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AN EXPERIMENTAL STUDY OF SLEEP*

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CHAPTER VIII

Experiments on Cats

IN passing now to my experiments on higher animals the results seem more striking and convincing. As in the case of the frogs, I can only quote some of the experiments performed, it would take up too much space of the present paper to quote all of them. Besides little will be gained by a literal transcription of my notebook, since many of the experiments are simply repetitions of one another. I shall bring as many facts before the reader as will sufficiently introduce him to the work and make him so familiar with the experiments performed that he may be enabled to follow closely the various threads that go to form the main strength of the present research.

A young kitten of about six weeks, very lively, runs about playfully, wide awake. When put on its back, it struggled violently. I then put the kitten in a cloth, kept it firmly so as to limit all the struggles and voluntary movements. At first it struggled and fought, but I restrained the kitten as much as possible, and then I closed its eyes for about a minute. The struggles ceased gradually and the kitten passed into a passive state of sleep. When I relaxed my grip on its body, it remained in the same position without moving a limb. At first the respirations went up and also

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the heart-beats. But as the kitten became more passive and went into deep sleep, the respirations and heart-beat fell. The kitten was deeply asleep, did not react to sound stimuli or to light; eyelids were firmly closed. At first a slight resistance in the outstretched paws, strongly suggestive of hypnotic catalepsy, was observed, soon the paws were fully relaxed and easily changed to any position, but without retention of impressed posture. The sleep lasted for more than twenty minutes and would have lasted longer, had it not been for the fact that I disturbed the kitten's repose to continue my experimental work.

The same experiments were repeated again and again under the same conditions of monotony, limitation of voluntary movements and inhibition. The results were uniformly the same. It may be well to call the reader's attention to the fact that holding the kitten down firmly, thus limiting its voluntary activity, is really at the same time conducive to greater monotony of peripheral sensations coming from the action and movements of the muscles, joints, synovial surfaces and so on; so that the factor of limitation largely aids the condition of greater monotony. Although the pressure exercised on the animal during restrictions may be intense, still, as we have pointed out, it is not so much the intensity of the sensory mass which keeps up the waking state, as the manifoldness and the volume of sensations and reactions ceaselessly varying from moment to moment as to quantity, quality and intensity.

The kitten was restricted in its movements; it was held down for some time, but it did not go easily into a quiet state. I found that the best arrangement was to enwrap the extremities, the hind extremities at least, in a cloth. This limited the voluntary movements effectually. It was still easier, when *all* the extremities were enwrapped in a cloth. When now I put my fingers over the kitten's eyes and closed them, there was little resistance and in a few seconds, not more than half a minute, the little thing was extremely quiet and in a minute or so it was fast asleep. The fingers were then removed, the kitten's eyes remained firmly shut. In fact, the eyelids resisted all efforts to open them. When forcibly opened, the eyeballs were found rolled up

and the pupils were contracted. The kitten would have probably kept on sleeping for some time, if judged by what had been observed in other kittens under similar conditions, had it not been disturbed in order to have the experiments repeated.

The kitten was snugly put away in a cloth, and all four extremities were restricted from voluntary movements. At first the kitten struggled a little, but was soon quieted. I then shielded the kitten's eyes with my hands, while I held it firmly for a few seconds only. The kitten's eyelids became half closed and finally closed fully. When the extremities were tested immediately, they were found resistive and slightly cataleptic. Occasionally the resistance was quite marked. The cataleptic state was rather transient. In some experiments I even succeeded in raising the paws into uncomfortable postures where they remained without change for a brief period of time. After a few seconds the catalepsy of the extremities passed off and the limbs were in a state of relaxation. The kitten did not react to stimuli, such as sound, light or smell; even slight pinching, change of the extremities, shifting of the posture of the body did not produce any reaction. When aroused from sleep, the kitten yawned and stretched its paws, looked sleepy and reacted sluggishly to external stimulations.

Kitten struggled hard when put on its back. It was enwrapped in cloth and still kept on its back, where it was held firmly without being allowed to turn over or even to move. I then closed the kitten's eyes. After a minute it remained in the same position. The kitten was lying quietly on its back, though the position was rather unusual and the whole attitude was very uncomfortable. The paws were raised in the air and at first there were manifestations of resistivity about the joints, but soon the resistivity passed off and the limbs, though raised, were really soft and relaxed. A little later the paws dropped slowly and remained in a state of relaxation. The catalepsy was replaced by lethargy. The kitten did not react to pressure or to tickling of the paws. When sounds were produced close to its ear, the ear moved, but otherwise, the posture of the kitten remained unchanged. Tickling of nostrils made it move its head, but the kitten remained in the same posture with eyes firmly shut.

The kitten was wrapped in its cloth as usual. At first the kitten was greatly excited and squealed. It was rather more difficult to make the kitten quiet than it was in previous experiments. The excitement was antagonistic to sleep. When finally quieted, which took some time, the result was even more successful than on previous occasions. The kitten was fast asleep. Before going into the sleep-state the same phenomenon of transient catalepsy and resistance was quite marked. The limbs then assumed a relaxed condition. It slept so soundly that stimuli that would have awakened the kitten on previous occasions did not disturb it at all, but simply called forth reflex reactions. The kitten slept for more than half an hour. It was then rudely awakened by me. The kitten was very sleepy and soon closed its eyes and sank once more into a deep sleep.

Three kittens eight days old. Eyes were open. Their movements were still incoördinate. They resisted, when put upon their backs. The kittens were wrapped in a cloth one by one. At first they struggled violently, but afterwards they became quiet and fell into a deep sleep. The limbs were in a state of relaxation. No manifestation of rigidity or of catalepsy could be observed while passing into or coming out of sleep. The induction of sleep took some time, but a few repetitions made the onset of sleep easier.

The kittens were wrapped in a cloth and their movements were restricted. After a little struggle and spitting they went to sleep. This time no symptoms of catalepsy could be observed. The kittens were probably too young to manifest any of these phenomena, for later the phenomena of catalepsy during the time of going into and coming out of sleep were, relatively speaking, quite marked. Closing the eyes did not play such an important rôle in young kittens as did the condition of limitation of voluntary movements. In this respect young kittens behave somewhat similar to young infants.

Kitten, two and one half weeks old; very lively. It struggled to get free. After three minutes the kitten was put to sleep; it was wrapped in a cloth and slept peacefully. On my attempt to open its eyes there was a little resistance, but not marked. On examination the eyeballs were not found rolled up, but they looked staring and

sleepy, and the pupils were contracted. The kitten closed its eyes immediately after and went to sleep again. There was little or no response to external stimulations of sound. In the next room much noise was made by a carpenter hammering with all his force. This was not favorable to sleep, but the kitten was deeply asleep and remained undisturbed. The kitten slept for fifteen minutes and was awakened by me for further experimentation.

The cloth has proved itself an excellent factor in putting the animals to sleep. This may be due to the fact that the movements are well limited without much pressure; the pressure present is more evenly distributed, hence, also more monotonous, a circumstance which greatly helps in bringing about sleep. The conditions must all coöperate to bring about *monotony*.

An attempt was made to put a kitten to sleep without the cloth. The animal was harder to handle, it took me some ten minutes before the kitten was made quiet. It fell asleep but for a brief period of time, possibly not more than a minute. Then it opened its eyes. Now for that short period the paws were found extended, somewhat resistive to but retentive of impressed movements. The paws trembled visibly. This tremor was due to the incoördination of the motor activity of the kitten.

I observed in my experiments on subjects and patients that *sudden* fright might bring about subwaking states and sometimes even hypnotic and somnambulistic states. Now when tested on kittens similar results were obtained. When the kitten happened to be specially refractory, it was frightened by sudden strong stimulations or by suddenly turning it around and around. To my great surprise I found that the kitten's struggles subsided,—the respiration became lowered and the kitten was asleep. As the experiments gave like results the few described will be sufficient for our purpose.

When one of the kittens was very excited and in a fighting mood, I seized it *suddenly*, kept it down firmly, the animal became very quiet, fell into a passive state and then was fast asleep.

Of three young kittens I seized one after another quite suddenly. The kittens became much excited. One after

another was put in a cloth, their limbs wrapped all round and kept down quite firmly, so that they could not move. There was but little opposition and still less fighting. By way of intensifying the effect they were given a couple of good shakings, the little ones became quiet, and fell into a sound sleep. They did not react to sensory stimuli; their paws were slightly resistive at first and then relaxed. Respiration, from being labored and quick, became quiet, uniform, easy and lowered.

These experiments were repeated by me over and over again and with the same results, showing that the latter were not a matter of accident. In fact I found that when I wanted to put the little kittens to sleep speedily, to frighten them by shaking was the surest way of putting them into a more agreeable mood and thus send them off without delay into a sound sleep.

In the experiments on the kittens we find the phenomena of the subwaking states somewhat more developed than in the guinea-pigs or in the frogs. The cataleptic phenomena are not so pronounced as they are in the frog, but the manifestations of the subwaking states approach more closely the manifestations observed by me in human subjects. The state is more hypnoidal in character, there is present the transient, scarcely perceptible catalepsy which appears for but a moment, giving way immediately either to sleep or to the waking state. Of course, we should not expect to meet with a typical, fully developed suggestibility or somnambulistic state in guinea-pigs or in kittens, considering the fact that even in man, the imbecile, the idiot and the mentally obtuse hardly go into any such state. It requires a mind of a highly organized constitution to get into a state of abnormal suggestibility and of somnambulism with their accompanying manifestations. What, however, we do find is the characteristic instability of the manifestations of the intermediary, subwaking, hypnoidal states, having some of the most general somatic symptoms of hypnosis, such as slight catalepsy, but leading into a passive condition on the intensification of the state. The state in which the animal is plunged under the condition of monotony and limitation is *hypnoidal* leading toward sleep.

CHAPTER IX

Experiments on Dogs

AS we come nearer to the higher animals we find it easier to interpret the phenomena under observation and experimentation. The subwaking states become more defined and sleep is fully recognized at the first moment of its oncome. Thus in dogs we can more easily interpret the different motor activities in relation to their subjective correlatives and accompaniments. Man can so closely put himself into the subjective mood of the dog he knows that he can understand apparently the slightest expression of the animal's wishes and emotions. The artificial selection of the most intelligent and most devoted dogs as well as the constant companionship with the human race could not but affect the canine races and bring the most manifold expression of their emotions, wishes, and desires within the scope of human interpretation. Dogs have the mental touch of man and are described by the poet as dreaming in their sleep:

“Consueta domi catulorum blanda propago
Degere, sæpe levem ex oculis volucremque soporem
Discutere, et corpus de terra corripere instant,
Proinde quasi ignotas facies atque ora tuantur.”

Lucretius describes vividly the active dreams of the hound hunting in his sleep:

“Venatumque canis in molli sæpe quiete
Jactant crura tamen sudito, vocesque repente
Mittunt, et crebras reducant naribus auras,
Ut vestigia si teneant inventa ferarum:
Experge factique sequuntur inania sæpe
Cervorum simulacra, fugæ quasi dedita cernant;
Donec discussis redeant erroribus ad se.”

Dogs have some imagination, even if they are not poets, and cannot retort man in kind. Dogs, standing higher in the scale of development, lend themselves far better than the rest of lower animals for the study of sleep. As adult dogs are rather difficult to manage for sleep experiments, because

of the excitement in which they are thrown and because of their resistance to being handled by men other than their masters, I selected for my experiments young dogs, especially puppies. I did the same thing in the case of cats for the same reason, as grown-up cats are still more unmanageable than dogs. It is true, as Huebel has pointed out, that if the master of the dog should try his hand, he would no doubt succeed in putting the dog to sleep. Puppies are very docile, they get easily adapted to a new person and do not manifest the individual liking of their master and the abhorrence of strangers as grown-up dogs do. I have no doubt that if a grown-up dog should be put by his master under the conditions of *monotony, limitation and inhibition*, the success would almost be certain in each and every case. In fact, I tried the experiment on an older dog of mine with great success every time I put the dog under the requisite conditions conducive to the oncome of subwaking states and sleep. I shall give an account of these experiments in this research. I find that dogs, like men, easily fall into subwaking states and sleep.

There is also another reason why I chose puppies for my experiments. Puppies, especially very young ones, sleep a good deal and not having the nervous activity and distractions of older dogs are more amenable to the conditions of subwaking states and sleep. In carrying out experimental work it is best to select the material and put it under the most favorable conditions.

We may pass now to the experiments proper. I quote from my notes those experiments which are typical of the rest.

Two puppies of about two months old; very lively, excitable, and barking violently. After some struggle each one was wrapped in a cloth so that even the forepaws did not protrude. At first they were greatly excited by the proceeding and proclaimed their indignation by loud yelping. I took my turn with each one separately. The puppy was held down firmly and given no chance to move its body or to struggle with its paws. I also closed the puppy's eyes with my fingers. The puppy struggled and wriggled under my hand, but I held on tightly. Gradually the puppy ceased

its struggles and became very quiet. Respirations became slow and regular. I gradually released my grip on the dog, when I found that its eyes were firmly closed. The puppy was fast asleep. The same performance was carried out in the case of the other puppy. After five minutes, during which time I held the dog tightly and kept all the extremities in close grip, the puppy passed into a quiet state and fell asleep as the first one did. Respiration was slow and uniform. Both puppies slept peacefully. There was no response to external stimuli. Limbs were in a state of relaxation. In spite of the noise in the neighboring room the puppies kept on sleeping. After twenty minutes one of the puppies woke up, made some show of struggle, but the eyes remained shut and he fell asleep again. I tried to loosen the cloth in which the puppies lay enwrapped. My manipulations did not disturb their sleep. The puppies kept on sleeping the sleep of the just. After a sleep of about an hour I had to disturb the repose of the little ones and wake them up, as I had to leave the laboratory, otherwise they might have slept much longer.

The cloth was now uniformly adopted by me in my experiments for the control of the voluntary movements. Unless the little ones were wrapped in the cloth there was great difficulty to restrict their activity. The puppies fought like furies. One of them was specially unmanageable. A few shakings quieted him. The puppy was wrapped in a cloth and after a few minutes went into a deep sleep. It withdrew the paws on irritation or on pinching, but the eyes remained firmly shut. Respiration and pulse were slow.

The puppies were put to sleep under the same conditions. This time they could not sleep soundly, on account of the continuous noise in the next room. They woke up every time, but fell asleep again. They growled in their sleep, evidently reacting to the external noises, but they did not wake up. One of the puppies turned on one side, apparently to make himself more comfortable and kept on sleeping. They were, however, to-day more restless than they were on former occasions. Maybe hunger gnawed at their entrails, maybe it was the noise of the school that the puppies could not stand. After about a quarter of an

hour they woke up and looked like two little surly pups. I gathered them once more up into the folds of my cloth, and gently, but firmly, forced them to sleep again. They went to sleep much more easily with no fighting. When passing into sleep, I tested the forepaws of each of the puppies. As this time the forepaws were quite free, I could observe well their position, change them, and manipulate them. At first the limbs showed some resistance to change of retained position impressed on them, a slight cataleptic state. Then the limbs relaxed and remained in this condition till the end of the experiment. This time the noise in the adjoining room ceased and the youngsters seemed no longer disturbed. I let them sleep for about three quarters of an hour, when I began to tickle them, pinch them slightly, and change the position of the paws. They began to move restlessly and gradually got out of sleep. The eyes opened lazily, and they evidently felt ready to go to sleep again. Before waking up fully there was a slight state of resistance in their forepaws, catalepsy seemed to return again. This slight catalepsy in regard to retained postures and to changes of the position of the extremities lasted a few seconds and disappeared. Thus in getting out of sleep the puppies passed once more through some subwaking state with its accompanying catalepsy.

The puppies were put to sleep again. The conditions of monotony and limitation were the same as before. Forepaws were free, protruding from the cloth. When the puppies sank into sleep, the paws were slightly resistive. The least disturbance brought the puppies out of the passive state. Typical manifestations of subwaking, hypnoidal state were present. Respiration gradually fell, the passive state became intensified, and the puppies fell into a sound sleep. The paws became fully relaxed. The eyelids were firmly shut and at first resisted pulling apart. When the eyelids were separated, the eyeballs were found rolled up; pupils were in state of contraction. When I let go the eyelids, they closed again and remained firmly shut. There was almost no response to external sensory stimulations. The puppies slept half an hour, when I began to waken them slowly, again before full waking a slight cata-

lepsy was observed in the limbs, the puppies passed through the intermediary, hypnoidal state. They looked sleepy when they opened their eyes and kept closing them. They stretched their little paws as after a good sleep and yawned.

One of the puppies was very irritable and surly; it fought like a little fury. It squealed, barked and yelped. After a little jostle in the cloth it fell asleep peacefully. Again a slight catalepsy of the limbs was observed for a brief period of a few seconds, then relaxation set in. The puppy slept very soundly; it did not react to stimuli of medium intensity. Reflexes of forepaws were present and when the stimuli became summated the paws changed position, the body then also tended to change its posture. The eyelids were firmly closed; when opened by force, the eyeballs were found rolled up and the pupils contracted.

The other little puppy was more amenable to treatment,—it did not resist, but seemed to be resigned to its fate. When wrapped in the cloth, it was very good natured. When I put my fingers on its eyelids and had them firmly shut, the puppy remained in the same position without fighting. Respiration was quiet, uniform, lowered. As the puppy sank into sleep the paws were found slightly resistive to bending; they were extended, but soon became relaxed and remained so throughout the sleep state. The puppy slept quite peacefully. Reflexes of forepaws were present. It did not react to slight stimulations, such as tickling or pinching of the skin, or even to pricking of the forepaws. It did not react by shifting the body or by waking up and opening the eyes, it only moved the forepaw that had been stimulated. The eyelids were firmly shut and resisted opening. When opened by force, the eyeballs were found rolled up, so that the whites or the sclera could be well seen partly covered by nictitating membrane. The dog was awakened by summation of slight stimulations.

Three new puppies were very tractable. They fell asleep with the greatest ease imaginable. The puppies were about two and a half weeks old, were quite gentle and showed almost no resistance. The same phenomena were present as in the other dogs; they went to sleep under the

same conditions, their paws for a brief period of a few seconds were extended and slightly resistive. Limbs retained the position given to them. The eyelids were firmly shut and there was resistance to attempts to force them open. When forced open, the eyeballs were rolled up, and the eyelids closed as soon as they were let go. The puppies seemed to possess the power of sleeping indefinitely. Now and then sucking and snapping movements were observed. They slept for more than an hour and would have gone on sleeping had not they been rudely shaken out of their peaceful repose.

The experiments were repeated, over again with the same results. As the puppies got older the manifestations of the transient, intermediate state became more pronounced,—catalepsy was more evident on falling asleep. The same held true in the case of waking up. There was a slight stiffness and catalepsy of the paws for a brief period when the puppy emerged from sleep. On falling asleep the puppies did not tumble at once into that state, they opened and shut their eyes, when my fingers were released from pressing their eyelids. They kept on blinking the eyes. The lids came nearer together and finally closed. The same process of blinking was observed on waking; they seemed to wake and fall asleep again, thus being really in the intermediary, hypnoidal state, hovering between waking state and sleep, both on going to and coming out of sleep.

With the repetition of the experiments the little fellows learned to go to sleep with greater and greater ease, manifesting, as time went on, more and more clearly the characteristic symptoms of subwaking and sleep states. After a time there was no need to keep their eyelids closed with my fingers; it was enough to shade their eyes with my hand or with any opaque body and the eyes after a few seconds began gradually to close. A slight tremor of the eyelids was observed as they kept on opening and closing, somewhat similar to what we find in the first stages of hypnosis. Only here it was not really hypnosis, but the hypnoidal state, partaking of hypnosis, waking state and sleep. The puppies did not really go into any hypnosis, but into something bordering closely on the hypnotic state. Instead of going

into the hypnotic state; however, as the fully developed human subject would occasionally do, the puppies went into sleep.

What interested me most in the puppies was the fact of their habituation to the sleep-procedures. They seemed to like the whole procedure and had no objection to my manipulations, so that after a time I even ventured to put them to sleep on the table without wrapping the cloth round their limbs; the little fellows went to sleep as cheerfully and as soundly as before. They lost all fear and lent themselves readily to the operations. It was thus sufficient for me just to put them down on their sides, and it did not matter on which (they would not sleep on their backs), when the puppies, of their own account, almost, went into their customary subwaking and sleep-states.

Those puppies were gone and another puppy, an untrained one of the same litter, had taken their place. This little fellow was about a couple of months old and was a hard nut to crack. He was sturdy, fat and refractory. I had quite a tussle with him. It took me more than half an hour to appease him. He became quiet for a few minutes and seemed to have gone off into a passive condition closely bordering on sleep, but he was soon up and in arms again. Maybe the loud knocking in the adjoining room disturbed the experiments.

I wrapped him all round in the cloth and shutting his eyes firmly with my fingers and holding him down tightly with my hands, I finally succeeded in moderating his ardent temper. The loud barking gradually subsided, and finally degenerated into growling. This growling really added to the monotony of the sensations. The growling then diminished and the little fellow began to breathe more quietly, the heart-beat due to excitement subsided, and the puppy fell asleep. He slept quietly for about ten minutes only and woke up again. His eyes looked sleepy and he yawned for some time.

An attempt was made to put him to sleep under the same conditions of monotony and limitation, but it was difficult to quiet him. He barked and struggled and refused to let himself be controlled. It was decided to let

him go for that day. This condition kept on for several days. The most that could be done with him was to wrap him in the cloth, hold him firmly with the hands, and have his mouth shut.

I confess that at first I almost despaired of ever breaking the youngster into the game. I kept at him, however, and after a long series of trials the little fellow did not meet me any longer with such feelings of opposition. Finally one day after a hard tussle and a few severe shakings I decided to leave him to himself. To my great surprise the puppy became quiet, his eyes became perceptibly narrower, and at last he fell asleep. The sleep was very sound. He did not open his eyes when I changed the position of his paws, nor did he even open his eyes when I tickled the paws or pricked them. The only response to those stimulations was the reflex movement of the paws, drawing them away from the direction of the stimulus. The eyes were firmly shut, and when I attempted to separate the eyelids, the latter resisted quite perceptibly my efforts. When I did open the eyelids, the eyeballs rolled up and the pupil was contracted. The puppy slept for about half an hour. I decided to awaken him and see what he would do and also to observe the stages which he would pass in getting out of the sleep-state. The cloth was unrolled. This awakened him. He opened his eyelids, stretched his forepaws and was going to sleep again; the eyes closed. On testing his forepaws, there was some resistance, though very slight, but it could be noticed on attempting to bend the paw at the joint. The eyes opened and closed; finally they opened fully and the little fellow stretched out his paws and yawned with a good relish as after a delightful sleep. At last then my long efforts were crowned with success. The puppy did fall asleep and in waking was observed to pass through the characteristic stages of hypnoidal states.

The advantageous moment was then seized to push the matter for all it was worth, to again induce sleep under the conditions of monotony and limitation now that the puppy proved so obliging and went off into sleep on its own account. The cloth was wrapped round the puppy's limbs

holding him down firmly. I closed his eyes with my fingers; the puppy, having been just awakened from his deep sleep, felt more gracious and did not kick much, opposed but little and in a few minutes fell into a deep sleep. After sleeping for about a quarter of an hour he was awakened. On awakening for a brief period the presence of the intermediary, subwaking, hypnoidal state was observed. I immediately proceeded to put him to sleep again, giving him no respite and plunging him rapidly in succession from waking into sleep and then again from sleep into waking states. This process was kept up a few times until it was quite certain that the little fellow was under control. The puppy got thus habituated to manipulations as well as to the rapid transitions from waking to sleeping and back again. Every time he was brought out of sleep the puppy was very quiet and did not resist my efforts to put him to sleep again. At first I did not dare to observe closely and especially to experiment on the first stages of going into sleep, lest I might disturb the puppy and thus break the charm, as I was anxious that he should first of all be habituated to the process and to the sleep-states under the conditions of monotony and limitation and should cease to show resistance. After a number of experiments the puppy became tractable and thenceforth the experiments could be carried on without any further protests and rows on his part.

From now on the experiments proceeded in peace. When occasionally the little fellow became obstreperous, a few shakings brought him to his senses.

After wrapping the puppy in the cloth, and holding him firmly with both hands, I closed his eyes with my fingers. After a few seconds the puppy fell asleep. The eyelids were firmly closed. When an attempt was made to open them, they resisted; when the eyelids were separated forcibly, the eyeballs were found rolled up. There was contraction of the pupils and when darkened with the palm of my hand, the reaction was very sluggish. When the conjunctiva was touched with my fingers, there was a slight reaction of closing the eyelids and slight shifting of head and body, but the puppy remained asleep. He slept

for about half an hour and was awakened for further experimentation. On awakening, the puppy passed as usual through the transient subwaking state characterized by slight catalepsy of the extremities.

The puppy was put to sleep again with the cloth about his extremities; the forepaws were more or less loosened for observation and experimentation. The head was left protruded out of the cloth so as to observe the changes. This condition was always observed in my experiments on sleep, only in some cases the head was kept a little covered so as to keep out the light. In this case I had the head fully uncovered. My fingers were kept on the puppy's eyelids, but I removed them in a few seconds. The eyelids were found partly closed and I observed a peculiar tremor of the eyelids similar to that found in human subjects before falling into the hypnotic state. The eyes of the puppy were shaded with the palm of the hand. Gradually the eyelids closed tremulously. It could be distinctly seen how they opened partly, and then closed again. After the eyelids became fully shut, a peculiar phenomenon strikingly analogous to one manifested in hypnotic subjects, was observed; the puppy seemed to try to open the eyes but could not do it. He tried evidently quite hard to raise the eyelids, but only succeeded in raising a part of the lids, thus exposing a slit of the sclera; the eyeballs in this ineffectual effort of the puppy to open its eyes were seen to be rolled up. The eyelids closed again. The efforts on the part of the puppy to open its eyes were repeated a few times and each time the attempts were in vain. The eyelids then closed and remained so. This is so striking and so similar to what is observed in the hypnotic subjects that one is almost tempted to describe this condition as hypnosis. At any rate one is justified in saying that we observe here a *phenomenon which is strikingly analogous to the hypnoidal state*. In going, then, into the sleep-state the puppy passed through a state which is evidently on the borderland of sleep and what in the human subject is described as hypnoidal. This borderland state forming an intermediary state between waking on the one hand, hypnosis or sleep on the other, is just what characterizes the subwaking, hypnoidal

state. There seemed little doubt that in going into sleep the puppy did pass through hypnoidal states.

Another fact that may be of interest in the sleep of this puppy, as well as of the other puppies under observation, was the shivering in going to sleep. The extremities trembled when raised and a transient state of resistance and catalepsy was often observed. This catalepsy was specially pronounced when the forepaw or any other of the extremities was extended and a little manipulated. It seems as if we give here a suggestion to the puppy, as is the case with the state of abnormal suggestibility in the human subject. I may add that these manifestations of the hypnoidal state were not so marked on awakening.

After control was gained over the puppy he could be handled safely. It was thought it might be well for the sake of the experiment to irritate the dog a little and see what would be the result. He was forcibly pressed and choked very slowly so as to avoid the sudden onset of excitement. He yelped, but it seemed that the habit of going to sleep was even stronger than the excitement. In spite of all the irritation the puppy soon became quiet and when his hind limbs were wrapped around, he soon was disposed to fall asleep. With my fingers I just covered his eyelids, but did not press on them. It was just the merest suggestion of pressure on the eyes, but the little fellow went into a sound sleep. Before falling asleep I observed the usual blinking of the eyes, the opening and closing of the eyelids and twitching of the orbicularis palpebrarum as well as the rise and fall of the eyelids until the eye became completely closed. On attempting to open the eyelids there was great difficulty in separating them. On examination the eyeball was found to be rolled up, the pupil contracted and not reacting to light. The conjunctiva was found almost insensitive. The dog responded to stimulations by reflexes of the forelimbs and on stronger stimulations by movements also of the hind limbs, but he did not wake up. At first the limbs were slightly resistive, especially when I manipulated them, pressing and kneading the muscles of the upper front leg. The cataleptic state of the extremities was, as usual, only transient and the limbs remained

during the whole state of sleep in a condition of relaxation. The same state, though slighter, was as usually, also present when the dog was aroused from his sleep by a summation of stimuli.

The sleep-experiments were carried out on this formerly refractory puppy with great ease. In fact, the facility with which sleep was induced far exceeded the experiments performed on any of the animals handled before. It could only be compared to the ease with which a subject on repetition of hypnotization goes into hypnosis. Still it is not possible to regard the sleep of the puppy as hypnosis. There is no suggestibility present, nor that characteristic *psychophysiological plasticity of associations and dissociations during or after hypnosis*. The state in which the puppy falls is nothing else than normal sleep. Only in passing into that condition *there are present manifestations which recall the hypnotic state*. The reason is very simple, the puppy is passing through a state which is intermediary in character between waking state and sleep. This intermediary state is hypnoidal in nature and has some manifestations which are analogous to hypnosis in the higher and more developed mental states of man. In the dog we have the foreshadowing of what is afterwards fully found in man alone. *The hypnoidal state precedes and succeeds sleep*.

As I continued my sleep-experiments on the puppy, it became easier and easier to put the little one to sleep; so much so that after a time I could put the puppy into sleep, first passing through all the stages observed, though the cloth, that magic for the induction of sleep, was no longer used. I put the puppy on the table, just kept him quiet by patting him a little, and pretty soon off the little fellow went into the land of Nod.

The puppy was put on the table, then laid down on his side—he did not resist, he kept as quiet as a little lamb. His eyes were shaded with a screen and the little fellow marched off into sleep. To produce sleep in the puppy after a few weeks' training was just child's play. The contrast to his previous unmanageable condition was great indeed. It was now possible with the greatest ease to have

him pass from sleep to waking and from waking to sleep. The contrast here was also very surprising, the puppy played, ran around, barked violently and in a few moments he was fast asleep with limbs relaxed and immovable, with eyes firmly closed, eyeballs rolled up, pupils contracted, conjunctiva anæsthetic, and all the sense-organs dulled and stupefied, as if by a hypnotic or anæsthetic. In a few moments more the puppy was up again, gave a yawn or two and was as restless and playful as ever. The transition from one state into the other was so rapid that it was almost marvellous.

The puppy was found very restless, barking and jumping, but as soon as he was put on the table, his limbs were kept quiet for a few moments, his eyes shaded; his eyelids began to blink and the muscles around the eyes to twitch, and the fellow began to shiver, not from fear, as the heart-beat was not accelerated, but slower, and the respiration was tranquil and lowered. The shivering was one of the phenomena observed in puppies, when on their way into sleep. What was specially interesting in the series of sleep-experiments was not only the significant fact that the puppy under the conditions of monotony and limitations was going off into sleep without resistance and delay, but that before going to sleep, when the eyes were about to begin to blink, and the eye-muscles to twitch, the *little fellow raised his eyes to me and looked at me and then, as if satisfied that everything was all right, off he went into his sleep contentedly.* This state is often observed in the hypnotic subject.

It seemed to me worth while to test whether the personality of the experimenter had any influence. When putting the puppy to sleep, I called Dr. Cannon to see it to test the phenomena of the subwaking hypnoidal state. To my great surprise I found that I could not succeed with the puppy as well. There was some difficulty in putting him to sleep, although there was not really active resistance. It took me some time before I could put the puppy to sleep and then test for the hypnoidal state and show it to Dr. Cannon. *There seems then to be a true personality-element present in the experiments.*

I then left the puppy for about a week. I wanted to see whether it would make any difference in the ease of putting him into the sleeping condition. After more than a week, I found that he did not submit so cheerfully as before. It took me fully ten minutes to put him in a state of sleep. Finally he did go into a sleeping condition with all the symptoms characteristic of the subwaking and sleeping state. In about a quarter of an hour he woke up, but soon fell asleep again and slept for another half hour, after which he was awakened. He seemed sleepy and looked ready to go to sleep again, which he really did after I had kept his limbs and body quiet for a few seconds and the eyes shaded. Thus the habit was quickly re-established.

To bring the personality-coefficient, so to say, more to the foreground, I decided that the dog should be put to sleep under the same conditions of monotony and limitation, not by me, but by another person. I asked Mrs. S. to lend me a hand in the present experiments and see what she could do with the puppy in putting it to sleep. The puppy was kept quiet on the table without being put into the cloth as I had been lately conducting my experiments; but the result was not successful. Mrs. S. then resorted to the old conditions, namely to the cloth. The puppy went to sleep, but after some considerable trouble, though I must say he did not show any fight as I should have expected. It was then easy enough to put him to sleep without any cloth, though Mrs. S. could not accomplish it as easily as I could. *There is then present a personality-coefficient in putting the puppy to sleep, but the coefficient is very slight in the puppy at least. The conditions of hypnoidal states and sleep, namely monotony and limitation, are the most important.* For Mrs. S. could put the puppy to sleep; it was only a matter of time. Monotony, limitation and inhibition may thus be regarded as the conditions under which we can induce in the dog sub-waking hypnoidal states and sleep.

I may add that I also carried out similar experiments on a dog of six months old. As the dog was used to me I had no difficulty in inducing sleep. I made him keep quiet and then closed his eyes firmly. He went to sleep. When I tried to open his eyes, they resisted. When I

opened them, I found the eyeballs rolled up, nictitating membrane over part of sclera, and pupils were contracted. There were present the same manifestations of hypnoidal states, the slight catalepsy on falling asleep and a similar, though somewhat slighter catalepsy on awakening. There was little difficulty in putting the dog to sleep. With the repetition of the experiments it was easier to put him into hypnoidal states and sleep under the conditions of monotony, limitations of voluntary movements and inhibition. The dog was very lively otherwise, but when put under the conditions of monotony and limitation of voluntary activity, he sank into a passive state and then into a state of sleep.

We see, then, that dogs are subject to the same condition of sleep-states as is the case with the other animals experimented upon. In fact the experiments on dogs bring out the fact that the conditions requisite to induce hypnoidal states in men also hold good in the case of dogs. The hypnoidal states, both on falling into, as well as rising from sleep, are far more pronounced in the dog than in the lower animals experimented upon; the states themselves come up far more closely to similar states observed in men under the same conditions of monotony, limitations and inhibition than they do in lower animals, such as the frog, the guinea-pig or the cat.

Phylogenetically regarded the hypnoidal is the primitive "rest-state" out of which sleep and hypnosis have become differentiated. The lower the animal the more insecure, the more instable are its "rest-states." The animal must be on the alert in its rest, and "sleep", if at all, with its eyes open, so to say. It must be quick to wake and run from danger or if it cannot get away, it must "freeze and feign death"; in other words it must be able for the sake of protection to fall into a state of catalepsy. Hence the rest-states must partake of waking, sleep and hypnosis, that is, must be essentially hypnoidal in character.

The experiments on dogs are more instructive than the ones carried out on the other animals, because they clearly bring out the general principle of monotony and limitation in the causation of sleep. *Diminution in the variability of the volume of sensory impressions brings about the state of sleep.*

CHAPTER X

Experiments on Children

THE experiments on animals were followed by experiments on children. The subjects were of different ages ranging from infants a few days old, to children twelve and thirteen years of age.

It is well known that children usually fall asleep more easily than adults; they sleep longer and also more soundly. This is specially the case with young children and particularly with infants. We know that an infant passes most of its time in sleep, when it does not eat. We should expect therefore that the material would readily lend itself to our present purpose of experimentation, — to the induction of sleep-states. Now as a matter of fact, I find that in a number of my cases dealing with children it is no difficult task to put them to sleep, or to induce some form of subwaking state, hypnoidal or other closely allied to it. The child easily falls into a subwaking hypnoidal state which may either pass into hypnosis or into sleep. When trying to put children to sleep I have often obtained a hypnotic condition and on the other hand when attempting to put my little patients into a hypnotic state I have only succeeded in putting them to sleep. Before going, however, into either the hypnotic or sleep-state, I observed by close examination the presence of the hypnoidal state induced under the conditions of monotony and limitation of voluntary movements.

Since limitation of the voluntary activity, limitation of the field of consciousness and inhibition all help to a greater monotony, we may characterize the whole set of conditions requisite for the induction of sleep as the conditions of *monotony*. In children and especially in infants voluntary activity and the field of consciousness are undeveloped and limited, we should expect that the child would form a far better soil than the adult for the induction of the intermediary sub-waking states and sleep. This is precisely what we find to be the case.

Moreover, the mind of the child, and more particularly of the infant, specially depends on muscular activity and on the wealth of incoming sensory impressions. That is why the child and the infant take such delight in motor activity,—in tasting, testing, and handling things. If now the motor activity is limited and the main source of sensory impressions, such as sight, is restricted, and if the environment is kept in a state of monotony, such as darkness and lack of auditory stimulations, or monotony is brought about by a continuous noise and buzzing of some instruments producing a uniform noise, the child, on account of the poverty of its inner mental life, easily falls into a subwaking hypnoidal state and then into sleep.

This ease of induction of sleep is furthered by the comparatively small amount of variability of conscious activity present in the child — the variability of mental content being an important factor in keeping up the freshness, continuity and qualitative intensity of consciousness. Now as the child depends entirely for the variability of its consciousness on muscular activity and external impressions, we can well realize that when those sources become limited and monotonous, the child falls under the influence of all the important conditions requisite for the induction of sleep. The child in short, has no inner wealth of mental life to fall upon; it has little, if any inner resources; that is why it falls an easy prey to sleep and hypnosis, when the external resources lose their variability, become uniform and monotonous.

It may be well, however, to point out the fact that the conditions of sleep are somewhat different in the case of infants of a few days or of but a few weeks old. Young infants sleep most of the time. The waking periods are brief and alternate with long periods of sleep. Really the infant's state is one of sleep and he only wakes to eat. We may characterize the infant's waking states as *feeding* periods. The perceptual world may be regarded as practically non-existent for the infant—ego and non-ego are absent. The external world is in a chaotic state with no interests, even instinctive ones, as yet present. The sensory organs are as yet undeveloped and the sensory elements are all incoördinated and unrelated. Even the raw ma-

terial going to make up the future world of the individual is still in an extremely imperfect state. In short, the material presented by the undeveloped sense-organs is chaotic, undifferentiated and is at its *minimum*. There is really no external world for the infant and whatever sensory impressions are present lack meaning and interest.

But if the sense-material coming from the sense-organs which is to build up the infinite wealth of the external world is still undeveloped and lacks all significance, it is quite different with the sensations coming from the internal organs, from the viscera. The visceral, organic sensations stand out in the foreground of what may be regarded as the infant's consciousness. Visceral, sensory material forms the main substance of the infant's universe. *Cænæsthesis plays the predominant, if not the only rôle, in the life of the newborn.* We can fully realize the importance and significance of cænæsthetic sensations in the case of the infant, because the processes of growth and nutritive functions are all engrossing. The newborn is a vegetative being; it is all belly, stomach; it is a little glutton, it has to grow and that very rapidly; it lives for that purpose — it eats and sleeps. The waking periods are sparse, short and far between, the infant wakes to eat, and when filled to the point of regurgitation, it sleeps.

In this respect it may be well to observe the characteristic motor reactions of the newborn; the sucking movements are the only ones that are well coördinated, responding regularly to external impressions. Thus in my experiments I have long ago described the interesting fact that in his early life the newborn responds to external stimulations with sucking movements. If the infant, for instance, is put to the breast and has his fill and the sucking movements stop, they will again be reinstated by any stimulations of his sense-organs. Make noise close to the infant's ears or throw some rays of light on his eyes, or tickle him, or cause him pain, or tug at the nipple, and the infant responds with sucking movements. In other words, all reactions of the newborn are coördinated and essentially adapted to nutritive purposes. *Nutrition and its psychic correlative, cænæsthesis, form the essence of the infant's early life.*

It is therefore clear that the conditions of monotony of external sensations and of limitations of voluntary activity, an activity really absent, as well as limitation of the field of consciousness, can hardly be of any import in the young infant. The gnawing of hunger, intestinal discomfort and pain play the only important rôle. In the early life of the baby visceral activity and its concomitant cœnæsthesia possess the greatest amount and intensity of qualitative variability that keep up the limited consciousness of the waking state. When the child is hungry, it is fidgety, cries and is awake; when hunger is appeased, the waking state lapses and the baby falls asleep. The waking state is a brief passing phase in the feeding of the baby, a feeding phase which begins and terminates in sleep.

If now we take all that into consideration, we should not expect to meet with clearly defined subwaking states and sleep under the conditions of monotony and limitation in the case of the newborn as we find it to be the case in the lower animals a couple of weeks old, or as we find it in the fully developed man. The young of the lower animals have a shorter training period and have a far larger amount of ready made and easily developed instincts or psychomotor reactions than the baby. When the newborn is put under the conditions of monotony and limitation of the incoming external impressions and under restriction of voluntary activity which does not as yet exist in him, the results are necessarily unsatisfactory. If the infant is full to the point of regurgitation, it goes to sleep, and if it is hungry the closing of the eyes and the attempts to hold it down by force are often quite ineffectual. The baby keeps on crying to the great discomfiture of the experimenter. The easiest and possibly the best way to bring about monotony in the newborn is to soothe the youngster's bowels. It again the young baby has indigestion, stomach-ache and cramps, closure of the eyes and holding the little one quiet without permitting him to kick will hardly do. In such cases the best way is to bring about *monotony and limitation of cœnæsthesia*. Giving the baby to suckle may appease temporarily the active peristalsis of the intestines and the little fellow may pass into the land of Nod; or we may press

uniformly on the abdomen and keep on rocking the little body at a uniform rate. By thus effecting a *monotony and limitation of the bowel-consciousness and intestinal activity* we can bring about a state of sleep. Still, even in the very young infants I succeeded, when the little one happened to be specially well disposed, in putting it to sleep by keeping it very quiet and closing its eyes. In one case I succeeded in putting to sleep a refractory infant under the usual conditions of monotony and limitation by closure of eyes and holding down the baby's extremities from being too active. Usually, however, in very young babies I somewhat modified my proceedings of monotony and limitation by addressing myself to the baby's *inner intestinal consciousness*. In older babies and young children of over a year, I did not vary my usual proceedings in the induction of sleep under the conditions of monotony, limitation of voluntary activity and of the field of consciousness.

We may now pass to the experiments. I shall follow here the same course as in my account of the experimental work performed on the lower animals, I shall not burden the reader with unnecessary details, but shall give a few cases of experiments, typical of the rest.

Boy of twelve days; he was quiet; he looked into empty space, seemed not to be specially hungry nor ill disposed. I covered his eyes with my hand and restrained the movements of his limbs. He wriggled a little under the restraint, but soon became very quiet. When after a minute's time I removed my hand from his eyes, the eyelids remained shut. Breathing was quiet and uniform. I tried to pull apart the eyelids and found them resistive. When I forcibly separated his eyelids, I found the eyeballs rolled up, pupils contracted. He slept this way for a few minutes. When he awoke I made a second attempt to put him to sleep, but this time with no success. The little fellow wriggled and squirmed. The eyes rolled incoördinately and looked vacantly into space. Closure of his eyes was of no avail. I then modified the procedure, patted his back, soothed his belly, and shut out the light from his vacantly blinking eyes. Gradually the little man relaxed his eyelids, began to work them and fell asleep. This

time he slept for about a quarter of an hour. I then awakened him by summation of slight stimulations. During the course of awakening, I observed a short state of resistance in the extremities. He was again put to sleep in the same way and when going into sleep the same state of resistance and catalepsy of the extremities was observed. The sleeping state was very deep, inasmuch as the little fellow was not disturbed by any sensory stimulations and only a good shaking brought him out of this deep state of sleep.

A girl of ten days; very quiet. I restrained her motor exuberance and with the other hand I closed her eyes; she at first resisted and cried, but after a couple of minutes she fell asleep. Respiration, quiet and equable. Eyelids resisted attempts to pull them apart. Eyeballs were found rolled up; pupils were contracted. I made another attempt and found it somewhat more difficult, but the child became quiet, had eyes closed for a couple of minutes and opened them again. The third time the success was even less marked. I then once more resorted to my method of back patting, bowel-soothing, by rubbing and patting the abdomen and monotonous rocking movements. The little girl was evidently pacified and went to sleep. When falling asleep, there was a short stage of catalepsy, the raised hand remained for a short period, a few seconds, in the position given to it, then a state of relaxation set in. This relaxation of the limbs did not persist during sleep, but now and then I could succeed in giving a cataleptic attitude to the arm. Soon the arm dropped and then again it was possible to put it into a cataleptic condition. The sleep was evidently not stable; the little girl apparently kept on oscillating between sleep and waking state. It seems to me, however, that it is more probable that the sleep-state in young infants is *not differentiated* as it is in the case of adults or of older children. The phenomena of sleep also present some characteristics of hypnosis and hypnoidal states, possibly, because the states of hypnosis proper are as yet embryonic — hypnotic or hypnoidal manifestations thus appearing in sleep.

Boy of ten days. I had great difficulty in putting him to sleep by the ordinary methods of closure and restriction of muscular activity. I had to resort to my modi-

fied method — patting, tapping and rocking until he fell asleep. In passing into sleep there was a slight state of rigidity and catalepsy of the limbs which soon changed to one of relaxation, but in the middle of sleep, when tested again for catalepsy, he developed one but it passed off and could not be again noticed until several minutes later I tested during that interval; limbs were found to be in a state of relaxation.

The interesting fact about the infant's sleep is that once asleep the infant is not so easily roused. This fact is sometimes very striking, especially, when the child has had its fill, and still more, when it has had its bath. To arouse the infant from its sleep is then pretty difficult and I have worked hard over the baby before I could disturb its peaceful repose. Some of the infants I have occasionally found so deeply immersed in sleep that even shaking could not arouse them. I had to give up all attempts to bring them out of the state of Nirvana and had to wait for a more favorable occasion.

Girl seven days old. Ordinary ways of putting to sleep did not work here and I had to resort to the rocking, patting and tapping before my efforts were crowned with success. The girl fell asleep in a state of rigidity and catalepsy soon replaced by relaxation. The eyeballs were rolled up, but the child was restless. I put her again under the same conditions of monotony and this time she slept more peacefully — I had in fact, some difficulty in waking her. The state of awakening was characterized by a greater resistance of the limbs than the sleep-state. Still, even in her sleep I could now and then discover a cataleptic state. *The sleep of the infant appears to have a mixed symptomatology of sleep and hypnosis.* The characteristic manifestations of sleep, however, predominate.

Boy two weeks old. I left him in the same position, but only shut his eyes forcibly with my fingers for not more than twenty seconds. He opened the right eye after thirty seconds, and the left eye remained closed for a minute and a half. This incoördination is observed in young infants. He did not fall asleep, however, before I tried the monotonous rocking, the baby being placed with his

belly downwards resting on the palms of my hands thus causing a uniform pressure. In sleep I observed a cataleptiform state. Hands remained in the attitude given to them. This lasted for but a few seconds.

I can induce sleep in the boy by the following procedure which is really another modification of the conditions of monotony and limitation of muscular activity. I either rock him for a time, while sitting quietly in the chair or take him in my hands and walk around with him, which also induces monotonous rocking movements. During all this time I sing to him some monotonous ditty. Sleep is more rapid in its onset, when the belly is pressed with my hands uniformly. The boy's eyes begin to close, first becoming as if fixed, hazy and vacant. He closes the eyelids, opening and closing them alternately, the eye is fixed in the same direction. The eyelids then close, then half open. The slit of the eye becomes narrower and narrower and finally the eyelids close and open no more; the little fellow is sound asleep. If his position is left unchanged, he remains asleep for a very long time. If, however, he is put in the crib, he wakes in about five or ten minutes.

When the boy is six weeks old, I can induce in him sleep, by simply closing his eyelids and singing to him some monotonous ditty. When the boy is not tired and has had a good sleep before, he falls into a peculiar state. *He is apparently not asleep and still he is unable to open his eyes for a couple of minutes and even more.* When he is fatigued, he immediately goes into a deep sleep.

Boy three months old. Can easily be put to sleep by monotonous stimulations usually of the character described. When asleep, he is slightly cataleptic; the lethargic condition, however, predominates. The limbs remain for some time in the position given to them, although the position is a very uncomfortable one. When he rapidly falls into deep sleep, he often retains the limbs, especially the arms in the *same position*, however awkward, in which they were put at the moment when he fell asleep.

In following the course of the child's sleep-states, I find that between the sleeping and waking states there is frequently, in fact there is almost always present, an inter-

mediary period of semi-waking, semi-sleeping state, or what is found by me to be present in lower animals as well as in man, when falling asleep, namely a subwaking, intermediary, hypnoidal state. This state is of long duration, sometimes lasting several minutes. It begins with the contraction of the levator palpebrarum, with twitching and trembling of the eyelids, the eyes gazing vacantly into space. The eyelids open and close unequally, the eyeballs begin to turn up, the pupil is contracted. If in this state, he is addressed in a caressing way with which he is familiar and which in the full waking state he greets with a smile and a kick, he now *starts violently*, the limbs going up, and he utters his peculiar cry of *great fright*. Often, however, when he is in this intermediary hypnoidal condition instead of passing back to the waking state, he falls into a deep sleep. When passing from this hypnoidal state into sleep, he is often seen to smile and almost laugh, occasionally he makes movements of mastication, sometimes gives a start and a cry, and keeps on sleeping. It is a form of hypnagogic or even dream-hallucinations.

As to the states which form the transition stages between sleep and full awakening or the intermediary states in his getting out of sleep, I have often had the opportunity to observe the following spontaneous manifestations. When the soundly sleeping child is awakened by a noise, he throws up his arms, as if in fright, half opens his eyes and falls immediately asleep again. The fingers of the hands remain *open and extended, as if in a cataleptic state*. When I try to close them, I find them *resisting* and after a time they close gradually. The rest of the body is in a state of relaxation. I observed it accidentally as the result of an unintended noise, but I since tried to reproduce some similar sudden noises and obtained like results.

When the boy was three and a half months old, I put him to sleep under the usual conditions of monotony and limitations of muscular activity. He fell asleep, his right hand and fingers remaining in cataleptic state, he kept them in the same position when he went to sleep. The fingers were outstretched and the arm raised. I tried to bend one of the fingers, there was no resistance, but curiously enough

as we find it to be in hypnosis, *the finger soon returned to its former position*. The arm remained in the raised position for about three and a half minutes and then gradually dropped. The child remained quiet in this position of fully relaxed limbs for about four minutes then suddenly gave a subdued cry of distress, probably due to some dream; the arms went suddenly up, especially the left one which remained in *a raised position with fingers tightly closed*. This lasted for about two minutes and a half. I tried to open one of the fingers, and met with no resistance. I kept the finger in state of extension for about a minute: as soon as I let the finger go, it *returned to its original bent position*. I soon observed him roll his eyeballs under the still tightly shut eyelids; then he opened his eyes, smiled at me and fell asleep again. As he was falling asleep with eyelids closed I could see the eyeballs roll, while the face retained its smile for a couple of minutes longer, as if smiling in his sleep at me. The state is evidently an almost fully developed subwaking, hypnoidal phase, bordering on waking, hypnosis and sleep. In fact we observe here already the *suggestibility of hypnosis which is on the way to become differentiated from sleep and hypnoidal state*.

We may now give a rapid review of experiments carried out on older children ranging from the age of four to the age of fourteen. The hypnoidal states become more marked, the hypnotic and even somnambulistic states come to the foreground, and we find that when sleep is induced we often get mixed manifestations of a subconscious order. Mixed, however, and still ill-defined as they are, when compared with the adult states, both the subconscious and sleep states are induced under similar conditions of monotony and limitation of voluntary movements. In trying to induce sleep we may get a subconscious hypnotic state and on the other hand in making an attempt to bring about a hypnotic state, we may get a state of sleep. A good deal depends on the fact whether or not we have eliminated the other conditions requisite for hypnosis, but not for sleep. The indispensable conditions, however, both for hypnosis and sleep are monotony and limitation of voluntary activity. These conditions are all the more indispensable as we have demonstrated

from our experiments that in order to reach either hypnosis or sleep the intermediary, subwaking, hypnoidal state must first be passed through. This intermediary state between waking on the one hand and sleep and hypnosis on the other, can only be induced under the conditions of monotony and limitation of voluntary activity.

A boy of four was put in a dark room; the metronome was set going, beating slow measure. The child was told to lie down on a lounge, stretch out his hands and legs and keep perfectly quiet. His eyes were then shut. After a few minutes his respiration became lowered and regular. He ceased to reply when talked to. At first his arm showed some slight rigidity, but soon after, the arm fell into a state of relaxation. He was not in a hypnotic state as he did not answer any questions and did not take any suggestions. When after a quarter of an hour he was awakened, he did not remember anything about talking to him, nor could we obtain it of him by any methods reaching the subconscious. He was really asleep and did not perceive anything during that period. These experiments were repeated a number of times with the same results. I observed that unlike hypnosis which can be induced in rapid succession, one state not differing very much from the other, in this particular case as the induction of the state was repeated, it was more difficult to bring it about, the state became lighter and lighter and the child was brought out of it by talking to him.

Boy of seven. I put him in a darkened room. My electric battery was set going. I told him to keep quiet and shut his eyes. After a few minutes he began to yawn, I told him to stop. He stopped and I soon observed that his little hand clutched mine convulsively, I tried the arm, raised it; it remained in the same position. I then challenged him to open his eyes. He could not do it. I let him alone in a very passive condition; respiration regular and quiet. When after ten minutes I came to him again, I called him by name; he did not answer. When I began to talk to him, he woke up. During the ten minutes he passed into sleep. This transition from hypnosis into sleep was effected through the intermediacy of the hypnoidal

state which forms the borderland of the waking and sleeping states. The general conditions of monotony and limitation of voluntary activity that favor hypnosis also favor sleep.

Boy nine years of age. I put him into a chair, told him to be quiet and then closed his eyes. He was passive, answered my questions; could open his eyes when challenged. When, however, left alone with his eyes shut and his limbs relaxed, he was found to be fast asleep. He did not answer any questions, did not take any suggestions, did not react to stimulations of medium intensity. When spoken to sharply, he woke up. Both before and after the sleep-state there was a short period when the passivity was quite marked and some resistance as well as disposition to leave the limb where it was placed, although he changed the position of the limb when challenged. In passing then into sleep as well as out of it he passed through the intermediate hypnoidal state.

Girl of thirteen. When put under the conditions of monotony and limitation of voluntary activity, she fell from the transient hypnoidal state into hypnosis and thence into deep somnambulism. After an hour, when left to the monotonous state of her somnambulist consciousness, she passed into typical sleep, as she ceased to answer questions and woke up when the questions and suggestions were given to her in the usual insistent way. From somnambulism she passed into sleep. On other occasions, when closely watched, it was observed that this transition was effected through the intermediary hypnoidal state. The girl passed from the waking state into hypnosis and somnambulism and then again back into the hypnoidal state and then fell into sleep.

Boy aged thirteen. I put him into a quiet state. Metronome was beating slowly. Voluntary movements of the boy were restricted. The boy was then told to close his eyes. I put my fingers over them and kept them shut for a few minutes. When I raised my hand, I found that his eyes remained closed. His arm, when raised remained in the same position. When his arm was bent, he could not extend it, but when after a few minutes I began to talk to him, he woke up. He was evidently in the hypnoidal state

on the way to hypnosis or to sleep. On another occasion he actually fell into hypnosis not being able to move his eyelids or his arms and even took various suggestions. After a few minutes he ceased to be in communication with me and when suggestions were given to him as they had been given to him before, he did not take them, but woke up when loudly spoken to. In other words he fell asleep, and the loud voice disturbed his sleep.

Boy of fourteen; he had difficulty in going to sleep under the conditions of monotony and limitation, but when these conditions were long continued, he finally went into the hypnoidal state. As I feared to disturb him by too much questioning I left him without change to his monotonous environment. After about a quarter of an hour he was fast asleep, snoring in the chair.

Thus we find that in infants and children, as in the lower animals, sleep, hypnosis, and hypnoidal states are intimately related, sleep presenting complex manifestations of subconscious states which become fully developed in the adult.

(To be concluded)