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## The Role of Certain Early Environmental Conditions on the Psychophysiological Development of Animals†

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The attention of research workers has, for a long time, been attracted by the existence of individual differences between animals of a particular group. On the whole, these differences are considered undesirable and everyone tries to eliminate them by working on groups which are homogeneous for age, weight, sex and lineage; a common heritage giving, in theory, a guarantee of psychophysiological similarity.

However, the persistence, in spite of these precautions, of important psychophysiological differences leads workers to take into consideration the intervention of other parameters such as the environment previous to the experiment, that is to say, the socio-psychological history of the animal studied.

In this paper we will deal with two points in turn:

1. The role of early environment.
2. The role of the social environment.

These two points are apparently complementary, but we shall see that bringing them together, perhaps, allows us to state the problems rather than solve them.

### 1. The Role of Early Environment

#### EFFECT OF GENOTYPE AND REARING CONDITIONS

Pavlov and his co-workers did not fail to remark quite early in their conditioning experiments, that dogs showed important individual variations; subjected to the same experimental situation one of two dogs will not learn as quickly as the other, and eventually one of them could develop neurotic disorders while the other would adapt easily.

This is also true for rats. If we consider a group of eight white rats (W.A.G.) subjected to a learning process which is currently in use in

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our laboratory (the rats learn to choose, for drinking purposes, between two jars, one of which is electrified) we find, for example, that:

One learns very quickly.

Five others learn less quickly but without difficulty.

One learns very slowly and seems only slightly sensitive to the electric current.

Finally, the last contracts an experimental neurosis.

The observation of such behavioural differences led Pavlov to elaborate his theory of "types of nervous system" and to consider the question of whether these types were congenital in origin or acquired.

Pavlov's experiments on this problem are few, but they have been substantially completed by Krushinskii (1962). This author was, during the war, in charge of the Red Army dog-kennels and so had available a considerable amount of experimental material with which to test certain hypotheses. It is well known that dogs differ in their reactions to the presence of a stranger. Some will face him, will indeed attack him (Active Defence Reflex, ADR), others, on the other hand, will be frightened and will go so far as to flee (Passive Defence Reflex, PDR). But it is also well known that PDR and ADR are developed more or less according to the breed of the dog. By a series of genealogical studies involving several hundreds of animals, Krushinskii first ascertained that PDR and ADR were linked to hereditary factors. Cross-breeding of aggressive dogs gives a majority of aggressives while that of timid dogs gives a majority of timid ones. However, rearing conditions are not without influence. In order to get a precise answer to this question, Krushinskii studied the PDR of dogs differing in their genotype and in their rearing conditions. The dogs studied were German Shepherds and Airedale terriers.

One hundred and forty-two Airedales and 162 German Shepherds were divided into four groups. Two groups (one of each breed) were entrusted to private individuals and the dogs were thus reared in contact with the variety of the outside world; the other group of each breed was reared isolated in the kennels. In studying the PDR of these dogs when they had become adult, Krushinskii made several discoveries.

First of all, comparing the German Shepherds reared at liberty with Airedales reared in the same conditions, a greater proportion and a greater degree of PDR is observed in the German Shepherds. This confirms the congenital aspect of this particular reaction in the behaviour of the dogs.

Secondly, rearing in conditions of isolation increases both the frequency and the degree of expression of PDR in the two breeds of dog

in comparison with the subjects reared in contact with the outside world; furthermore, this accentuation is more distinct in the German Shepherds reared in isolation than in the Airedales. Thus, Krushinskii concludes: "a passive defence reflex is formed by the interaction of the influences of the genotype and of the external conditions of rearing".

The fact that rearing conditions influence the subsequent behaviour of the animals, leads one to ask which factors of the environment are the active ones.

#### EFFECTS OF HANDLING AND GENTLING

Let us recall first of all two early works on subjects appreciably different from those with which we are concerned here, but which contain observations directly foreshadowing them. Hammett in 1922 found that rats which had been habitually handled withstood surgery better than those which had not been handled. Greenman and Duhring in 1931 found that 75 percent of their handled rats survived parathyroidectomy while there were fewer than 15 per cent survivors among the others.

Knowledge of these facts could be useful in animal experimentation. But it was not until the 1950's that the attention of workers was specifically attracted to the role of "gentling" and of "handling", and that a series of experiments was undertaken to prove their importance. It is the work of Weininger (1953, 1954, 1956) which seems to show the way.

This author took two groups of rats separated from their mothers at weaning and identically fed. Over 21 days, for 10 minutes per day, the young rats from one of the groups were taken and fondled by the experimenter. All were then placed under conditions of shock, kept fasting for 48 hours, sacrificed and autopsied.

In comparison with the animals which had been fondled, the "deprived" animals showed (apart from a decrease in general activity and greater timidity) a considerable slowing down in weight-gain and bone development, and a lowered resistance to stress as proved by the state of the viscera and the intensity of the endocrine reaction (adrenocortical) to repeated alarm.

Subsequent to this work, numerous publications on the study of the effects of "early handling" or "gentling" appeared.

Thus were studied:

*Weight increase:* Brooker (1958), Levine and Otis (1958), Mogenson and Ehrlich (1958), Mogenson *et al.* (1957), Newton (1955), Scott (1955), Rosen (1961).

*Emotionality:* Levine (1957), Hunt and Otis (1955). Denenberg and Smith (1963), Levine and Broadhurst (1963).

*Aptitude for learning*: Bernstein (1957), Denenberg (1958), Levine (1958), Denenberg and Karas (1961), Levine and Broadhurst (1963).

*Social behaviour and dominance*: Rosen (1958, 1960, 1961).

"*Consummatory behaviour*": Levine (1957, 1958).

*Resistance to various assaults and to inanition*: Levine (1957), Long (1955), Levine and Otis (1958), Bovard (1958), Ader (1959).

This list, however incomplete, suffices to underline the interest in the problem of early handling, but it is convenient to relate it to other work on the effects of stimuli, not only those furnished by the experimenter ("Experimenter mediated" stimuli — Denenberg *et al.*, 1962) but also those furnished by the mother ("Mother mediated" — Denenberg *idem*, 1962) or by the other animals in the brood. In this type of experiment the consequences for the behaviour traits mentioned above, of grouping, isolation, more or less early weaning, etc., are studied.

Thus, Kahn (1951) observes that mice reared in isolation after weaning are more aggressive than others. Fredericson (1951) finds at 72 days that mice which have had to compete for food before the age of 35 days fight more than others. King and Gurney (1954) find less pugnacity in mice reared in isolation and Seitz (1954) observes that rats reared in large broods have a tendency to be more successful in competition than those originating from small broods. Beniest-Noirot (1958) notes that mice raised by the experimenter show much greater aggressiveness than those reared by a rat. Denenberg, Ottinger, and Stephens (1962, 1963) show that the excitability of litters of rats can be increased by the emotionality of the mother or by frequent change of mother. Chanel and Cosnier (1963) observe that the process of adoption of a newborn rat into a younger or an older litter always leads to psychophysiological differences from the litter of origin.

It is not possible to give details or even to enumerate all the work of this kind. But those papers which have just been cited permit the observation that the nature of the stimuli (experimenter-mother-siblings) and the psychophysiological effects examined were very varied. Their common trait is that the effects of stimuli applied to non-adult animals were studied, that is to say, what one may call "early experience". A general rule seems to emerge from this: the richer in cutaneous stimuli the world of the young animal is, the better will be its chances of emotional adaptation to new situations. This effect of early experience together with the genotypic predispositions forms the differing behaviour patterns of species or sub-species (King and Eleftheriou, 1959; Lindzey *et al.*, 1963; Levine and Broadhurst, 1963).

However, as regards the details, many unknown quantities not to

say mysteries, remain. Let us take some examples. Early handling is always accompanied by a gain in weight and a subsequent dominant social behaviour. But on the other hand, while in a big litter contact stimuli would be more frequent, it has been proved that weight increase is less than in limited litters, while dominance in competition is more marked in the former (Seitz). However, Rosen (1961) comparing weight gain and dominance in rats reared in pairs for three weeks after weaning, with those of rats reared in isolation, does not find significant differences between the two groups. But if it is admitted, with Brooker (1958), McClelland (1956) and Weininger (1956), that handling provokes these differences, it must be asked: what mysterious factor appears during the contact of the animal with the experimenter's fingers?

In fact, it seems necessary to define the term "early experience". Levine and Otis (1958) had already remarked that the results of handling were not the same depending on whether it had been done before or after weaning (fixed classically at 21 days for rats), but there is much to show that many of the experiments cited were carried out after it.

#### PHYSIOLOGICAL DIFFERENCES DEPENDING ON AGE

Some experiments demonstrated not only behavioural but also great physiological differences between newborn rats and those three weeks old. First of all, we will refer to the difference in metabolism; let us compare (Cosnier, Duvéau, Chanel, 1965) the oxygen consumption of rats taken from the nest and isolated for a quarter of an hour at 21°C (normal room temperature) and at 32°C (temperature approximating to that of the nest); these measurements were made with different animals, aged 1 day, 6 days, 12 days and 20 days; ten experiments were done in each condition (80 animals in all, 10 animals per point on the graph) (Fig. 1 and Table I).

TABLE I—OXYGEN CONSUMPTION IN RATS ISOLATED AT 21°C OR 32°C FOR 15 MINUTES AFTER REMOVAL FROM NEST

Isolation temperature	Age of rats			
	1 day	6 days	12 days	20 days
21°C	† m = 0.036 7 ‡ S.D. = 0.006 6	m = 0.036 8 S.D. = 0.007 6	m = 0.059 4 S.D. = 0.006 1	m = 0.075 1 S.D. = 0.007 7
32°C	m = 0.016 3 S.D. = 0.009 0	m = 0.056 3 S.D. = 0.016 7	m = 0.050 1 S.D. = 0.007 8	m = 0.047 3 S.D. = 0.004 9

† m = mean oxygen consumption in cm<sup>3</sup> per gram per minute

‡ S.D. = Standard Deviation.

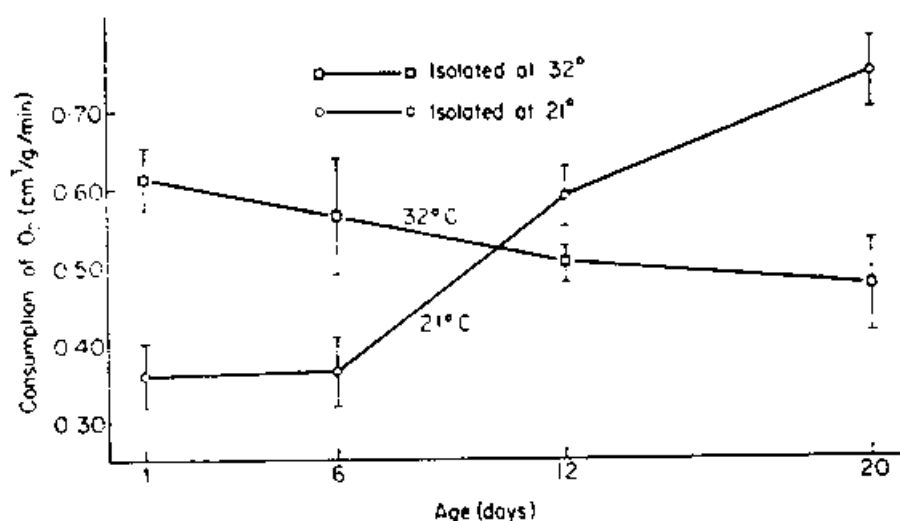


FIG. 1. Consumption of oxygen according to age and temperature

An examination of the corresponding curves shows that if at 1 day old the oxygen consumption of the rat was higher at 32°C than at 21°C, at 20 days the position is reversed, which illustrates the poikilothermy of the first week and pin-points the progressive establishment of homeothermy between 6 and 12 days.

A result in agreement with the above will be furnished by the study of resistance to inanition as a function of age and grouping in white rats (Sherman) (Cosnier, 1965).

TABLE II—RESISTANCE OF RATS (SHERMAN) TO INANITION AS A FUNCTION OF AGE AND GROUPING

Age	1 day		10 days		20 days	
	isolated	grouped	isolated	grouped	isolated	grouped
Number of animals	20	18	18	16	16	16
Means of survival times in minutes	4 029	3 620	3 280	3 540	2 008	2 846
Standard Deviations	544	524	621	551	384	641
Differences of means	409		260		838	
Significance (Student's <i>t</i> )	<i>t</i> = 2.3 P < 0.10		<i>t</i> = 1.2 P not significant		<i>t</i> = 4.4 P < 0.01	

For this experiment we select the animals from a single litter; after weighing, four or five of them are placed together in an enclosed space with a latticed ceiling and four or five others placed in analogous conditions but isolated from one another. The animals are left without water and without food. Times of death are noted (Fig. 2 and Table II).

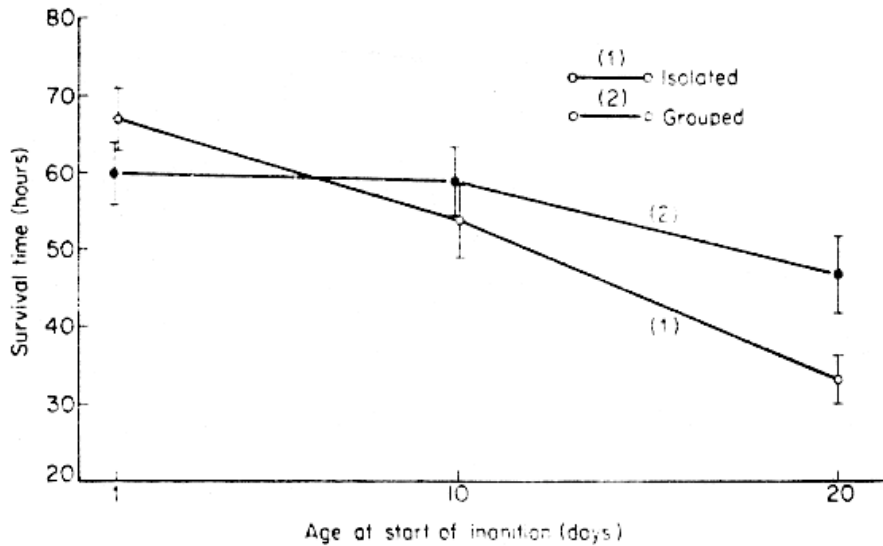


FIG. 2. Resistance to inanition

Thus:

1. At 1 day: there is a mean difference of 6 hours 58 minutes between the resistance of the grouped animals and that of the isolated ones to inanition; grouped animals appear more sensitive.

2. At 10 days: this tendency is reversed.

3. At 20 days: this reversal is accentuated and the grouped animals resist inanition distinctly better than the isolated animals (mean difference 13 hours 53 minutes).

4. In addition, we note that the youngest animals resist inanition better than the oldest ones; the isolated animals of 20 days old die on average 33 hours 41 minutes before those of 1 day ( $t = 7.52$  and  $P < 0.01$ ); the grouped animals of 20 days old die on average 12 hours 54 minutes before those of 1 day ( $t = 3.87$  and  $P < 0.01$ ).

These results are not surprising; at 1 day old, poikilothermic animals will slow down their metabolism at low temperatures. This phenomenon will be reversed at 20 days; having become homoeotherms, the animals will fight against heat loss and will consume their reserves the more quickly the lower the temperature. This explains why they die more quickly than the young ones and why among them the isolated

animals, being deprived of the protective effect of the group, are more vulnerable.

### PSYCHOMOTOR EVOLUTION

The important metabolic differences between the newborn rats and the 20-day-old ones are accompanied by sensory and motor differences no less great. The psychomotor evolution of the newborn rat may be summarized as follows (Donaldson, 1924; Griffith and Farris, 1942; Radouco-Thomas *et al.*, 1961): at birth the rat is hairless, blind and has closed ears; its limbs are not very developed, its movements which are slight are carried out by creeping; its head which appears to be always in search of stimuli makes oscillatory movements in a horizontal plane. The afferent sensory system functions from the 1st day, the audio-visual system from about the 14-15th day. The static and stato-kinetic reflexes are there in outline about the 7th day and are normally developed around the 15th day; it is also at this point that activities of play and exploration begin.

Thus, cutaneous sensitivity precedes by several days the relatively late appearance of the action of the telereceptors. This fact has an influence on behaviour which may easily be studied (Cosnier, 1963). Let us observe first of all a litter of young rats 10 days old. The first thing that strikes one is this: even if the nest is open, its sides removed, the infant rats will remain in a group. If the cluster they form is scattered with the hand it will soon re-form. Then a very characteristic tendency of the animals, to burrow in under their neighbours, is observed.

This reaction is set off as soon as the muzzle of one animal comes in contact with the body of another. It is easy to provoke it by placing two infant rats at right angles to one another, one of them having its cephalic extremity in contact with the other's flank. This contact immediately causes the animal to creep and push its congener firmly while trying to slide its head under him; it will thus sometimes displace him by several centimetres, and may even knock him over.

It must be noted that it is only the contact of the cephalic extremity that is effective: an analogous stimulation of the thorax or the posterior part of the body does not, in fact, provoke any orientated reaction.

The burrowing reaction, which is an expression of active gregarious behaviour, appears to be particularly important for the maintenance of the cohesion of the group which, thanks to this, is able to maintain itself in the absence of the nest and of maternal care. The age at which this reaction appears and the stimuli which provoke it remain to be established.

Classically, the oscillatory movements of the head of the small isolated animal are attributed to a quest for olfactory or gustatory



stimuli. It is by means of them that the newborn animal comes into contact with the bodies of its congeners or of its mother, and we are tempted to consider this as appetitive behaviour. But the olfactory or gustatory nature of the object sought after appears doubtful. The burrowing which seems, in fact, to constitute a "consummatory act" can be provoked by contact other than with a rat; it can be made to appear by placing three fingers arranged in a cup shape in contact with the muzzle of the animal; the index and ring fingers are placed on the table in contact with the lateral surfaces of the muzzle and the middle finger forms a roof and is in contact with the frontal region. Such contact provokes locomotor activity; the animal advances, seeking to slide into this tunnel. If the fingers are then progressively drawn back while maintaining contact, the animal can be led to traverse several centimetres (and this can be done from the very first hours after birth).

In order to analyse this reaction more precisely, we have made use of lures which are cylinders of nylon fur with the hair turned towards the interior. The cylinder is 7 cm long, with a total diameter of 4 cm. The head and front paws of the young rat are placed in the entrance to the cylinder. At the end of 30 seconds its progress is noted. So that the results will be quantitative we assign marks corresponding to a division of the body into four regions:

- 0 If only the head and the scapular zone are in the cylinder (that is, if the animal has not budged).
- 1 If he has entered up to the middle of the trunk.
- 2 Up to the pelvic region.
- 3 Completely.

We carried out these measurements on rats aged from 1 to 16 days selected at random from a total of 350 animals belonging to 40 different litters (all Sherman strain). Each rat was placed at the entrance to the lure immediately after having been taken from the nest. In addition, we took the temperature factor into account, establishing a temperature gradient between the lure and the surrounding floor. Thus three types of experiment were done:

- 1 "Temperate" floor and lure (20 to 24°C).
- 2 "Temperate" floor (20 to 24°C) and hot lure (35 to 40°C).
- 3 "Cold" floor (5 to 12°C) and "temperate" lure (20 to 24°C).

The results obtained are summarized in the graphs, where each point represents the figure given by twenty animals (Fig. 3). Analysis of the results

shows that up to the 8th day the burrowing reaction is provoked by a complex stimulus: thermal gradient plus tactile stimulus in the cephalic region.

Then, quite rapidly, around the 8th day, the tactile element becomes preponderant, while the thermal element loses its importance. So we are dealing with the "huddling" behaviour which persists in a very characteristic manner in the adult rat, and we have shown (Cosnier, 1963, 1965) that this behaviour remains at a very primitive level of

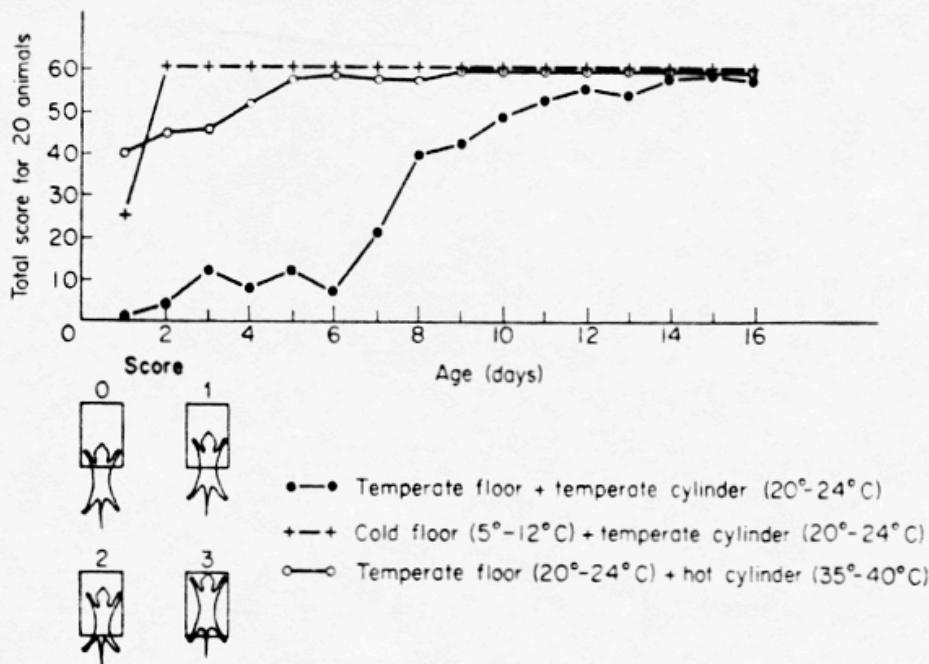


FIG. 3. Burrowing reaction in young rats

integration since it remained in spite of the exclusion of vision, hearing, smell and even in spite of total neodecortication.

Using the above findings, it is possible to trace the patterns of evolution of the behaviour of the rat:

*From birth to 8-10 days:* symbiotic period of narrow social dependence, no real individuality, communal homoeothermy. Activities: sleep, burrowing, feeding.

*About 9 days:* transitory period of inversion of the metabolism curves, of resistance to inanition: change in the significance of the group.

*From 15-20 days:* sensory maturation — appearance of exploration and play activities — start of individual feeding.

At this period the "gregariousness of survival" is transformed into "gregariousness of cyclic repair" (sleep-rest), where the individual regresses temporarily, abandoning its strictly social activities.

*20 Days:* weaning possible. The young rat is capable of surviving alone.

*Around 2 months:* puberty. Development of sexual and aggressive behaviour.

We see that tegumentary stimuli will play a fundamental role up to the period of transition, 10–14 days, from which development of tele-reception and of homoeothermy will come into play. It is by these means that the newborn rat will orientate itself in its environment, and its activity apparently consists of a search for tactile and thermal stimuli.

#### EFFECT OF DEPRIVATION OF TACTILE AND THERMAL STIMULI

What happens if the young rat is deprived of them? It is very difficult to answer this question because the newborn rodent is fragile and up to the present it seems impossible to rear it without any contacts (either with its mother, or with the experimenter).

However, we have tackled this question (but only in a preliminary way). The principle of the experiment was as follows: to separate a number of young rats from their litter for 4 hours per day, to place them in different situations and compare their somatic development with that of the controls left in the nest and in contact with the mother.

The different situations were:

Isolation on the bare floor at room temperature (21°C).

Isolation on the bare floor in a warm atmosphere (32°C).

Isolation with a non-suckling female rat with induced maternal behaviour.

The experiment was continued from birth to 20 days. At this age the mean weight in grams of the different groups was in the following order:

Controls:  $20.5 \pm 0.89$ .

Mothered:  $19.3 \pm 0.5$ .

Isolated at 32°C:  $18.7 \pm 1.7$ .

Isolated at 21°C:  $16.6 \pm 3.3$ .

In addition, the opening of the palpebral slits in the controls and the mothered rats preceded by 12 hours that of the animals isolated at 32°C and by 24 hours that of those isolated at 21°C.

It will be necessary to pursue these experiments further in order to be able to draw precise conclusions from them, but we think that there is evidence that feeding, tegumentary stimuli and thermal environment

intervene in a complex but fundamental manner in the development of the newborn.

Furthermore, it is not sufficient to say that the animal has experienced "manipulations" during its "early experience", the period must be exactly defined, and it is necessary to remember that "handling" and "gentling" are complex stimuli which, in fact, approximate to mothering. This is not just simply physical contact and is all the more active the younger the animal. But in addition, the importance of these factors allows us to admit, not surprisingly, that "handling" and "gentling" are capable of intervening in the psychophysiological development of the animals. In this connection, though we have only been talking of rodents, it is pertinent to recall the work done on the primates.

#### EFFECT OF MOTHERING

The work of Harlow (1959, 1960, 1962) on the Rhesus monkey is well-known. Using "artificial mothers", some of wire, others covered with fabric, this author has shown that young monkeys reared in the laboratory prefer the "clothed mothers", and this preference is independent of the presence or absence of food. To establish more precisely the importance of this contact, he studied its consequences on emotionality. In the course of diverse experiments the animals were subjected to frightening stimuli or placed in unaccustomed circumstances (open-field-test). The behaviour of several groups of young animals, reared with or without contact with a clothed mother, was studied in emotionally traumatic situations in the presence and absence of a maternal substitute. Significant differences between those reared in the presence of clothed mothers and the others were noted.

Placed alone in the "frightening" cage, all display intense emotional disturbances, crying, cowering on the floor, incapable of adjusted motor behaviour. But if the "clothed mother" is present in the locality the animal previously reared in contact with it pounces on it immediately, clutching it very firmly and using it as a base from which to explore the room and handle the different objects. The clothed mother is obviously endowed with security-giving properties. On the other hand, the wire mother does not affect the reactions.

These first experiments were completed by Harlow and other workers (Davenport and Menzel, 1963; Mason, 1960), and it seems to be established that young monkeys reared separately from their mothers or starved of social stimulations show behavioural disturbances.

In particular, it has been possible with these animals to describe "behavioural stereotypes" (Berkson *et al.*, 1963) consisting of rocking and oscillation of the body, thumb-sucking, unaccustomed postures and self-hugging. These activities, which one is tempted to describe as auto-

erotic, are intensified in conditions of isolation and in states of emotional tension.

But Harlow has particularly stressed disturbances in social isolations. If isolation is continued beyond six months, sexual activities and play and defence behaviour are irreversibly altered (even if the animals have a clothed mother-substitute). On the other hand, contact with congeners of their own age permits a quasi-normal development. Thus, the exchange of social stimulations would appear to be paramount in mammals, and among the first to act we again find tegumentary and proprioceptive stimuli.

## 2. The Role of Social Environment

The problems of social influence on the psychophysiological development of the young animal are far from being simple. The majority of the foregoing experiments show us, in fact, that certain stimuli or environmental conditions play a beneficent and necessary role in the proper development of the animal. But a certain number of recently discovered facts about animal socio-psychology leads us to consider that they are not all equally favourable. It is not a simple quantitative need, but a certain qualitative arrangement of stimuli which is needed by the animal, and just as the absence of these environmental factors thwarts normal development, the presence of these same factors or of related factors, temporally or spatially badly distributed or in excess, also risks unfavourable effects. We will refer only briefly to these problems and cite only some significant experiments.

### EFFECT OF POPULATION DENSITY

Several authors have in recent years established that free growth of confined populations would obey a law which would limit its extent, even under favourable material conditions (excess food, water and nest-building material) (Calhoun, 1948; Strecker and Emlen, 1953; Clarke, 1955; Southwick, 1959; Christian, 1956, 1959; Louch, 1956; Crowcroft and Rowe, 1957). Crew and Mirskaia (1931) and Retzlaff (1938) had already shown that the reproduction of rodents diminished as a function of the number. Christian and Le Munyan (1958), returning to this problem, placed 20 female and 20 male mice together for 6 weeks without obtaining reproduction; with 10 females and 10 males all the females became pregnant but only seven gave birth. Besides, the litters of females which had previously lived in overcrowded conditions had, at weaning, a mean weight lower than babies reared by mothers which had lived under isolated conditions, and further, the descendants of these deficient litters had in their turn lower weights even if the mothers had been isolated.

Now, this effect of population density on the individual would

appear to be a characteristic "group effect" (in the sense defined by Grassé). It is the socio-psychological stimuli which would act through the medium of the telereceptors on the central nervous system, this latter would modify hypophyscal-adrenal function, and such modification in its turn would influence the functioning of the gonads; thus, there would be a "feedback" neuroendocrine regulator of population growth.

Many workers support this. Clarke (1955) showed that if a strange *Microtus agrestis* is placed for 27 days in a cage — habitual home of a resident pair of *Microtus* — the stranger loses weight and exhibits hypertrophy of the adrenals and spleen, and atrophy of the thymus. Davis and Christian (1957) placed house-mice in a group of six; a hierarchy was rapidly established with dominants and subordinates as a result of some fights, and an adrenal hypertrophy was found in the subordinated animals, while it was slight or absent in the dominant animals which on the other hand had more developed reproductive organs. Southwick (1959) established an eosinopenia by the simple expedient of placing a mouse each day in a new environment, and showed the same phenomenon in animals placed in a group. Christian (1959) placed mice separated at weaning in groups of 4, 8, 16 or 32 per cage for a week and found that the adrenal hypertrophy and the gonadal atrophy progressed as the log of the population.

Now this author remarked that the only element common to the whole population is the social interaction which is present in two kinds of situation:

- (a) invasion of the territory by a stranger;
- (b) establishment and maintenance of the social hierarchy.

These situations of conflict which constitute "social pressure" would not act by means of physical trauma (wounding in fights) but by means of a more or less permanent emotional tension in conditions of overcrowding. This would result in a decrease in reproductive abilities and a decrease in general resistance to diseases which would assure social regulation. However, the influence of social pressure, naturally, also depends on the genetic make-up (Bronson and Eleftheriou, 1963).

### Conclusion

Thus, the factors which will affect the psychophysiological development of a young rodent are complex. On the one hand certain early stimuli appear to have a favourable effect on somatic and emotional development, on the other hand the presence of other individuals, even though they are a source of these same stimuli, would seem to act in the opposite manner.

In fact, our present knowledge of the psychophysiology of the new-

born rat and of "huddling" (Cosnier, 1963, 1965) leads us to describe two large categories of stimuli:

(a) tegumentary stimuli (tactile and thermal) which first act ontogenetically, appear to control the "huddling" behaviour and are of sub-cortical integration, since they are active in the newborn with an immature cortex and in the newly decorticated adult; these stimuli control an archaic thigmotropic gregariousness which permits the symbiotic survival of the newborn and restorative anabolism of the adult (units of rest and sleep);

(b) suitably social stimuli in the category of telereception which will provoke advanced behaviour according to specific patterns (reproduction, defence of territory, hierarchy, etc.) and will be liable in certain circumstances to modify the endocrine activity of the animal temporarily or permanently.

These facts, still far from being elucidated and in some cases even from being definitely established, have a certain importance for scientific research. They induce workers engaging in all animal experimentation to take into account the history of the animals used, to compare with one another animals placed in strictly identical social conditions and, finally, to include as a factor the experimenter himself whose contact with the animal, even when reduced to a strict neutrality, is not wholly immaterial. To put it another way, it would appear that all scientific experiments on a given animal species are in fact interspecies situations where the human animal cannot fail to intervene as such. All experiments may be considered as the action of the human species on an animal species and this fact, which is often unknown to the experimenter, is much less so to the animals he uses.

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