STUDIES IN DEPRESSION.

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I.

THIS series of investigations originated in a study of the Necker cube. It has been suggested that the fluctuation-rate of this and similar ambiguous bodies will serve to differentiate between the introvert and the extravert (1). While this assertion was being investigated, it was found that those patients who were depressed showed a slow fluctuation-rate. It was decided to investigate the question whether or not the fluctuation varied with the degree of depression. Since the fluctuation-rate is known to vary considerably from person to person (2), it was decided to study a group of depressives over a long period of time, if possible until recovery. The stability of the fluctuation-rate in the same person from day to day is considerable. Guilford and Braby report a coefficient of reliability of ·96 (3).

TECHNIQUE.

The ambiguous figure used was that of a staircase which fluctuated in appearance between that of a normal staircase and a staircase seen from below. The patient called out the fluctuations, which were counted over six separate periods each of a minute. A rest of two or three minutes was allowed after the first three counts. The total for the six minutes was charted (Chart 1). In some cases the regularity with which the fluctuations occurred was also reported. At the same time, notes were made as to the patient's condition, based on his statement, on our observation at the time, and on the patient's behaviour chart records.

RESULTS.

Eleven cases were followed over varying periods of time. Of these, six are shown as being typical:

CASE A.—An elderly woman who was readmitted agitated and very depressed. Throughout the year during which she was tested she improved considerably, though with occasional setbacks, which were reflected in the fluctuation-rate. She is still in hospital, but is in an open ward and has single parole; she is also doing work in the Nurses' Home, and her discharge is being contemplated.

CASE B.—This woman is in the menopausal years. At the time of commencement of testing she was depressed and agitated. There was marked picking and

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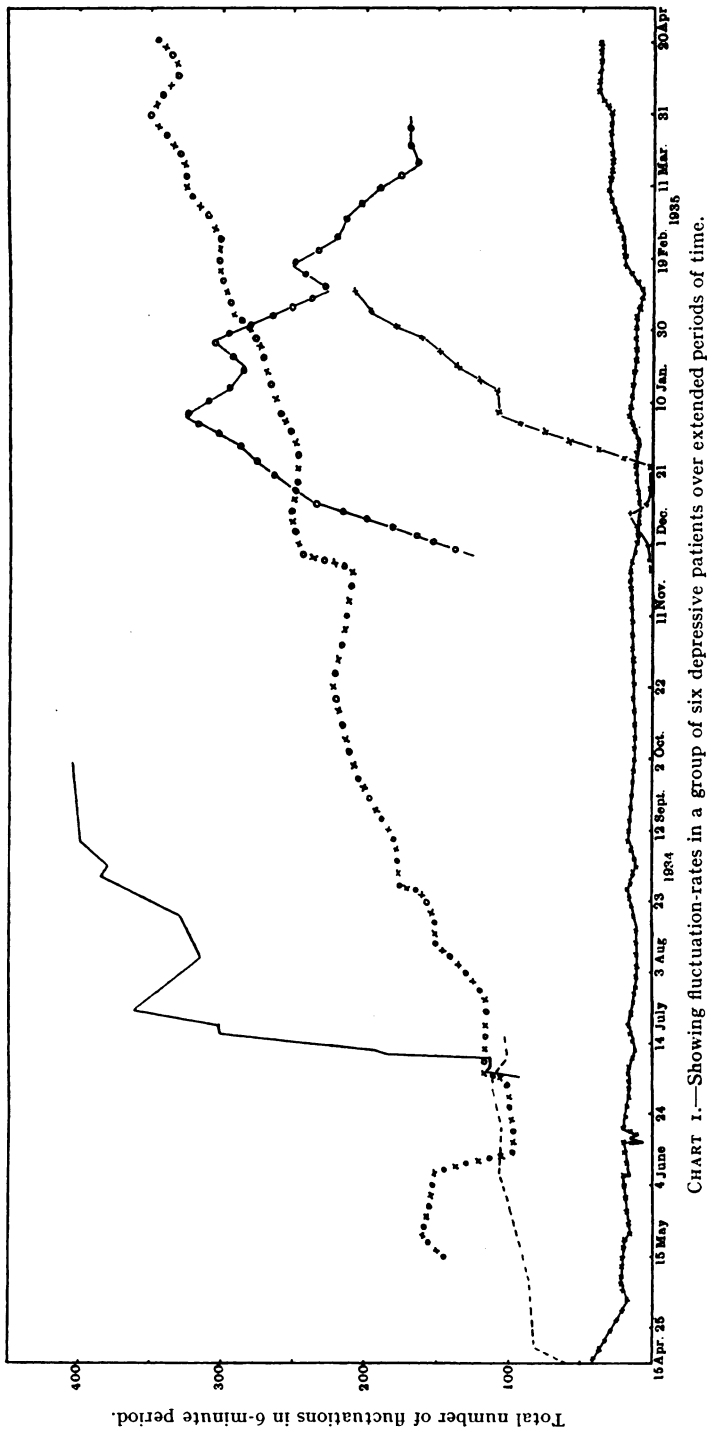


CHART 1.—Showing fluctuation-rates in a group of six depressive patients over extended periods of time.

rubbing. She is noted as having a slump at the end of April, 1934. Thereafter there was very little change in her, until spring, 1935. She was then so far improved that she was able to be given group parole and to be transferred to the open ward. She is still in hospital.

CASE C.—This woman was admitted depressed and mute. She remained so until a few days before the commencement of the test. She improved rapidly, was transferred from the disturbed ward on July 4, 1934, and was transferred to the open ward and given parole on July 17. A few days later, her husband died very unexpectedly. She was discharged on August 7, 1934. It was not thought that she was showing more than usual grief (note the drop in the curve). She had, however, to be readmitted on August 17, 1934, having been suffering from sleeplessness and a mild return of agitation. She rapidly improved once more and was discharged a few days after the last test.

CASE D.—At the commencement of the test this woman complained of emotional numbness and inability to concentrate, but no actual unhappiness. There was steady clinical improvement, and her behaviour chart was clear throughout December and January. The patient herself did not report any improvement. Following on this, there were some unsatisfactory interviews with her husband and the patient developed a marked degree of insomnia. This steadily deepened, and with it there occurred quite definite feelings of depression. The test had finally to be interrupted on account of the growing weakness of the patient, due to the extreme and exceptionally resistant insomnia.

CASE E.—Little comment is necessary. This woman, at the time of commencement of the test, was depressed, retarded and unable to concentrate. She improved steadily until her time of discharge. As in most of the cases, her own account of her condition was the most unreliable guide to the progress of the reaction.

CASE F.—This middle-aged woman was admitted following a suicidal attempt. At the time of starting the tests she was deeply depressed, suspicious, and unable to concentrate to do any but the simplest tasks. She improved steadily. By the middle of January her behaviour chart was clear, and by the end of that month menstruation was re-established. She was discharged a few days after the last test. It is of interest to note that when the depression reaches a certain degree of intensity no fluctuations occur.

In the course of following up the development of these cases, we found that this test was a more delicate index than can well be shown without an extremely detailed clinical account. It was possible, e.g., to demonstrate a difference between the rate as taken in the early morning and that taken some hours later in those cases that showed a morning exacerbation. It happened that in two of the cases the patient's husband died, with the result that the rate showed a marked fall. One woman was apprehensive about coming to conference. She was re-tested a few minutes after being told that this had been arranged. There was a fall of about 50% in the rate.

It was also noted that the rate at which the fluctuation occurred was usually irregular during the more severe period of the depression. As improvement began, considerable regularity in the rate of occurrence was established.

COMMENT.

From the chart shown and the accompanying description, it will readily be seen that the fluctuation-rate tends to increase as the patient gets better. The aspect of the depression with which this improvement best correlates is

the patient's capacity to concentrate, as shown by his ability to grasp what was said to him, to enjoy reading, to move around, and generally to get things done. It was also noted that the rate becomes more regular the more the depression subsides.

These observations led us to inquire into the mechanism at work. After consideration, the theory was evolved that it might be that in states of depression we have a constant flow of painful stimuli (" thoughts ", " ideas ", " feelings ") which, like any other powerful stimuli, produced inhibition, partial or complete, of all other activities. If this is the case, it is clear that this particular activity, namely that involved in the fluctuation of perception of the figure,

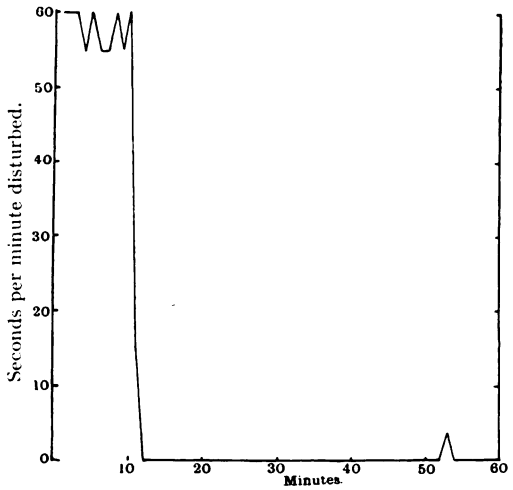


CHART 2.—Effects of strong stimulus in producing inhibition in disturbed patient.

will also suffer from inhibition. The inhibition will naturally be the greater the more severe the depression. In order to demonstrate the inhibiting capacity of a strong stimulus the following experiment was devised:

II.

A continuously excited and over-talkative patient was placed in a room from which all possible stimuli were eliminated. A record of his talkativeness over a period of half an hour was made. Ear-phones were then attached to his ears, and a continuous sound of a harsh penetrating character was led into the phones. This sound was controllable in intensity.

RESULTS.

As can be seen from the chart (Chart 2), the patient almost at once became quiet and remained so for a considerable time. Any tendency towards talking within this period could be overcome by increasing the intensity of the sound

stimulus. After an hour it became apparent that this stimulus was becoming painful. Ultimately the patient began to shout very loudly in an attempt to drown the other sound stimulus. This experiment was repeated several times on the same patient and on others. It can be seen that a strong stimulus will inhibit activity even where that is of an extreme kind. It is also to be noted that, where this strong stimulus continues over a long period, the organism finds it painful and endeavours to inhibit its activity by producing other stimuli (the loud shouts).

III.

From the foregoing, it appeared that it might be possible to regard the depressive reaction as primarily an inhibition produced by the long-continued action of a strong stimulus. The most prominent symptoms in depression are undoubtedly those of inhibition-retardation of skeletal muscular activity and to some extent of smooth muscular activity, retardation of thinking, poor concentration, "dearth of ideas". On the basis of this concept it was determined to attempt to produce a depressive reaction experimentally. The animal chosen was the guinea-pig. It is clear that the now frequent studies of animal behaviour must accustom us to the possibility of disordered behaviour occurring or being produced in animals. From a careful study of psychogenic factors said to be the cause of depressive reactions it would appear that one of the more common components of most of them is frustration. That which tends to limit the free thrust of the individual against his environment, that which tends to hobble and handicap him in his struggle with the world, sets up a serious and threatening situation for him. This situation is met by an increased concentration of the individual's endeavours to deal with it. In some organisms this essentially preservative mechanism of concentration and preoccupation (with its necessary inhibition of other activities) proceeds too far and a state of extreme inhibition is set up. In searching, then, for a stimulus which would be ot this order for the guinea-pig organism, we kept in mind those frustrations which would be most serious for the survival of the organism. After review it was decided to frustrate the animal's locomotion.

Technique.

This frustration was produced by applying plaster casts to both hind legs in the position of extension. In order to check the degree of inhibition obtained, it was necessary to select some activity which readily yielded to exact measurement. This, after some trials, was found in the respiratory-rate. In the guinea-pig this is very responsive to outside stimuli, so that special care has to be taken in securing constant temperature (22°–24° C.), constant illumination and freedom from noise. All the animals in the experimental room should be of the same sex. The rates must be counted at the same time after feeding.

Even so, some difficulty is experienced in obtaining a steady base-line. We have found it necessary in many cases to count over a period of 30 or 40 days. The respiratory-rates were counted for three one-minute periods night and morning. Readings which did not fall within a range of 10 were discarded and further counts made. In the charts the average of the six respiratory counts is recorded. The weight in grammes was also recorded daily. It is to be noted that the pigs prior to experimentation had been in pens of about 100 sq. ft. The cages in the experimental room are 1 sq. ft. in size. This, coupled with the fact that there is no constant fall in the respiratory-rate

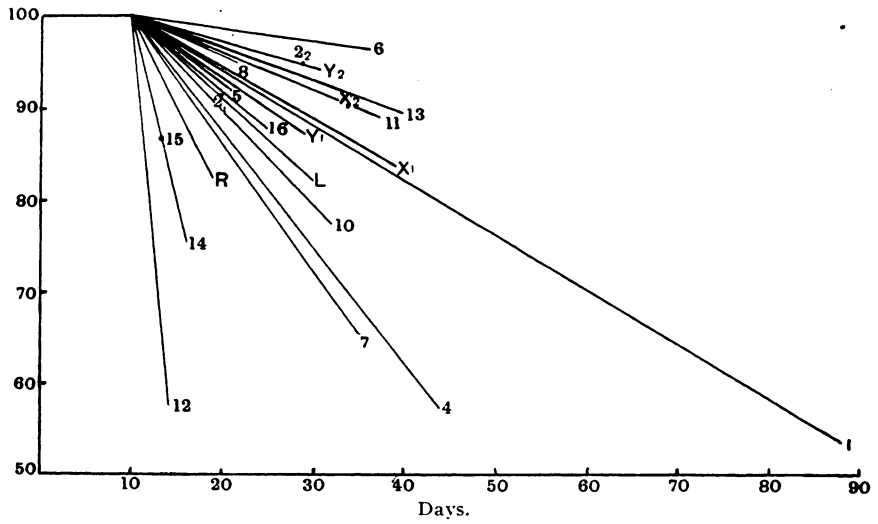


CHART 3.

during the first few weeks while a base-line is being established, disposes of the possibility of the lowering of the respiratory-rate being due to a metabolic adjustment to decreased activity.

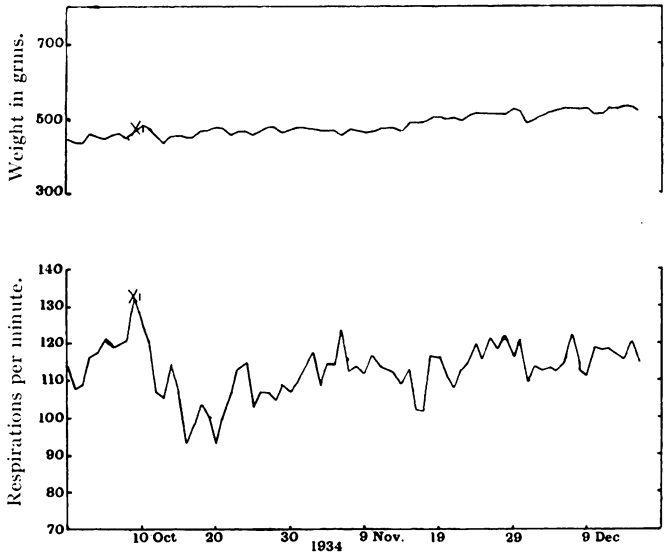
RESULTS.

In all 18 pigs were experimented upon. On 3 of them the procedure was carried out twice, involving daily observations on most of them over a period of 60 days or more. In one case observations were carried out for 127 days. Clear-cut inhibition, as shown in the fall of the respiratory-rate, was produced in 9. In the others, lesser degrees of inhibition could be detected by statistical analysis. Chart 3 shows the percentage drop in respiratory-rate which occurred from the time the casts were put on till the lowest point in the depression was reached. The respiratory-rate at the time of putting on the casts was taken as average for the last 10 days raised to 100 The

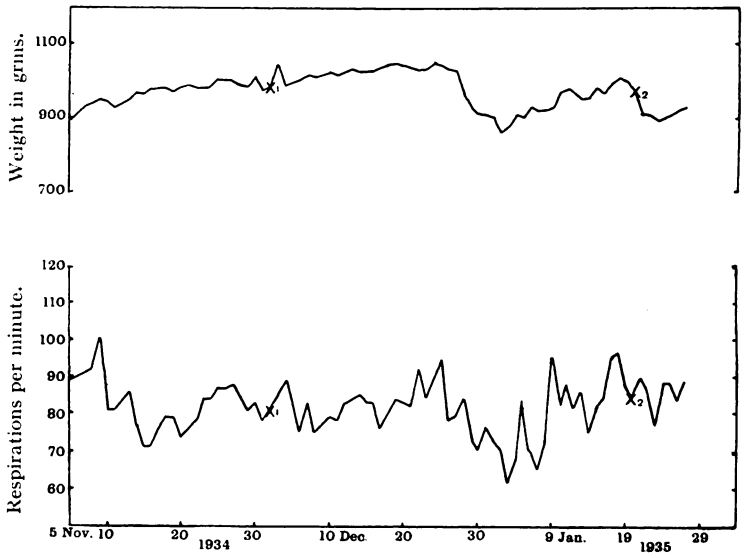
lowest point was taken as the average of 5 days at the lowest point and raised proportionately. Slowing of the respiratory-rate usually set in at once (Pig 4, Pig R, Pig 7). Very occasionally it did not develop for some time afterwards (Pig X). It then fell, to reach its lowest point in a few days up to about 2 weeks, though longer falls are noticed (Pig 1). At times the fall is rapid and extreme (Pig 4, Pig 12). Following on the full development a partial recovery may take place even though the casts are kept on. This is considered as being due to adjustment of the pig to the frustration. In some cases the pigs were observed over extended periods to see whether recovery would take place while the cast was still on (Pig 1, Pig 4). While there is a partial recovery, complete recovery does not occur. In Pig 4 some skin infection took place, which probably tended to raise the respiratory-rate latterly. Where the cast was taken off, the respiratory-rate improved with the recovery of function of the legs (Pig 7, Pig 12). Unfortunately where the casts remained on for extended periods there was always damage to the legs (long-continued stiffness, œdema, blood blisters and even gangrene). These latter developed a day or so after the removal of the cast. Where the cast can be taken off early, before damage occurs, recovery in respiratory-rates is rapid (Pig 12). In the occasional case (Pig 7) removal of the casts renders, through the development of these injuries, the locomotion of the pig temporarily more frustrated than before with a subsequent transient increased inhibition. It has been noted that for some months after work has ceased on the animal, and it has been returned to the pens, it tends to be less active than the ordinary pigs and to keep more under cover. The weight curve usually keeps pace very closely with the respiratory-rate, falling as it does and rising with recovery. In some cases this was obscured by the fact that the pigs were young and rapidly growing (Pig R, Pig Y), and on one occasion by the fact that the pig was pregnant (Pig 12). It was considered to be of importance to discover whether the tendency towards depressive reactions remains the same over a period of time in the same pig. Accordingly Pig X, Pig Y, 1, and Pig 2, 1, in whom very slight depressions had been produced, were after several weeks again subjected to the same procedure. The second depressions vary very little in intensity from the first.

Discussion.

From these experiments we suggest the following concept of the depressive reaction. All organisms on being exposed to frustration react by concentrating their activities to deal with the situation. Concentration naturally involves inhibition of other activities. In certain types of organism, especially in those in which inhibitory reflexes are easily produced, this inhibition becomes much intensified and an abnormal state of inhibition arises. This is suggested by the impression that we received from our work



Pig R.—Casts were applied at X^1. This was one of the earliest pigs and the casts were inadequately applied. The pig removed one of the casts with damage to the leg on November 6, and removed the other also with injury to leg on December 2. In spite of the injury there was considerable freedom of function by the end of the experiment.



Pig X^1.—Casts applied at X^1 for about three weeks, when quite a definite fall in the respiratory-rates and weight occurred. Further experiments will be necessary to determine the nature of this delayed reaction.

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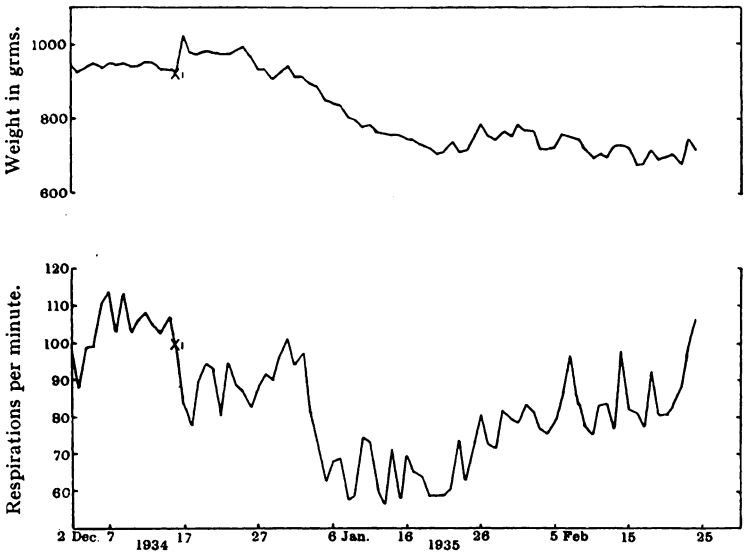
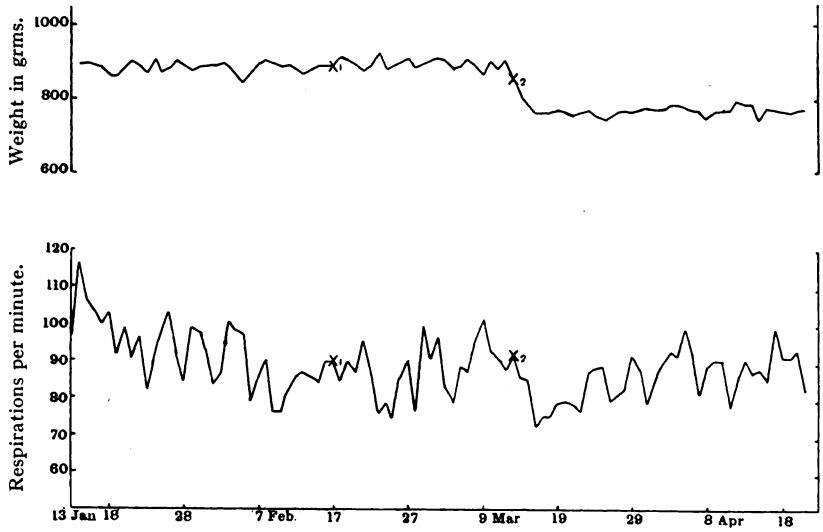


Pig. 4.—Casts applied at X^1. Casts were not removed. Note gradual adaptation to the situation, with rise in respiratory curve and decreased fall in the weight curve.



Pig 13.—Casts applied at X^1. No depression. Cast was light, and frustration of movement was not complete. Cord was severed at X^2. Inhibition ensued. Sepsis set in, and probably caused later rise in respiratory-rate. Paralysis of both hind legs was complete throughout.

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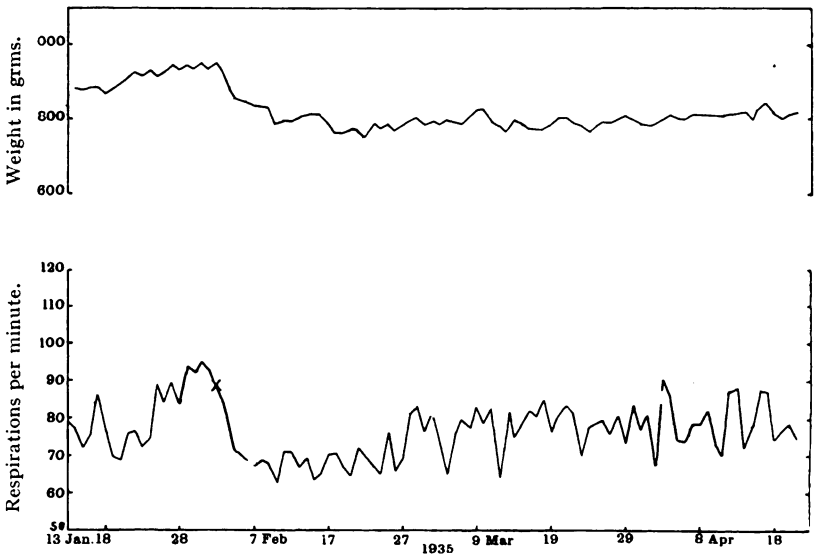
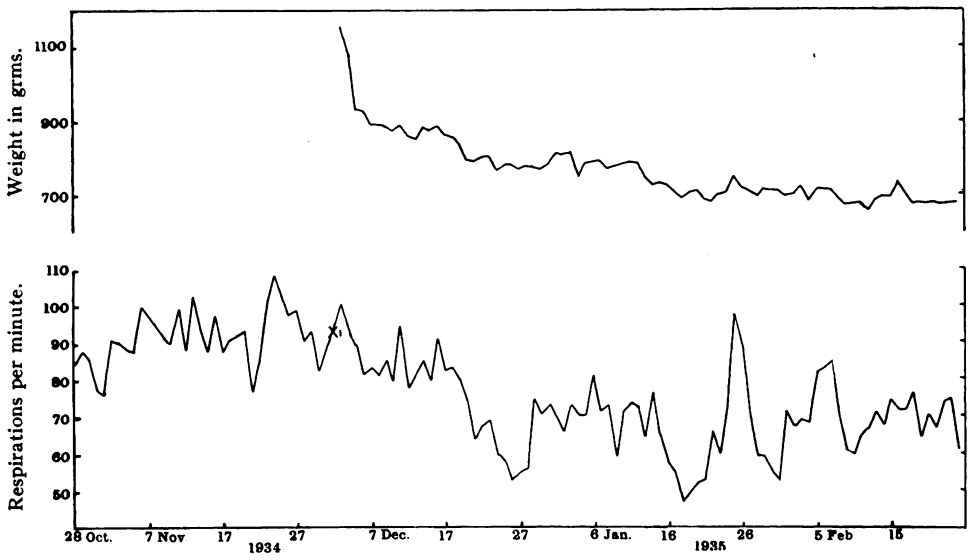
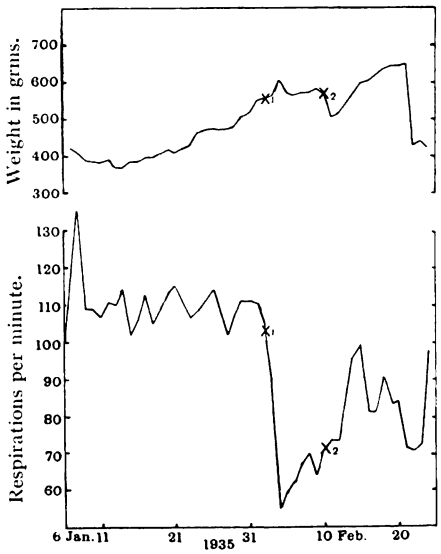


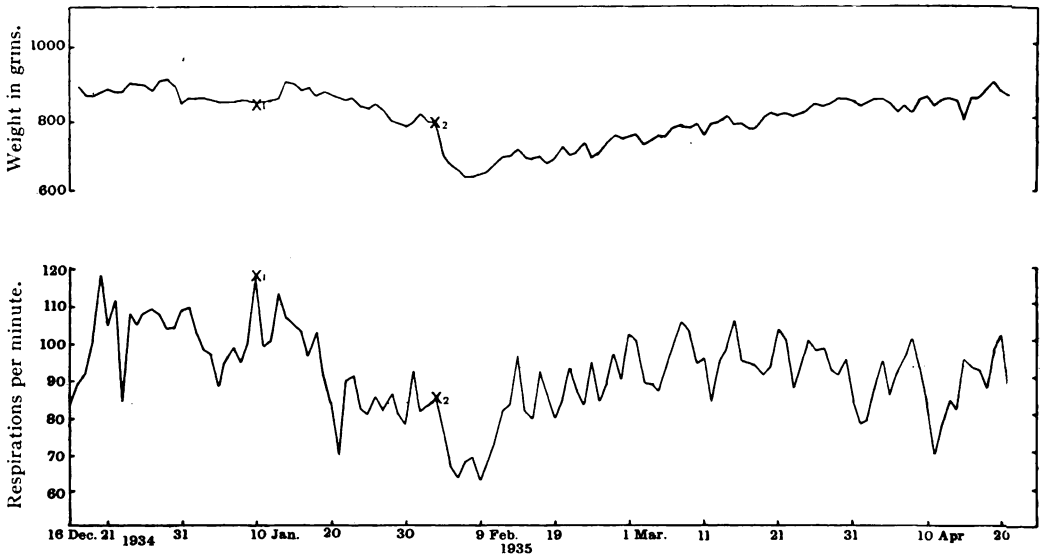
Pig 14.—Casts applied at X^1. This pig's cord was severed. Complete paralysis of both hind legs occurred. The first evidence of recovery of function in the right leg was noted on February 24. A slight return in the left leg was noted on March 10. Function was still very limited at the end of the experiment.



Pig 1.—Casts applied at X^1 and not removed. There was very little adaptation to be noted, save that the fall in respiratory-rate stops, and fall in the weight curve becomes much slower.



Pig. 12.—This pig was advanced in pregnancy. Casts were applied at X^1, and removed at X^2. The weight curve was affected by progressing pregnancy, and by delivery which occurred on February 21.



Pig 7.—Casts were applied at X^1, and removed at X^2. There was considerable damage to the feet. Note the further drop after the removal of the casts, due probably to increased frustration from damage to the feet. A fair recovery of function was attained.

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with the pigs, that it was those animals in which it was difficult to provoke inhibitory responses in any case—those pigs in which it was hard to produce "freezing" reactions and which were startled by any chance stimulus—that did not readily pass into depression. It is necessary to stress, however, that we do not feel that we are as yet in a position to state beforehand with any certainty which pigs will develop definite depressions and which will show slight if any response. The value of such data if transferable to the human organism is obvious.

We have conjectured that the feelings of depression, sadness, loneliness, anxiety and apprehension which we too frequently assume to constitute the whole picture should be regarded as psychic pain due to the action of a stimulus. Our view would put it on the same basis as somatic pain arising from a harmful stimulus applied at other functional levels.

The feeling of guilt, necessity of repentance (long periods of grieving and confession of wrong-doing, necessity of atonement by self-injury), the feeling of the inevitability of punishment and the support of these concepts by hallucinations and delusions are, we consider, the manner in which the individual presents the situation to himself. These various methods of presentation are dependent on the early training and experience of the individual, and are not, we suggest, fundamental to the situation.

At no time during the experiments on the guinea-pigs did we note anything suggesting an excitement. A lead which should be kept in mind is that given by the patients under strong sound stimulus. Where the stimulus was long-continued the patient became very excited and noisy. A conjecture is that since the depressive reaction is definitely a more serious and more unpleasant form of reaction, the organism may under certain circumstances protect itself from entering the depression by breaking up the threatening inhibition by the development of a capacity to be readily stimulated. It would seem that this could only be done where the original situation was of a less serious nature. Possibly these excitement reactions could be produced by less drastic forms of frustration.

With regard to the mechanism of recovery, we have as yet got comparatively little information from our experiments. It would seem that, as long as the stimulus as represented by the cast on the legs remains only partial, recovery can take place. Even this point, however, will have to await a better technique of restraint. Damage to the legs is always present where the casts have been kept on for over two months, while we have noted that the pigs that are returned to the pens are sometimes quiet and inactive for several months after their return. The partial recovery indicates that the organism has the capacity to adjust itself to some extent to the situation. In certain pigs this capacity to adjust is very much more marked and more rapid in its action. These are the pigs in which little or no depression can be developed. There is clearly a close analogy between what happens here and what happens in the human

organism. On being exposed to equally harassing situations only a certain proportion of a group will show depressive reactions. Moreover, recovery from the reaction will occur while the external situation remains the same.

We suggest that the central fact in a depressive reaction is an abnormal preoccupation with a dangerous situation, or, reducing the statement further, that the organism undergoing a depressive reaction to a situation which is harmful or threatening, is an organism in which the capacity for adjustment is so slow and so inadequate that an abnormal degree of preoccupation (i.e., inhibition of all other activities) with the situation is necessary.

The loss in weight during the period of growing depression and the gain in weight as the depression subsides we feel to be comparable to what occurs in the human organism; namely, that the inhibition which is revealing its presence in the lowered respiratory-rate is part of a generalized inhibition with reduction in the output of gastro-intestinal secretions and a slowing of peristaltic movement.

Summary.

On the basis of three groups of experiments, we suggest some clarification of the concept of depression, and also the possibility of producing experimentally in animals reactions comparable to the inhibiting aspects of the depressive reaction in the human organism.

The experimental observations demonstrate firstly that the rate at which ambiguous figures fluctuate varies indirectly with the severity of the depression, secondly the inhibiting effects of a strong stimulus on the activity of the organism are shown, and finally we have recorded the influence of a long-drawn-out stimulus of the nature of frustration in producing a state of inhibition resembling the depressive reaction.

These observations suggest to us that those organisms that react by depression to difficult situations, especially those in which frustration is prominent, are organisms that are not capable of making the necessary internal readjustments to prevent the normal concentration and preoccupation with the difficult situation from spreading and intensifying till the organism is partially or wholly overcome by the accompanying inhibition.

With regard to the other phenomena usually associated with the depressive reaction there is little material directly arising out of these experiments. No further information is forthcoming as yet as to what we have termed " psychic pain ". Likewise, we have no information as to the work-mechanisms which exist in the guinea-pig organism to promote recovery. The fact that the responses of repentance, atonement, and the necessity of punishment seem to exist only in the human organism, while it is apparently possible to produce this generalized and profound inhibition in an organism such as the guinea-pig, leads us to feel that inhibition in the face of difficult situations of all activities

save that concerned with the re-adjustment to the situation may well be a common attribute of organisms which have reached a certain level of integration. It would certainly suggest to us that the inhibition—retardation, dearth of ideas, lack of concentration, weakness, indecision, reduction of secretions and slowing of peristaltic movements—is the central fact in the depressive reaction.

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