THE SIGNIFICANCE OF THE FRONTAL LOBES FOR MENTAL PERFORMANCES *

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OPINION concerning the significance of the frontal lobes for psychic performance is divided. Nobody, however, will nowadays deny it some significance, as was the case not very long ago. Clinical and experimental facts have furnished too obvious a tale for that. It is not my intention to review here the pertinent literature or to discuss the interpretations proposed by the various workers in this field. I shall confine myself to setting forth the facts emerging from my own investigations. But before I do so, I would briefly touch on the grounds underlying the prevailing divergence of opinion.

There are various groups of such causes. (a) Inadequate attention has been paid to site, extent and nature of the lesion. Cases of small circumscribed tumours or injuries need not show any mental disturbance, particularly not under examination by the usual methods, and more especially when the lesion is in the right half of the brain. Ascertainable mental disturbances will be found only in cases of extensive lesion localized in the prefrontal region in both hemispheres, or, at least, an extensive lesion in one hemisphere, especially the left. It is not possible, however, to generalize on the appearance of psychic symptoms in lesions of the left side, because the so-called cerebral dominance of one hemisphere is subject to individual disposition and no hard-and-fast rule can therefore be given. It is important also to pay attention to the nature of the lesion, because in different diseases the amount of microscopic tissue damage extending beyond the gross lesion may differ widely.

(b) Another factor leading to differences of opinion lies in the differences in manner of investigation. As I shall attempt to set forth later, the psychic changes characteristic of lesions of the frontal lobe are of a definite type and may easily be overlooked, because the methods of examination usually employed are unsuited for disclosing them. The psyche may appear undisturbed because the patient's behaviour may be ostensibly normal, in spite of definite psychic alterations, the existence of which can be discovered

* Read at the Second International Neurological Congress, London, 1935. From Columbia University and the Montefiore Hospital, New York City.

only by special examination. In general it is to be said that negative results must be regarded as of less importance than positive results, particularly as the considerations mentioned previously have received insufficient or no attention.

For these reasons, the greater part of the literature is useless for answering the question whether psychic disturbances occur in cases of lesion of the frontal lobe, and if so, what these disturbances are. My personal opinion as to the importance of the frontal lobes for mental performances is based, in the main, upon my own investigations of a great number of cases of both injury and disease, most of them kept under observation for a period of years. For the methods of investigation employed, I refer to my earlier publications. My view of the psychic function of the frontal lobe is set forth in a paper published in 1923.¹ Subsequent investigation confirmed the earlier findings. In addition I would mention two papers by Brickner² and Penfield,³ published recently, with instructive observations on patients who had undergone surgical operation on the frontal lobe. I shall revert to them later. With the experiments on animals by Fulton, Jacobsen and others, I cannot deal here, but should like to mention that their results appear to agree with mine.

SYMPTOMS OF MENTAL CHANGE

Now, let me proceed to sketch some of the phenomena of mental change to be found in patients with lesions of the frontal lobes (cf. Siekmann⁴).

Here is a man, 30 years of age, who does not seem to be very much disturbed in his customary way of life. He is a little slow; his face is rather immobile, rather rigid; his attention is directed strictly to what he is doing at the moment—say, writing a letter. Addressed, he will be somewhat startled, and give the impression of one awakened from sleep. He first looks at me quite astonished, then he smiles and gives the necessary replies or performs the necessary tasks, if we set him tasks which he is able to perform. As to the tasks which this patient can perform, and those he cannot, there seems to be, at first sight, no regularity that would make it possible to speak of his showing a lack of capacity for any specific performances. In fact, it would seem at times as if the patient had no defect at all in performance, except perhaps a degree of slowness. He seems to be oriented in time, space, and the attributes of his person. He gives correctly the date of his birth, the ages of his children, etc. He can count, and is able to solve simple problems in arithmetic. He can reproduce the elements of his schooling and can report the events of his more recent experiences.

I tell him a simple story, and he is able to recount it after some interval. He can draw simple designs, a house or human face, can copy a simple drawing, and recognizes pictures known to him. His language is somewhat simple in structure. Frequently he seems to be hunting for words, but when the right word is supplied he usually recognizes and adopts it readily. He can read

and write. He does very well in simple reaction tests—for instance, in a test requiring him to withdraw his finger from a reaction key whenever a light is shown. Whatever fields of performance I tested, and I tested a great many, I may say that in nearly all I found apparently normal responses. As I have said before, the patient is slow; at times he appears to make a great effort to respond; he perseverates; yet, up to this point, he has shown no grave defects.

But, in the same patient we may also encounter *a totally different behaviour*. In tasks which on the surface seem closely similar to those he has performed quite well, *he suddenly fails completely*.

The patient has just copied successfully a little 'house' built up of small wooden sticks. Now, we place before him one of these sticks in a definite position, pointing, for example, from left below to right above. He is asked to note well the position of the stick. After a half minute exposure the stick is removed, then given to the patient; he is asked to put it in the position in which he had seen it before. He tries to replace the stick, but fumbles. He is all confusion, looks at the examiner, shakes his head, tries this way and that, plainly uncertain as to the correct response. The final upshot is that he cannot replace the stick in the required position. The same inability we may observe if we put before the patient two sticks placed together so as to form an angle with the opening pointing upward. The patient tries to put the sticks together in the same way, but is unable to place them in the proper position. If he succeeds it is manifestly accidental. Next, we show the patient a little 'house' built up of such sticks, a house with a roof, a door, a window and a chimney, and he succeeds very well in reproducing the design.

At first sight, these differences may seem totally ununderstandable. Further examination clarifies the situation. We have seen that the patient fails in the test with two sticks joined together in the form of an angle with the opening upward. It appears amazing at first that if we compose the same angle with the opening pointing down, the patient will reproduce the figure very well at the initial trial. When we try to ascertain how this is possible, when we ask the patient how it happens that he can reproduce the second figure but not the first, he says, 'this one has nothing to do with the other one,' and 'this is a roof.'

These two replies lead us not only to an understanding of the patient's behaviour in these tests but also of the fundamental change undergone by him.

What is the difference between the two tests? What produces effects so contrary or what accounts for the differences of the behaviour of the patient in performing these tasks? His first reply makes it clear that the two objects with which he has to deal in these two tests are to him totally different from one another. The second answer shows that the angle pointing downward is apprehended by the patient as a concrete object of his own visual experience, and he constructs a concrete thing with the two sticks. A concrete apprehen-

sion and concrete behavioural action are sufficient to meet the conditions of this test. In the former test the two sticks did not arouse in the patient an impression of a concrete thing. He has to conceive of the positions of two meaningless sticks in a meaningless connexion, one with the other. He must regard the sticks as mere representations indicating directions in abstract space. Furthermore, he must keep these directions in mind and rearrange from memory the sticks as representatives of such abstract directions.

In the first test the patient needs to deal simply with a known object ; in the second one he must give an account to himself of relations in space, and act on the basis of abstract ideas. His action is not determined directly by a given concrete thing, but by a representative of an abstraction.

The disturbance of the patient, it is apparent, lies in the circumstance that he is unable to assume an attitude towards the abstract, but is able to act in a concrete way. Therefore, he is unable to perform tests the execution of which demands that attitude. The angle test with the opening pointing down does not demand it and the patient is able to execute it perfectly. It is for the same reason that he is unable to place a stick in a definite direction but is well able to imitate the constructing of the little ' house ' which does seem to be much more complicated.

We may conclude from these slight indications that the patient's lack consists, in these tasks, in an incapacity for a definite behaviour which we may call abstract behaviour. We shall soon reach a more precise characterization.

METHODS OF EXAMINATION

Let me interpose here a few words bearing on the method governing the examination. If it happens that the patient has given to him only tasks of the second kind, for example, the angle which he identified as a roof, the examiner will obtain the impression that the patient's spatial attitude is perfectly normal. His failure—in face of the singularity of the task of the other kind—will then be readily attributed to other causes, such as inattentiveness, fatigue, etc., as long as one has not recognized the specific difference of the two sorts of performances for the patient. This difference may be easily overlooked, since to a normal person there is no real difference. In the same way, one can be wholly deceived concerning a patient's spatial competence, by noting that he can quite correctly point to the source of noises or can lead us, on demand, from one place to another over an apparently complicated path. That, none the less, this patient suffers from a grave spatial disturbance becomes manifest as soon as we simply ask him to tell where the noise is, instead of pointing to it, if it is on the right side or the left side—or to describe the path over which he has just conducted us. Then he is at his wit's end.

The same is to be observed when we ask him to traverse the path from a different starting point. In the latter case he can no longer support himself by the concretely known path, but must give an account to himself of the situation from a new starting point, with its relation to the goal and to the

possibility of reaching it. Because he is unable to do so, he fails. An example : A female patient, suffering from such a disturbance, led us from the examination room, well known to her, to her ward and her bedside, by the shortest possible route. In the same way, she later took us from the ward to her workroom, situated several stories higher. She went to the elevator without the slightest hesitation, pushed the right button and arriving at the workroom floor, led us to her place there. The entire trip was quite complicated. She would make the return trip from the workplace to her ward in the same unerring manner. But when she was led into the corridor on the workroom floor and then asked to take us to her ward, she went up the corridor, which is a replica of the one on the ward floor, just as if she were actually in the latter. Naturally she reached the wrong place, noticed it and showed signs of annoyance. She had no inkling of how she had come to a wrong place, could not understand where she was, and was unable to find any way out. Her helplessness was due to the fact that it was impossible for her to conceive on what floor she was. This behaviour makes it clear that her correct routine accomplishment of this trip between ward and workplace did not rest upon any real knowledge of the path but upon simple concrete behavioural action. If this distinction is not heeded, a gross misjudgment of the patient's spatial attitude may result from his ability to go from one place to another in a complicated passage.

These examples show that it depends entirely upon the nature of examination whether we achieve a correct judgment as to a patient's capacity or reach false assumptions about his disturbance.

SPATIAL AND TEMPORAL DEFECTS

Our assumption concerning the defect in the patient finds its confirmation in examinations of many and varying performances, of which I can give only few examples.

First, in a test in which the apprehension of space relations plays a great rôle, the patient is to throw a ball into boxes successively situated at a distance of 3, 9, 15 feet from him. He does it quite well. Then he is asked how far the several boxes are from him, but he is not only unable to answer this question, but even to say which box is nearer, which farther. However, he may give correct replies if he is allowed to walk over a definite distance and to count his steps, knowing that each step covers 1 foot. He can tell by counting how many feet there are for each distance and thus can infer as to which box is farther and which nearer.

What is the difference between the two tests ? In the first, the patient has only to deal with objects in a behavioural fashion. It is unnecessary for the patient to be conscious of his act and of objects in a world separated from himself. In the second test, however, he has to separate himself from the world and must give himself an account of his actions and of the space relations in the world facing him. Therefore he fails.

Now, let us regard the behaviour of the patient in situations in which space does not play an essential rôle.

We find in our patients the same modification in their attitude to time as to space; that is, they can tell us certain aspects of temporal things but they really do not know what they mean. They cannot really distinguish between different durations. Actually they do not understand the meaning of longer and shorter time. Their concrete behaviour indeed might arouse the impression that they are quite at home in matters of chronology. An example: One patient was required to present himself for repeated examination at four o'clock. He had a journey of three-quarters of an hour from his house to the hospital. He always arrived with the greatest punctuality. How did he manage it? He knew it would take him 45 minutes. He knew that in order to be at the hospital at four o'clock he must leave his house at a quarter past three. These factors were furnished to him by a certain position of the hands of his watch, without his knowing or needing to take into account their meaning in a general way.

Though such patients show their ability to use a watch apparently normally, none the less they have no sense of time at all. This is brought about by a simple test such as asking them to say where the minute hand of a clock is at a certain time, for example, at 13 minutes past four o'clock. A normal person would immediately say: slightly ahead of the hour-figure two. Our patients, on the contrary, could not give a description at all, or could reach it only when they are allowed to point with their finger at the minutes from 60 to 13.

OTHER FAULTY REACTIONS

Now, let us observe the behaviour of the patient in situations in which space and time do not play an essential rôle.

We choose a simple reaction test: the patient is instructed to execute a simple movement in response to an abruptly flashed signal. After some practice he learns the situation. He reacts correctly in relatively short time. We then flash a red light, then a blue light, and the patient is instructed to execute the movement on seeing the red light but to do nothing on seeing the blue. In this and similar selective reactions his performance is inadequate. He seems to become confused and either does not react at all or makes many errors or reacts after long intervals.

What is the difference between the two tests? In one the patient has to react in a simple way to a simple stimulus. His behaviour is simple, directly determined by the stimulus. In the second test he has to choose: that means, he has to face two possibilities, or, in other words, an abstract situation, and here he is defective because he cannot achieve such an attitude. This is the very thing he cannot do because he is unable to deal with any merely 'possible' situation at all. Thus we can describe the deficiency in this patient as a lack of capacity for approaching a 'possible' situation.

The following test, in quite a different field, adduces confirmation. A simple story is read to the patient. He seems unable to understand it. Perhaps he repeats some single words, but he does not understand their meaning and is unable to repeat the essential points of the story. Now we read him another story which for a normal person is surely not easier to understand. This time the patient understands the meaning very well and recounts well the chief points.

What was the difference between the two stories? The first one dealt with a simple situation, but a situation which had no connexion with the actual environment of the patient. The second story, on the contrary, had a direct bearing on his situation. Again we observe that the failure is due to incapacity for an abstract approach, or, as we may also express it, an approach to a situation presented only in imagination. Choosing stories with this point of view, we are able to predict beforehand which ones the patient will be able to understand and which not.

The same lack is observable in tests with graphic representations. Pictures of single objects are recognized almost always. In illustrations which contain a number of things and persons in internal contact with each other, the patient may pick out some details, but is unable to understand the picture as a whole and fails in acting in response to the whole. A precise examination reveals that the patient's real understanding does not depend on the greater or smaller number of components in a picture, but on whether the components, whatever their number, hang together concretely, and in ways familiar to the patient's experience, or whether understanding of their connexion requires a more abstract synthesis on his part. In one case, the patient may apprehend pictures with many details. In the second, he may lack understanding even if there are only few details. The patient's deficiency lies in his inability to find out the essence of the picture. Thus, I may also characterize his total deficiency as merely another manifestation of his unfitness for finding out the essence of any situation.

If the patient is given enough time he may, after recognizing some details, then draw a conclusion which enables him to react with passable correctness. Since in tachistoscopic examinations the time is too short, the patient fails in such examinations. He fails also if the test demands the comprehension of a succession in time of separately given parts of a situation, as, for example, in picture series (such as the comic strips of American newspapers) which cumulatively tell a story.

In the examples mentioned, we have already seen the change in the patient's capacities for action. More definite examinations of his actions disclose the same characteristics. It depends on the situation whether the patient is or is not able to execute two acts apparently equivalent. Differences between the two acts insignificant to normal apprehension may suffice for his succeeding in one act and failing in the other. Failure is the more certain and pronounced if, after he has begun to act, the situation is modified in

such a way as to require readjustment on his part. Such a change in adjustment or approach is an out-and-out impossibility for the patient. Therefore, he is wholly unable to continue an action thoroughly familiar to him when it is suddenly interrupted by outside interference. Let us suppose he is made to count from 1 to 20 : interrupt him when he comes to 9, and he cannot continue. He may be able to write a phrase or a sentence, but he is unable to continue if he is interrupted during the writing, and so on in other activities. In such situations there develop partial reactions, false position of the parts, perseveration, etc. Acting may be further altered by deficiency in emotion and memory, of which we shall soon speak.

In situations which do not allow correct reactions, the hindrance to action may become so great that the patient becomes excited or confused and loses interest in trying to place himself in relation to his environment, because he cannot do so effectively and these attempts only throw him into fresh confusion. The result is so-called 'akinesis'. The tendency to refrain from action may be increased by motor difficulties, such as change of tone, disturbance of associated movements, adjustment, movements, etc., which often occur in frontal lobe lesions. The abnormal difficulty of all behavioural action causes the patient to abandon each and every activity and leaves him also appearing affected much more in his mentality than is really the case.

Some authors have also spoken in this connexion of an impairment of a primary impulse drive, of volition. Such terms do not correspond to the real facts. The 'will,' the 'Antrieb' are not disturbed at all, but they cannot function, because to many situations in which 'will' appears the patient is unadjustable. The patient appears disturbed in will and 'Antrieb' in general.

EMOTIONAL CHANGE

Frequently the patient exhibits a dulling of the emotions, but we note also in other situations that the same patient does not appear to be without feeling. On the contrary, we observe in him a great excitability. These facts make it doubtful whether there is really a simple emotional defect. I do not suppose so. If we analyse precisely the situations in which the patient appears emotionally inert and those in which the contrary is the case, we ascertain that the presence or absence of emotional expression corresponds to his entire behaviour in the given situation, and that the emotional behaviour is at best inseparable from the rest of the behaviour. The fact seems to be this : If a patient apparently does not react emotionally in a satisfactory way, it is in situations in which he also fails to comprehend the essentials to which a definite feeling attaches. The patient appears emotionally inadequate when he is in a situation in which that feeling which we regard as belonging to it cannot be aroused because the patient may have grasped only a part of the situation to which that affect which the patient shows may be appropriate. It appears to us inappropriate because we regard the whole situation and not merely a part of it. If we regard the behaviour

of the patient from this point of view his feeling does not appear abnormal to the situation as it is experienced by the patient.

Thus we have to understand the lack of interest in the next example, in a patient with a large lesion of the frontal lobe. This patient, a male, never seemed to be concerned about his family. He never spoke of his wife or children, was irresponsive when we questioned him about them and when it was suggested to him that he should write to his family he would show cool indifference. Thus he appeared to lack all feeling. Now it was an established practice that he should visit his home, situated in another town, and stay there several days. While at home the patient conducted himself, as we learned, quite as would a normal man in the bosom of his family, kind and affectionate to his wife and children, interested in their affairs, in so far as his ability would permit. After his return to the hospital from such a visit and being asked about his people, he would smile in an embarrassed way, giving evasive answers. He seemed utterly estranged from his home situation. Unquestionably what ailed this man was not really a deterioration of his character on the emotional and moral side.

Our assumptions also lead to an understanding of the fact that the same patient who appears very dull may suddenly become excited in a situation which at first seems to contain no cause of irritation. Analysis makes it intelligible to the patient that this situation is of such a nature to give cause, from his point of view, for becoming excited. This, once recognized, is but a small step to a recognition of the fact that the—to us—groundless excitement of the patient is—to him—perfectly rational. An example: A patient of mine had a friend who was his close companion. One day the friend went to a cinema with another man. He did not take our patient because the latter had seen the particular picture before and would not go to see it a second time. When the friend came back from the 'movie' our patient was in a state of great excitement and refused to speak to him. He was not to be quieted by any arguments. No explanation that his friend did not want to offend him, that his friendship had not changed, made any impression. From that time on, our patient was his old friend's enemy.

This reaction, at first so unintelligible, can be understood if we remember that the patient is able to make only a direct concrete approach to any situation. This is also the case in his approach to his friend. He saw only that his friend was keeping company with another man and he felt himself slighted. He was unable to understand that his friend's conduct in no way actually affected their relations. He could not recognize why his friend went without him and he could not perceive the situation as a whole because he could not abstract it from his own concrete personality. He saw only the concrete separation between himself and his friend and from this standpoint his exaggeration was thoroughly understandable, particularly if we consider how difficult it is, in the case of a change of attitude, for a patient with a lesion of the frontal lobe to enter into the relation of friendship. The patient

felt his loneliness and sank into a catastrophic situation of confusion and anxiety. He regarded his friend as its cause. This insight into the workings of his mind renders his behaviour intelligible. Since many situations are not grasped conceptually by the patient, his total affective state must necessarily be more equable and the result is that he appears emotionally blunted.

The mania for inane witticisms, so often described in our patients, finds its explanation in a similar manner. Their jokes, to us so meaningless, do not spring from an abnormal feeling for relations—but from the appeal to them of some details in a situation which we normal people do not notice because we see the situation as a whole. Once that detail comes to our attention, we discover that it is really of a nature to arouse our own sense of humour too. The mania for witticisms is thus seen to be but another manifestation of the patient's changed attitude toward the world.

MEMORY AND ATTENTION

Finally, we have yet to deal with two symptoms very frequent in frontal lobe lesions, viz. alteration of memory and of attention, which are often considered the basic disturbances in these lesions.

Considering memory first, we find that under certain circumstances the faculty for reproduction of facts acquired long ago may be normal. For example, school learning, etc., may be recalled very well in some situations—but not in all. The situation must be adapted to reawaken old impressions. The patient must be able to regard the present situation in such a way that facts of the past belong to it. If that is not the case, the patient is unable to recall at all the identical facts which he has reproduced very well in another situation.

He is incapable of recollection when he is asked to recall things that have nothing to do with the given situation. But when it is possible to put him into a situation to which the material inquired for belongs, recollection appears suddenly. The patient is also unable to remember if the required answer demands an abstract attitude or whether it demands that he give an account of the matter in question. Therefore, the patient fails in many intelligence tests which may seem for us very simple—and he is amazingly successful in apparently difficult ones.

Observation of the patient in other situations demonstrates clearly that memory failures are not caused by an impairment of memory content but that the lack of memory is caused by his faulty attitude or approach that is requisite for the specific test. The patient has the material in his memory but is unable to use it freely; he can use it only in connexion with a definite concrete situation to which it must seem to him to belong. In the same way he is able to learn new facts; he may be able to learn numbers, syllables, or movements by heart; he is able to hold in memory situations, facts of environment, etc., but he is able to learn these only in a concrete situation and to reproduce them only in the same situation in which he has learned them. In the specific situation, he may be very well oriented, but he is

unable to give an account of some place he had visited. Therefore, the acquisition of new material remains scanty.

Thus we come to the conclusion that there is in these patients not a real defect in remembering, but that reproduction and new acquisition are defective because the normal basis of reproduction and acquisition is not given. Therefore the patient's performance constantly varies according as the task is embedded in a concrete or in an abstract situation. In the first, the patient performs well; in the second, he fails. Since in normal memory the abstract situation plays an important rôle, for reproduction as for acquisition, the memory of the patient seems to be feeble.

Finally, as to attention: Here, too, one finds wide differences in the facts. At one time the patient appears inattentive, at another even abnormally fixed in attention. Attention is usually weak in the special examinations, particularly at the beginning of them, before the patient has gained the real approach to the whole situation. In such a situation he appears much distracted. However, if the patient comes into the picture, then his attention may be satisfactory, may even be abnormally fixed. He may be totally untouched by other stimuli from the environment to which normal persons will react unflinching. Thus he may appear distracted in some tests, in others attentive, depending upon whether he is equal to the test or not. In some tests he will always appear distracted, for example, in those which demand a change of approach (a choice reaction) because he is incapable of making such a reaction. Thus it is not correct to speak of a change of attention in these cases in the sense of a plus or minus of attention. The patient's state of attention is but an expression of his total behaviour and is to be understood only in connexion with it.

DISCUSSION AND EXPLANATION

Summarizing the facts found in cases of frontal lobe lesion, we may say: (1) There are disturbances in different fields of psychic performance, in each field perhaps, but the disturbance of no one field can be regarded as the basic cause of the other disturbances. (2) No field is disturbed throughout its extent. There are always some performances which the patient is able to execute. (3) The basic change is not a change of any one field or any one performance, but a change of total behaviour, with a lack of a particular behaviour, which lack finds expression in certain performances in all fields and leaves intact certain performances in all fields.

We have given only a few examples from a few fields. More comprehensive investigation including diverse fields discloses the same state of affairs. From our observations, it can be said that all performances are changed in the same way: thinking, acting, feeling, attention, volition, counting, speaking, understanding, orientation in space, in time and all other factors which we may examine.

I have characterized the patient's lack in different terms, as lack of

abstract attitude, as lack of approach to imagined things, as inability to give himself an account of acting or thinking, as inability to make a separation between the ego and the world. At bottom, all these terms and others which one may use to characterize the facts mean the same. The widely different manifestations in behaviour represent, without exception, one and the same defect in the underlying attitude.

We can distinguish two different kinds of human attitude toward the world: (1) A *concrete* attitude, in which we are directed toward given objects and directed in our thinking and acting by them; (2) a more *abstract* attitude, in which we are moved at first to think about the objects and to give an account of them to ourselves. To each of these attitudes belongs a particular kind of behaviour. In the first we are acting in the world, manipulating the objects; our activity is determined directly by the claims of the objects upon us. In the second attitude we are thinking rather than acting, even our activity being directed by thinking. Our actions are governed not so much by the objects before us as by what we think about them. In the first attitude we behave more passively, in the second, more actively. Some tasks can be performed only by the one type of behaviour, others only by the other. In patients with lesions of the frontal lobe, active (abstract) behaviour is lacking, but the concrete behaviour may be very well preserved.

From the standpoint of general physiology the patient's deficiency may be designated as a disintegration of a higher, more complicated process, which is rather determined by the whole organism, to a less complicated, lower one, determined more by the stimuli of the outer world. This disintegration of function is well in accord with the general type of disintegration of the function of the cortex, wherein all of its varieties exhibit the same ground form.⁵

This proposition, in general, well meets the conception of 'dissolution' put forward by Hughlings Jackson. Here I do not wish to deal with some disagreement that exists between the opinion of this great master of neuropathology and my own, a difference which concerns his contention that disintegration, or as I would prefer to call it, 'dedifferentiation,' means a 'dissolution' which he regarded from the standpoint of evolution.

Here I should prefer to emphasize what conception Jackson and myself have in common, as such agreement is much more important than are any differences between us.

Concerning the facts at issue, a number of more recent observations, particularly those of Penfield and Brickner, agree with my own. This agreement carries particular weight because the cases of these authors deal with lesions of the most unambiguous character, each involving surgical operation and anatomical examination.

As far as I can gather from the case-reports, the symptomatology differs markedly from the symptomatology I have described. But the difference is only an apparent one: viewed more closely, the differences are seen to be

the result of a variation in methods of investigation. If the phenomena described by the authors are re-analysed from the point of view set forth here, they would lead to a conception of the basic changes identical with mine.

As to these authors' views concerning the psychic deficiency in the patients observed by them, Penfield contents himself with mere matter-of-fact. Brickner reaches a conception which on some points is in agreement with mine, but in others not. He, as I do, rejects the notion of alterations of different single mental performances, such as memory, intelligence, affect, etc., but assumes a basic deficiency, as expressions of which the different disturbances are to be regarded. I should like to stress particularly that we agree that the emotional symptoms act simply as an expression of this basic change, not as an affection of any particular function. I emphasized this view years ago.

I should not omit to mention, however, that despite this general agreement, I differ from Brickner in the conception of what is the basic change. I contend that there is not only a lack of synthesis, as Brickner assumes, but a lack of a definite form of general behaviour of which the patient's inability to 'synthesize' is only the consequence, or more correctly, a phenomenological expression of it. Synthesizing, it should be remembered, is not a primary psychic function, but a performance, and like all other performances it may appear disturbed or unaffected, depending upon whether a concrete or an abstract synthesis is to be performed. The patient's apperception may be equal to the task of 'synthesizing' an indefinite (and quite a considerable) number of 'parts'—more exactly, what the normal observer views as parts—into a whole and to react to this whole correctly or normally, provided that the 'parts' will fit together for him concretely. If they do not fit together concretely to satisfy him he fails.

The facts here displayed furnish the foundation for the diagnosis of affections of the frontal lobe. It is true that the modification is not always of such an advanced form as that which we have described. According to our view that performances differ in point of complexity or simplicity, varying degrees of lesions will entail varying degrees of impairment of performance. Important for the diagnosis is the establishment of the particular nature of the change undergone by the patient's performances. If the examination is undertaken in the proper way and if the damage is not too slight, the characteristic modification will, without doubt, be discoverable in some examples of performance.

In attempting to base the diagnosis of a frontal lobe lesion on the mental change there is one differential diagnostic difficulty—the determination of a frontal lobe lesion as against a general damage of the entire cortex. There is no question but that the clinical picture of the mental change is very similar in both affections, and many investigators tend to assume that the mental disturbances in frontal lobe lesions are conditioned by such a concomitant general affection. The facts warrant no such assumption. We have enough

trustworthy observations of definitely circumscribed lesions of the frontal lobes which exhibited all of the characteristic symptoms.

Why then the similarity between these cases and diffuse affections? The function disturbed in either case is one of the highest order, making the greatest demands upon the cortex. Owing to the damage of a certain degree of severity the highest function will naturally be the foremost to be disturbed. The frontal lobe is essential for the highest functions. Therefore we find identical symptoms in lesions of the frontal lobe and in diffuse cortical affections which implicate always, as well, the frontal lobe. The symptoms observed in cases of frontal lobe lesions are therefore not manifestations of an assumed general cortical affection; on the contrary, the characteristic symptoms in diffuse cortical affections are manifestations of the damage to the frontal lobe. A close consideration of the whole—psychic and somatic—picture will make it possible to decide if the psychic change, as mentioned, is caused by a localized process of the frontal lobe or a diffuse lesion of the brain cortex.

Finally, I wish to stress one point: The significance of the frontal lobe for the psyche can be fully grasped only if we bring the psychic performances into connexion with those performances which we include within the function of the frontal lobe, on the ground of the determination of lesions of the frontal lobes found in such disturbances. Such performances comprise on one hand a complex of somatic processes serving the maintenance of the equilibrium of the body as a whole and of its parts, especially control of direction; and, on the other hand, certain motor activities that are internally connected with the psyche, such as speaking, writing, making gestures and the like.

From a comprehensive point of view, all these performances reveal themselves as the several expressions of a specific behaviour characteristic for the human attitude toward the world and the means of maintaining this behaviour, a behaviour which manifests itself not only in the abstract attitude, but also by the capacity for maintaining a deliberate direction of thought and movement which may be no less manifested in speaking and working and in the erect carriage.

It seems to me that the conception outlined here, perforce summarily and rather sketchily (I have developed it more fully elsewhere), furnishes the foundation for reaching an understanding of the specific place of the frontal lobe in the animal kingdom and its special development in man.

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