It was therefore of great interest to try to distinguish a difference between the 2 categories of ants (hyperactive and hypoactive ants) on the basis of biochemical characteristics.

Catecholamines and serotonin are supposed to be involved in aggressive behavior in ants[15,16]. However, to our knowledge, octopamine has never been described in these animals. Moreover, the amount found in this study is high as compared to other invertebrates[5,6]. The observation of considerably larger amounts in the head may indicate its association with the CNS of ants; further investigations at the brain level are necessary. Of great interest is the relationship between the activity and the levels of octopamine. This observation is not limited to mammals[8] but applies also to invertebrates. It may indicate a general involvement of octopamine in behavior. However, the relationship between the not, as yet, well delineated biochemical functions of octopamine and higher activity in animals has still to be clarified.

Table 2. Activity coefficient of ants selected for experiments

Hypo k_a	No. of individuals	Hyper k_a	No. of individuals
1.41	6	4.50	6
1.33	9	4.58	4
1.25	3	4.66	6
1.08	2	4.75	2
		4.81	1
		4.91	1

Table 3. Octopamine content of heads and bodies of hyper- and hypo-active ants

Heads		Bodies	
Hypo	Hyper	Hypo	Hyper
1.58±0.22	3.83±0.20*	0.673±0.05	1.32±0.05*

The octopamine values are expressed in µg/g of tissues±SEM from assays on 4 pools (heads) and 3 pools (bodies) each containing 5 pieces. The various pools were formed directly from the selected ants, whose k_a coefficient is given table 2. (B, C, D individuals in table 1 were used in previous trials and did not appear in table 3). (* = $p < 0.001$ as compared to hypo).

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How can *Drosophila* flies without aldehyde oxidase detoxify acetaldehyde?[1]

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Summary. The flies of a *Drosophila melanogaster* strain, called 'AO null' as it lacks the enzyme aldehyde oxidase, are nevertheless able to detoxify acetaldehyde. It seems that this action could be attributed to aldehyde dehydrogenase, or some other enzyme which ressembles aldehyde dehydrogenase.

In a previous publication[2] we questioned the almost exclusive role attributed to aldehyde oxidase (AO) in the degradation of the acetaldehyde resulting from the metabolic oxidation of ethanol by alcoholdehydrogenase (ADH),