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THE INSANITY OF DOUBT.

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INSANITY of doubt is a form of mental disturbance which is brought about by certain disturbances of the psychical processes, to which the various names of insistent or fixed ideas or imperative conceptions have been given. The imperative conception or representation (*Zwangsvorstellung*) plays as important a part in the genesis of the insanity of doubt as the delusion does in the genesis of paranoia. Therefore this form of mental disturbance has often been termed the "malady of fixed ideas," and before studying it, these fixed ideas or imperative representations must be considered.

Westphal defines them as "those representations which enter into the foreground of consciousness without and even against the volition of the individual affected, who, in other respects, is still possessed of an intact intelligence. They are not brought about by any affective or emotional condition. They cannot be dispelled. They prevent the normal current of ideas. The patient recognizes them as abnormal and foreign, and opposes them with his entire consciousness." Although this definition serves in many cases, it excludes too much. The mental obsession by some overpowering emotion cannot, of course, be classed in the same category as the ordinary imperative representation, but, nevertheless, the ordinary representation is not always free from some affective or emotional element. Wille, moreover, points out that in certain cases the intelligence does not remain intact.

In this instance, as in many others, hard and fast lines have been drawn which are not justified by the facts. As will be shown later, the boundaries of the imperative conception or of the insanity of doubt itself are by no means rigid. Insanity of doubt shades off, with all gradations, from healthy mental action on the one hand to the more pronounced types of mental disease on the other.

Imperative representations in a mild form are not uncommon in health. We all of us know how a phrase or a tune sticks in the mind against our will and often to our annoyance. After an evening at the card-table it sometimes happens that the combinations of the cards will follow me to bed, and persist in my mind for some time before sleep comes, and the same is true of other games. Another form, also common in health, is the impulse to suicide which every one feels, especially in the impulse to jump from high places. Not long ago I heard of a young man who, knowing nothing previously of such impulses, was suddenly forced to jump from a height of some thirty feet. He fortunately landed in soft earth, and, on reaching the ground, had not the slightest idea why he jumped, except that he "had to." Others have impulses occasionally to perform some absurd act, in violation of the social proprieties. These impulses are transitory, and are excited only by the presence of an opportunity for gratifying them. Impulses to other overt acts, murder, arson, and the like, are much less common in health.

From these slight and common forms of imperative representations the transition is easy to the more severe and longer-continued yet still transitory forms, such as are seen in cases like that reported by Luys, where a young accountant, after very severe work and fatigue, found himself involuntarily repeating his calculations. "The cerebral machine had been going with too much force to stop," and this involuntary toil was continued for several weeks before the patient recovered.

These forms arise from the exhaustion of the healthy brain; in other cases we have to do with the morbid action of an invalid brain, and here the imperative representations may be permanent, and give rise to much more serious conditions; they then become the true pathological dominant ideas which form the basis of the insanity of doubt.

As an example of these imperative representations, I will cite the case of Mrs. R., a lady of considerable intelligence and fair education, a public reader, aged 46, who consulted me in April, 1886. There was a marked psychopathic heredity; one aunt had the fear of contamination, another believed she had committed the unpardonable sin. The patient herself had always been nervous and a victim of migraine. For six or eight months she had had much headache, "a distressed feeling at the base of the brain," and other neurasthenic symptoms. In addition she was impressed by the idea that everything was corruptible and transitory; when she saw anyone she recognized all the anatomical details, bones, muscles, blood-vessels and nerves, she could not help seeing them and thinking of them; and she constantly thought of the connection between mind and body. She recognized the foolishness of such thoughts and realized the danger of persisting in them, yet she was utterly unable to control them.

Griesinger, who was one of the first to call attention to this condition, cites several cases, among them one of a lady who constantly questioned herself as to the why and wherefore of everything. "Why do I sit here? Why do men go about? What does this chair signify? Why do men come into being? Why are there men?" and similar questions. Another of his patients was continually questioning "why this man was so large; why he was not as high as the room; why men are only as large as they are; why they are not as large as houses; why there are not two suns and two moons, etc." One of Ball's patients believed that he had vanished, and that all about him was unreal, and constantly questioned himself about it, having an absolute loss of the feeling of identity. Buccola reports a case from Tamburini's clinique, where the patient had to know the course which bank-notes took after they were issued. Legrand du Saulle tells of a woman who had the idea that some one might fall from a window into the street when she went out, and she constantly put questions to herself in regard to the results of such an accident. Another of his patients questioned about colors, why grass was green; why the sky was blue, etc. Höstermann tells of a man who was constantly tempted to insult the crucifix by some blasphemous act, and cases similar to this fill the old legends of the saints.

These represent the early or rather the simpler states of imperative representations. When the idea becomes still more insistent it forces the victim to perform certain actions in accordance with it. Dr. Johnson's trick of touching the posts and of entering the room with one foot always first are well-known examples of this. One of Ball's patients, remembering that thirteen was an unlucky number, next thought that it would be dreadful were God thirteen, and, to avert this, he constantly repeated "God thirteen, infinity thirteen, eternity thirteen." Hammond tells of a woman who had to search all parts of her room repeatedly lest detectives should be hidden there. Westphal cites the case of a man who began to speculate about paper, then he thought that he might commit some crime and write his confession on paper which might be found and put in evidence against him; thus he was led to cherish every scrap of paper to avert this disaster. Baillarger reports the case of a man who, if any woman whom he saw was pretty, was impelled to find out certain facts about her, her age, antecedents, manner of life, etc. If he was told that she was not pretty he had no need of this information. One day he left Paris for a distant city, and, on arrival, he asked about the ticket-seller at Paris. His companion unguardedly said that he had forgotten to look at her, and so they had to return to Paris at once to settle the matter. Charcot and Magnan have reported a case of "onomatomania," where the patient feels the necessity of recalling some word, and can get no rest until he has done so.

Wille classifies imperative representations as either absurd, senseless or utterly foolish, or entirely natural and comprehensible, but false. As an example of the latter class he mentions a lady who was beset by the idea of her husband's infidelity, although she firmly believed in his fidelity.

Westphal divides the imperative representations into three classes; the first, where they are merely theoretical and have no influence upon the actions; the second, where the patient is compelled to perform various acts by reason of his dominant ideas; and the third, where idea and act are so bound together as to give rise to the so-called impulsive acts.

Tamburini's classification is similar:

1. Simple fixed ideas, insistent ideas proper, in which the anomaly of ideation is limited purely to the field of intellectual operations, a field purely theoretical, without being manifested externally or passing into action (metaphysical insanity, insanity of calculation, first stage of the insanity of doubt.)

2. Ideas accompanied by feelings of fear and by an emotional state of anxiety. These ideas may be more properly termed emotional ideas, in which, as a necessary consequence, there is a passage to action, imperative acts (second stage of the insanity of doubt, delirium of touch, mysophobia, etc.)

3. Ideas which can more properly be called impulsive, in which the idea so penetrates and unites with the impulsive act that it is very often of a grave and dangerous nature (impulsive ideas, homicide, suicide, etc.)

These classifications I have cited for convenience, and I shall return to them later. At present we must discuss the pathogenesis of these representations.

Consciousness is the sum of present sensations, including representative and re-representative sensations. In other words, at any given moment certain sensory cells in the cerebral cortex are actively engaged in performing their functions, that is, they are in a state of active stimulation; while other cells are either totally inactive or in very feeble activity. Thus, as I write, certain sensory cells that receive impressions from the sight of the objects about me, from the noises of the street that come through my window, and from the contact of the objects near me, certain motor cells that hold the body in position and preside over the movements of writing, and certain more complex intellectual cells or combinations of cells in which are stored up certain ideas, all these cells are in a state of functional activity. Furthermore I am conscious that certain other sensory cells are ready to act, being now slightly stimulated by associations with the cells in present activity, and, were I to stop writing, they might take on more active functions and inhibit the action of the former set of cells. The idea that this paper must be written is, for the present, the dominant idea, the imperative representation which inhibits the action of the second group. In the healthy brain the sway of such a dominant idea is usually temporary. It arises from association or from external impressions, and may be replaced by some other idea with more or less ease. At present, with no urgent need of finishing writing, it would be a very simple process to stop,—the entrance of a patient, a certain weariness of writing, or the attraction of a novel could easily bring about a cessation of my work, and there would be merely a dim idea in the background of consciousness that the duty was still to be performed.

Now in the healthy brain, as we all know, there are many ideas more or less present to our consciousness, which have no effect upon our actions and but little upon our thoughts. Among them are the feebly insistent ideas of which I have already spoken. Their genesis cannot always be easily traced; they may be re-representative ideas excited by some obscure association, or they may arise from external impressions. In the "invalid" brain the same processes are going on, but here some group of cells, some "ideational centre," has been aroused by some pathological process to unwonted activity. The idea may be any of the absurd ones already cited. In each case that individual group of cells continues to act, it dominates consciousness, and inhibits the action of other cells, and finally the nervous energy extends to the motor cells, and produces a discharge. The patient performs some act in accordance with his idea. "In the malady of fixed ideas," says Buccola, "the anomaly of the association of ideas is due to the anomalous functioning of a few groups of cells, which, not diffusing their energy, vibrate with such preponderance as to impede, as we say, the contemporaneous and active manifestation of the other groups of the cortex, with which they ought to be in harmony to impart to the mind a sound and perfect tone."

I do not wish to be considered as thinking this condition akin to epilepsy (oddly enough one of Griesinger's patients had had convulsions), but there is a curious analogy to be drawn between the victim of the malady of imperative representations and that form of epilepsy described by Hughlings Jackson, which is due to organic brain disease. Some of us may have had the opportunity of watching the victim of the latter affection during a seizure. He is perfectly conscious of his surroundings, he is aware and he tells you that a seizure is coming on, he feels the signal symptom, the sensory aura in his hand, he watches the muscles of the arm pass into a state of tonic and then of clonic spasm, and, although he knows everything that is going on, it is as much beyond his control as are the movements of Jupiter's moons. So it is with the victim of the malady of imperative representations. He knows that he has a dominant idea that he is in danger of contamination, he recognizes that it is utterly absurd, but yet that idea dominates every other in his consciousness, and finally is expressed by repeated acts of purification, which often he is as powerless to control as the epileptic is his convulsions.

The very curious case reported by Berger is of interest in this connection. The patient, who wrote out a full account of his mental symptoms, had paroxysmal attacks, beginning with a period of metaphysical quibbling (*Grübeln*), and passing to a state of double consciousness, where the psychical processes on one side were calm but on the other were of a tumultuous character. In addition to the psychical symptoms the face became flushed, and there was a profuse sweating, and at times symptoms of motor irritation, contraction of certain muscles. One of these attacks came on in sleep and was dreamed of. Berger, however, although recognizing the analogy between this and epilepsy, opposes the idea of any connection between the two affections—an opinion in which he is sustained by Westphal.

The insanity of doubt is based upon imperative representations, but, as will readily be perceived, it is connected with only a portion of these representations. The mild insistent ideas which occur in the healthy brain and the insistent ideas resting largely upon an emotional basis which are common in melancholia are to be excluded on the one hand. The third class of representations in the classifications of Westphal and Tamburini, where idea and act are so bound together as to the so-called impulsive acts, belongs to the class of impulsive insanities. Furthermore, the imperative representation has certain connections with delusions which will be spoken of later.

This form of insanity was recognized before we had any clear ideas about the imperative representations upon which it is based. Esquirol[1] reports the case of a girl who feared lest she had carried away something valuable from the place she had visited, and therefore undertook endless brushings and ablutions to prevent it. It is commoner in women and among the more intelligent classes, and is seen perhaps more frequently outside of an asylum. The imperative representations upon which it is based may develop suddenly or gradually, and finally they dominate the patient's whole existence, inhibiting all other forms of thought or action. After a time the patient may be compelled by them to perform certain acts, often of an absurd character. He may be aware of his situation and realize the unreasonableness of his ideas, but all to no purpose. Hence the affection is sometimes termed paralysis of the will. There is usually but little emotional disturbance, and delusions are not very common. The case rarely terminates in dementia.

Ball has classified the different clinical types of the insanity of doubt as follows:

1. The metaphysical, where the patient constantly questions himself in regard to transcendental problems, God, eternity, and the creator.

2. The realistic, where the patient questions about less important matters, why men are not as large as houses, why there is but one moon, etc.

[1] Esquirol. Des maladies mentales, ii, 63.

3. The scrupulous, where the patient is in constant distress lest he has done something he should not, and therefore he has to repeat and re-repeat every act or perform many foolish and trifling acts to avert the consequences of wrong-doing.

4. The timorous, who fear to compromise themselves, and take endless precautions lest harm should come.

5. The calculating type, where the patient must count or multiply everything.

6. The patients who fear contamination, who shrink from contact with external objects, and are compelled to perform endless ablutions (*folie du doute avec délire du toucher*, mysophobia).

Emminghaus has given a classification which seems more comprehensive, making three principal groups:

"1. Fixed ideas in an interrogative form, a marked necessity of questioning; which comprises the so-called, 'mania of why,' metaphysical insanity, (*Grübelsucht*, Phrenolepsia erotematica), and the first stage of *folie du doute*, (Meschede has shown that this morbid questioning is always purposeless and about useless things.)

"2. Fixed ideas of multiplication, or morbid necessity for calculating; arithmomania, insanity of calculation.

"3. Fixed ideas with anxious hypotheses; which comprise agoraphobia and the allied forms of morbid fears, and the second stage of *folie du doute*."

Neither of these classifications is satisfactory for the simple reason that the imperative representations which form the basis of the insanity of doubt are of so endless a variety as to render any attempt at classifying them nugatory.

Legrand du Saulle, to whom much of our knowledge of one of the forms of insanity of doubt—*folie du doute avec délire du toucher*—is due, has divided the course of the affection into three stages. In the first stage the patient is susceptible, exacting, dreamy, egotistical and timorous, yet in full possession of his reasoning powers. He is filled with morbid thoughts, he begins to inquire into the reason for every trifling thought, or act, or object about him. With that comes a lack of confidence, a distrust of his own powers, a need for verifying everything he does, of re-reading everything he writes, a constant repetition of words and acts, and an exaggerated scrupulousness in the most petty actions. In this stage the reasons for his scruples and his actions are often concealed. It corresponds to the first division of the imperative representations in the classification of Westphal and Tamburini.

"This period," says Tamburini, "is ordinarily distinguished by the spontaneous, involuntary, and irresistible productions of some series of thoughts upon indeterminate, theoretical, and sometimes ridiculous subjects, without any illusions or hallucinations. This series of thoughts is brought to the patient's consciousness with interrogations, demands put continually to himself, a profound and constant sentiment of doubt, a species of monotonous rumination, obstinate and oppressing him by the same ideas, and sometimes with a mental representation of certain images which excite persistent pre-occupations. The sole external effect of this inward struggle is merely the necessity of frequently repeating certain acts, upon which the doubt still extends without ever being satisfied or convinced. Therefore the patients are in a state of continual inward hesitation, they are powerless to subtract this incessant labor from their thoughts, which therefore never arrive at any definite result; they are disquieted, impatient, and always plunge still deeper into a struggle which is fatally sterile; therefore they become gloomy, susceptible, egotistical, and exacting. Lacking confidence in themselves, they verify numberless times whatever they do, control whatever they say, read and re-read whatever they write, and take a quantity of precautions for every act which they perform. The ideas by which their mind is tyrannized vary according to the persons, their education, the environment in which they have lived, etc. Some question continually about metaphysical subjects (so-called metaphysical insanity), about the existence of God, creation, religious dogmas, the more general and fundamental theorems of physics, mathematics and other sciences, and sometimes about futile and inconclusive arguments; others are obliged to multiply all the objects they see or think of (insanity of calculation); in other cases the patient is tormented by the doubt that he has not done a thing well, he has not counted money right, or concluded some negotiation properly, etc., and he is obliged to repeat the same act again and again, or else the doubt and pre-occupation return (insanity of doubt proper). In this period the patients usually conceal their trouble or confide it only to the physician or some intimate friend." Legrand du Saulle, however, places the dividing line between the first and second stage at the point where the patient begins to reveal his doubts. In this stage Westphal thinks that there is little or no emotional disturbance, except as it may arise secondarily. When the patient confides his trouble to any-one, however, he is in urgent need of another's will to enable him to overcome his dominant ideas, and to reassure him of his doubts. The manifestations of his questionings or of his ideas are often paroxysmal. Wille attempts to draw the line between sanity and insanity at this point, where the imperative representations are transformed into imperative acts. In the same way the man with hallucinations is accounted sane as long as he perceives his hallucinations to be such. Although legally this distinction is of value, it does not affect the case in any other way. Each man has an unhealthy brain, and the distinction is merely one of degree.

In the second stage of the insanity of doubt the patient begins to reveal his distress to all his friends, to give prolix recitals of his doubts, to put endless questions, and to require constant re-assurance. This for a time may relieve his perplexity, but it soon returns. There are often periods of distinct excitement attended with or preceded by praecordial or epigastric distress. The suffering becomes more intense, and emotional conditions become more pronounced. In mysophobia the ablutions become constant; it takes hours to make a single toilet. Cases of doubt are common, and both in this and in the first stage remissions are often noted. "This period," says Tamburini again, "which is usually initiated by the urgent need of revealing the patient's sufferings and giving long descriptions of them, is characterized essentially by the fear of touching certain or all objects, fearing to be soiled or poisoned, or injured in some way; the patient avoids touching them, or provides himself with gloves, handkerchiefs, etc.; if he be forced to touch the objects dreaded he has palpitations, anxiety, cold sweats, and sometimes convulsive phenomena, which enter upon the scene and may even go on to syncope; the patients call these attacks their crises. This fear often originates from an instinctive aversion and dread of certain animals, rats, cats, or dogs, and the dread of the latter may even reach the degree of true terror, by exciting the idea of rabies, and it generally compels the patient to perform all the characteristic acts of mysophobia. . . . . . . The strange and characteristic acts performed by these patients are accompanied by continual monologues and doubts, if the washing has been sufficient, if every trace of filth has been removed, if they have touched new soiled objects, etc., but not content with their own affirmations they seek the assurance of others and oblige the persons about them to repeat certain stereotyped phrases which alone have the power to re-assure them for the moment. Withal they never succeed in being truly convinced and satisfied, since the doubt always re-appears with equal force and insistence."

Finally the patients lose confidence in their assurers. They still see the unreasonableness of their doubts, but the doubts have still greater dominion over them. The doubts are constant instead of being paroxysmal, the victims shut themselves in their houses or in their rooms, and live in their ideas and fears. Their anguish increases, "they are a prey to continual agitation, they do not read or write, and pass the greater part of their time in the midst of timorous irresolution and vague apprehensions, which keep them in a state of almost complete inertia. They are easily fatigued merely from speaking to others, while they often soliloquize in a low voice, or move only the lips with a low whisper; yet in spite of these symptoms, which would seem to indicate a complete weakening of all the mental functions, they never, or hardly ever fall into true dementia, remaining in this state unchanged for years, to the end of their sad lives." (Tamburini.) Here the mysophobist neglects his person, seldom changes his linen, and sits clothed in rags.

Such is the accepted picture of the stages of the affection and its onward progress, but it seems questionable whether there is any true progress through the various stages. That all these classes exist is not disputed, but it is certainly wrong to say that because a patient has mysophobia, and performs acts of purification, he is therefore in a more advanced, and consequently in a more hopeless condition than a patient who simply questions.

In order to get a clearer idea of the perversion of the mental processes in this affection, we must refer to the formula of thought presented by Mercier.[1]

Mental relation		Environmental relation
a		A
:	corresponds with	:
b		B

In health we find that our concepts of the relation $a:b$ correspond perfectly with the environmental terms, $A:B$, or if not, the process of adjustment being intact, we can bring them into harmony. Thus the mental relation "*a* is *b*" is compared with the environmental relation, "*A* is not *B*," and the adjustment may be made at once, the mistake is noted. In the delusions of insanity, however, the disordered process is in the process of adjustment itself, so that correct thought becomes impossible; the patient can no longer see that the mental relation is out of harmony with the environmental relation, that "*a* is *b*" differs from "*A* is not *B*." Now the abnormality of the thought process in *folie du doute* lies between these two. In health the want of adjustment is detected at once, and need not be repeated. In the delusion the want of adjustment cannot be detected, no matter how often it is repeated. In *folie du doute* the want of adjustment is perceived, but not realized; it is apprehended, but not comprehended; the victim must compare and re-compare, and although he sees the lack of adjustment, he is never sure of it. The accompanying scheme, modified from Mercier, will show this point more clearly, the bracket pointing out the point of disturbance:

[1] Mercier, The Nervous System and the Mind, p. 251.

Mental relation				Environmental relation
Mistake	$a : b$	corresponds with	$A : B$	Can be corrected by adjustment.
Insanity of doubt	$a : b$	corresponds with	$A : B$	Not permanently corrected by adjustment.
Delusion	$a : b$	corresponds with	$A : B$	Cannot be corrected by adjustment.

To take a concrete example: the healthy man gets his hands dirty and duly washes the dirt off, or, if he be a surgeon about to do a laparotomy, he washes his hands with the special precautions of disinfection; the mysophobist, recognizing not only the fact that his hands are now dirty, but the possibilities of dirt, is not satisfied with washing them once or twice, but must repeat the process indefinitely; the victim of the delusion believes not only that his hands are dirty, but that no washing can cleanse them, that he is a source of corruption to the world.

The imperative representation is thus seen to occupy that position between the normal ideational process on the one hand, and the delusion on the other; and its malady, *folie du doute*, stands between the healthy reasoning process, and paranoia. Again it must be insisted that there is no fixed line of division. We have seen how the healthy insistent idea may pass by all degrees into the insane insistent idea, and the insane insistent idea may finally cease to be recognized as false, just as the hallucination finally ceases to be recognized as false, and the idea becomes the delusion. Thus a patient of Meschede had finally hallucinations and delusions of persecution; one of Wille's patients, who had the insistent idea that everything was damned, finally developed true hypochondriacal paranoia. Schüle[1] classes *folie du doute* as a disease of the defective constitution and states that part of the cases go on to delusional melancholia. Westphal classes it as an abortive *Verrücktheit*, while Krafft-Ebing[2] goes farther and sets it down as merely a variety of paranoia, *primäre Verrücktheit in Zwangsvorstellungen*, ordinary paranoia being *primäre Verrücktheit in Wahnideen*.

[1] Schüle, Klinische Psychiatrie, p. 18, 468.
[2] Krafft-Ebing, Lehrbuch der Psychiatrie, ii, p. 10.

Krafft-Ebing[1] has also analyzed these two forms of insanity, showing the common features in their development, and the distinctions between them. Paranoia and *folie du doute* are alike in the following respects:

"1. Heredity or original neuropsychopathic constitution, which can almost always be detected, and which points to original functional anomalies of the nervous centres.

"2. Slow invasion of the disease, reaching back to puberty.

"3. The primary onset of anomalies of representation, deprived of any affective basis.

"4. Representations of a strange and unassimilable character, projected from the depths of consciousness and connected with consciousness by associations, either as imperative representation or delusion as the primordial creation of a diseased brain.

"5. The typically congruous nature of ideas in different individuals, as in mysophobia or the congruous delusions (of persecution) in paranoia.

"6. The purely constitutional, but permanent and stationary character of the two affections.

"7. Neither of them ends in dementia."

They differ in these respects:

"1. In paranoia the ideas are of a delusional character, while fixed and insistent ideas treat only of simple formal alterations of the process of ideation.

"2. In paranoia the morbid ideas are soon taken up and assimilated by the consciousness, but the fixed ideas always remain more or less completely extraneous, shut out, and opposed to consciousness, which is still perfectly clear, and to the reason and the will, which are dominated by them. Hence come the pain and distress to which the patients are a prey, which arise in part from the sad consciousness of the formal disorder of ideation, in part from the nature of the fixed ideas which are almost always painful and sometimes dangerous to themselves or others, and in large part from the impossibility of getting away from these ideas and acts." Here, again, I believe that too sharp a distinction has been

[1] Krafft-Ebing, Allg. Zeitschr. f. Psychiatrie, XXXV., 1878.

made, as the *folie du doute* and paranoia evidently blend.

I have traced the growth of the imperative representation from its simple manifestation in the healthy brain to its full development in the invalid brain. The factor of doubt, which plays so important a part in these cases, has also its analogy in health. At times even in the healthy brain there will come phases of doubt, when we are uncertain whether we have properly performed some act, whether the door was locked when we left the house, or whether the letter just mailed was properly directed and stamped. A striking instance of the sort was related to me by a friend remarkably free from any psychopathic taint. It often happens that he does scientific work in the evening at the Agassiz Museum. When he leaves for the night he puts out the gas and then stands and counts slowly up to a given number until his eyes are used to the darkness, in order that he may detect any spark of fire that may have started while he was at work. This is his invariable custom, but it sometimes happens that when he goes back home so strong a feeling of doubt comes over him lest he may that once have omitted to do this, that he is uncomfortable until he returns to the museum to make sure. The act has become so automatic, probably, that the higher centres take but slight part in it, and so it is not recalled to the memory like some unusual action; but—and here is the point where the action of the healthy brain differs from the brain of the victim of *folie du doute*—when he has gone back and repeated his accustomed act, thus assuring himself of its performance, he has no further trouble, while the insane doubter must verify and re-verify and verify again, and yet at the end he is still in doubt.

Turning back to the other end of the scale, where the insistent idea approaches the delusion, where abortive paranoia (*folie du doute*) approaches paranoia, the following case shows clearly the mixture of insistent ideas and delusions, the combination between insanity of doubt and paranoia.

Margaret K., a servant-girl, unmarried and forty years of age, came to me at the Boston City Hospital in May, 1886. How much of a psychopathic heredity there was it is hard to say, for the patient knew but little of her family; one sister, she said, was "not right in her mind," being cross and quick-tempered. The patient herself was small, rather anæmic, moderately well nourished, and was much marked by small-pox. She consulted me "because her head was upset." She was unable to give the date of her attack of small-pox, but it was during her early years. Except for that she had always been well. Her sexual desires had always been very strong, and she had practiced masturbation at various times. As a girl she had allowed various men to take liberties with her, but she had never permitted coitus. For fifteen years or more she has been a victim to various forms of doubt, and she has had sundry imperative representations. She has had the belief that her employers were wronging her about her wages, and that she has had money which has disappeared. She is unwilling to say anything about her losses because she does not know whether she has actually had the money; she thought she had it, but she is not sure; she cannot be sure that anyone took it, she thinks they did, but she is not sure; someone offered to restore the money to her, but she was unwilling to take it, because she was not certain whether it was taken, or whether she ever had it; the restoration might be to try her, and it might cause her injury if she accepted it. She thinks the money that disappeared was stolen, but she does not want to say that it was, neither will she state the amount. If she suspects anyone, and listens, she thinks she hears voices talking, but of this she is doubtful. She is disposed to think everything sinful, she is disturbed about the future life on account of her sins, and fears that the dead may return. When it is suggested that the dead don't want to return from heaven and can't return from the other place, she says "Yes, I know it; they can't come back, but yet I think about it." On the next visit she returns to the same subject as before. She says she has been careless and talked about her neighbors, which is a sin. When asked if she had ever said anything bad about them, she says, "No, I don't know that I have, I don't remember, but sometimes I think I might have." She wants to tell her faults over and over again at the confessional before she is satisfied. She is afraid if in a lonely street in the dark lest some one should kill her. She thinks men want to abuse her, as she has seen them with their clothes unbuttoned. At another time she said she did not think she had ever indulged in coitus, but she couldn't be sure. One day she asked if there was not such a thing as sin with a dog; she had heard of it and was anxious about it; she had never committed it, at least she thought she had not, but sometimes it seemed as if she might have. When she went to bed she had to have the clothes arranged in a particular fashion as a protection; if she did not she thought it was sinful. It was a sin. too, if she did not lock her door. All this and more would be repeated at each visit, and when she was assured that she had done nothing wrong, that these ideas were all nonsense, and she need not worry about them, she would say, "Yes, I know it, I don't think I have done anything wrong, and yet sometimes it seems as if I had." As might be expected, her doubts and her imperative conceptions continued, assurances to the contrary having but slight effect, and after a time she passed from observation.

Insanity of doubt may develop at almost any age; it is commoner among women and in the better classes, the case just cited being an exception. Among the predisposing causes are acute diseases, anæmia, masturbation, sexual excesses, overwork, anything that may weaken the nervous centres and depress their tone. The majority of writers regard it as distinctly a psychical degeneration like paranoia, and claim that the psychopathic taint and bad heredity are the chief factors in the origin of the disease. This is undoubtedly true of the severer cases, but Cowles has shown that in the milder types the hereditary taint is absent. From our study of the development of their conditions, such an opinion must be accepted. There is no hard and fast line between the fully developed insistent idea, (the pathological obsession), and the normal obsession, so that between the two must lie many cases of slighter degree, with no psychopathic taint. Moreover, the insanity of doubt has been shown to be a lesser disturbance of the mental process than true paranoia, hence the brain must be less impaired.

The following case of typical mysophobia (*folie du doute avec délire du toucher*), shows one of the milder types of the disease, although theoretically belonging to the second stage. Here there was a speedy recovery, and no special taint. In the case of Mrs. R., already cited, although nominally in the first stage, the condition was much more persistent, and was complicated with a bad heredity.

Miss G., aged eighteen, consulted me on the 16th of April, 1888. Her father and sister are "quite nervous," beyond that I could get no special history of a neurotic taint. She, herself, is a slight, anæmic underdeveloped girl, a student in one of our higher schools. For some months she has been working hard at school, and has been slowly losing strength; her appetite is poor, she has a tired feeling in the chest, menstruation is irregular. She consulted a physician, who prescribed a tonic containing iron, which she took with some benefit. About a month ago, however, she began to feel that she must use especial care in rinsing out the glass she took her medicine in, otherwise it would cause trouble. She began to be fearful of poison. She felt that she must wash her hands with great care lest ammonia should get on them. The trouble increased, and she began to feel that she must repeat the washings in order to be sure that no poison or ammonia could get on her. If she tries to overcome the feeling she has a headache. If she neglects her washings she has a predominating idea that some one will be hurt if she does not repeat them. She was ordered to leave school, and a course of baths, feeding, and an out-door life was prescribed. She was assured that no harm could come to her or to any one if the washings were neglected, and she was urged to resist any inclinations to yield to these involuntary representations. A week later she reported improvement, she can overcome her feelings better and they are less strong, but she still has the feeling that she has been careless, she knows she really has not been careless, yet the doubt continues. The treatment was continued, further encouragement and assurances were given her, and two weeks later, on the 7th of May, she reported that she had no more trouble.

Some years ago I had the opportunity to observe at the Boston Lunatic Hospital a patient who was apparently in the third stage of insanity of doubt. The case has already been reported by Dr. Boland,[1] so that I will refer only to certain points in the case. There were certain fears of wrong doing, and the patient had to repeat her words and acts five times to be sure that they were right. These repetitions weary her so much that she will sit for hours motionless, dreading to move lest the act should require repetition. She becomes somewhat depressed, and from this dread of the repetitions, is careless of her dress. At the first glance her expression and attitude are that of a patient with melancholia attonita. In spite of her being apparently in the third stage, she has recovered from three similar attacks, (I saw her in the third) and is now undergoing a fourth. As a matter of fact insanity of doubt may begin with or very soon pass into any stage, and any stage may be recovered from.

Although, however, many of the cases of insanity of doubt have no psychopathic taint behind them, it is a curious fact that imperative representations (of a non-affective character) are rarely met with in neurasthenia. On going over one hundred consecutive cases, I found such symptoms noted in only one. Neurasthenic patients are timorous, doubtful, and need constant re-assurance, but true insistent ideas are rare.

[1] Boland, Boston Med. and Surg. Journ. 9 April, 1885.

Many authors class the various morbid fears, agoraphobia, claustrophobia, etc., with the insanity of doubt. The classification seems erroneous. The victim of agoraphobia has a sudden attack of morbid fear under certain external conditions. It rarely happens that his fears have anything to do with previous processes of ideation, and it is still more rare to find the slightest trace of anything like an insistent idea. There is rarely any element of doubt or hesitancy, but a sudden physical inability to perform an act. Agoraphobia, and its kindred affections, form a class in the intention psychoses recently described by Meyer[1], and have little to do with the insanity of doubt, although one of Krafft-Ebing's patients, who had imperative representations, had also agoraphobia. Some victims of agoraphobia, however, are haunted by their morbid fear, even when in the house, thus showing a gradation between the intention psychosis and the imperative representation.

Impulsive insanity, (homicidal mania, etc.,) is so strongly differentiated from the insanity of doubt, that, although based on imperative representations, it must be put in a separate group. In the insanity of doubt there is an imperative representation, with incessant speculation and hesitancy, and finally numberless petty acts and an inability to perform the necessary duties of life. In impulsive insanity there is an imperative representation leading to the performance of a single act; this is resisted for a time, but finally the impulse becomes irresistible, and the discharge takes place. In the one there is paralysis of volition, in the other a convulsive discharge.

The following table will represent the genesis of the various representations and the relations of certain forms of insanity to the insanity of doubt:

[1] Meyer, Arch .f. Psychiatrie, xx, 1888.

TABLE I.

IDEAS HAVING AN AFFECTIVE BASIS.	ERRORS OF SENSE PERCEPTION.	IDEAS NOT HAVING AN AFFECTIVE BASIS.		
Normal depression. (Grief.)	Normal errors of sense perception.	Normal egotism. (Sense of self importance, suspicion, etc.)	Normal insistent ideas.	Normal impulses.
Abnormal depression. (*Melancholia.*)	Hallucinations, perceived as such.	Abnormal egotism, transitory delusions.	Transitory pathological obsessions.	Morbid impulses, transitory and resisted.
			Permanent imperative representations. (*Insanity of doubt, abortive paranoia.*)	*Impulsive insanity.*

Delusional Melancholia. Fixed delusions. (*Paranoia.*)

It may be added that in insanity of doubt certain physical symptoms are noted: Headache, pain, præcordial distress, tremor, vertigo, tinnitus, vaso-motor disturbances, loss of appetite, insomnia, etc.

The prognosis is regarded by almost all writers as very bad; but the majority of them look upon insanity of doubt as a psychical degeneration. Spitzka alone says that many of the mild cases get well in three months. From what has been already said it is plain that Spitzka's view seems more correct. The important factor in prognosis is the existence of a hereditary taint. In well marked cases, where this exists, the outlook is, of course, bad.

Beside the ordinary tonic treatment, rest, forced feeding, etc., stress must be laid upon mental and physical gymnastics. The necessity for doing certain acts in regular repetition, for repeated efforts of volition, such as are required, for instance, in using the chest weights, may have a beneficial result on other mental processes.

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See also the treatises of Krafft-Ebing, Emminghaus, Spitzka, Ball, Maudsley and Hammond. Reports of single cases are omitted.

THE EFFECT OF FATIGUE ON VOLUNTARY MUSCULAR CONTRACTIONS.[1]

WARREN P. LOMBARD, M. D.

In March, 1889, I had the good fortune to spend three weeks in the physiological laboratory of the University of Turin. It is with much pleasure that I take this opportunity to express my appreciation of the great courtesy of Professor Angelo Mosso and his assistants. It was only by their advice and aid that I was able to make the research recorded in this paper.

Apparatus and Method.

The research was begun at the suggestion of Professor Mosso, who proposed that I should continue Dr. Maggiora's[2] work on the fatigue of voluntary muscles, and who placed the apparatus which Dr. Maggiora had used entirely at my disposal. This apparatus, which is very simple and satisfactory, has been described at length by Professor Mosso—*Li Ligi Fatica Studiate nei Muscullo dell Uomo*, R. Academia dei Lincei, 1889.

All the experiments were made upon men, and most of them on the flexor muscles of the second finger. The muscles were stimulated voluntarily or electrically, and the corresponding movements of the finger were registered.

The record was made by a pen which was carried by a little car. The car was supported by two parallel horizontal steel rods, upon which it slid with very little friction. A string, fastened by a leather loop to the finger, pulled the car in one direction, and a cord, which passed over a pulley to a weight, drew the car in the opposite direction. Thus, when the muscles contracted, the finger was flexed and the car was drawn forward, and when the muscles relaxed, the weight caused the finger and the car to return to their original posi-

[1] This paper was read before the Physiological Congress at Basel, Sept. 29th, 1889.

tions. The movements of the car were recorded by a pen on the horizontal drum of a Baltzar kymographion.

The subject was seated during the experiments. The hand and arm were securely fixed on a convenient rest, and, in spite of the violent muscular contractions which were often required by the experiments, made no movement of a kind to influence the record. This question was carefully studied. Also the action of the finger was watched, to see that all the joints moved with each contraction, in other words, that all the muscles which assist to flex the finger were contracted.

Discovery of the Periodicity.

As the first step of the proposed research, it was necessary for me to ascertain the normal curve of fatigue of my muscles, because Dr. Maggiora had found that this varies in different individuals. In these experiments, I voluntarily contracted the flexor muscles of the second finger of the left hand every two seconds. The signal was the sound made by the interrupter of an electric clock. Each contraction was the strongest possible, and, as the weight was three kilograms, the muscles soon began to weary. The drum revolved slowly and the following curve of fatigue was recorded:—

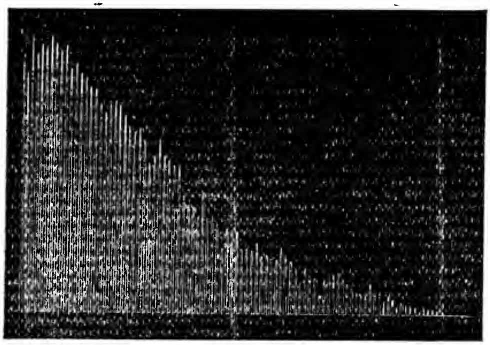


FIG. I.

Several records closely resembling this were obtained. On the second day, however, the work was continued in one experiment longer than usual, because I was determined to fatigue the muscle so completely that no contraction should be possible. After 110 seconds of continuous work, I could hardly stir the weight, and thought the experiment nearly at an end. To my surprise, however, I began to recover the lost power, and during the next half minute each of the succeeding contractions was higher than the one which had preceded it. The effect of fatigue then began to manifest itself again, and the contractions became smaller. I concluded that I had made a mistake, that I had not exerted all my will power before, and I determined for the rest of the experiment to do my best. As the contractions grew smaller I threw all my energy into each attempt to raise the weight. I was conscious that, as is always the case during violent muscular exercise, I was contracting many muscles of the body, and that my face was flushing under the strain; nevertheless, the contractions became gradually less, and I supposed that I had finally succeeded in tiring out the muscle, when, to my astonishment, I began to recover my power a second time. The contractions became stronger, reached a maximum and fell, only again to recover. In short, for some inexplicable reason, during the twelve minutes that the work was performed, the ability to voluntarily contract the muscles with sufficient strength to raise the weight, decreased and recovered five times. During the intervals of decreased strength the power was almost entirely lost, while during the periods of recovery, the force was equal to that shown half a minute after the beginning of the work. Fig. II, Plate I, is a better witness than any words.

The recovery of power which I observed in this and in similar experiments interested me so much that I gave up the intended research and devoted my time to studying its nature and cause.

Constancy of the Phenomenon.

A few days of work showed that the observations which have been described were not exceptional, but that in my case, at least, the periodic loss and recovery of force could be found every day and at all times in the day; on the muscles of both arms, and on the extensors as well as flexors; with weights of ½, 1, 2, 3 and 4 kilos.; and when the muscles were contracted at intervals of 1, 2 and 4 seconds.

Experiments upon Others.

Unfortunately, lack of time prevented extended experiments upon others; nevertheless, the power to voluntarily contract the muscles was seen to vary in a like manner in the case of two other strong, healthy men. Fig. III, Plate II, is a reproduction of the record obtained from one of these experiments.

The phenomenon is, therefore, normal. It is, however, far from sure that it can be found well marked with all men. I failed to obtain it in a few experiments which I made on six other men, although in some of them suggestive irregularities were seen. As has been said, the phenomenon is distinctly a result of fatigue, and, therefore, the experiments are not agreeable. Men are very differently constituted, both as regards their ability to concentrate their efforts, and to continue muscular work after fatigue has made it painful. One sees this exemplified in races, on the march, and whenever long continued and violent muscular exertion is required. I do not know that these constitutional differences have ever been satisfactorily explained, or, indeed, that anyone has a well defined idea of the physiological conditions which are essential to endurance and tenacity.

Study of a Characteristic Experiment.

In long continued experiments with weights lighter than that which was employed in the experiments recorded in Fig. II, Plate I, the alternating loss and recovery of power, though appearing later, is even more striking. Fig. IV, Plate I, records an experiment on the flexor muscles of the second finger of the left hand, with a weight of half a kilogramme. The muscles were voluntarily contracted every two seconds, and each time with the utmost force. In this case the difference between the height of the contractions during the interval in which the voluntary power was lost, and the periods when the muscle responded well to the will impulse, was very great. For the first half minute of this experiment, the height of the contractions varied from 53 to 57 mm., and averaged 55 mm. They then began to decrease in size, and at the end of $9\frac{1}{2}$ minutes had fallen to 5 mm. The change during the last half minute was very rapid. In the preceding half minute the contractions were irregular and varied from 17 to 32 mm., but averaged 24 mm., while during the last half minute they were, viz.—22, 23, 17, 19, 17, 12, 15, 11, 15, 12, 8, 6, 7, 6, 5.

From this time on the alternating intervals of loss and periods of recovery of power became well marked, as is seen in the reproduction of the curve, Fig. IV, Plate I, and in the following table.

The table records the variations in the size of the contractions during the first eleven successive periods. The size of the contractions is stated in millimeters. Each column of the table contains the contractions which occurred from the time that the power began to be recovered until it was lost again.

TABLE I.

1	2	3	4	5	6	7	8	9	10	11
6	9	6	9	7	7	12	10	10	10	12
6	10	8	22	9	6	11	18	14	10	12
8	11	23	44	7	7	10	15	10	23	15
14	17	44	47	9	9	12	22	14	42	20
11	12	46	44	11	10	29	26	16	47	34
11	26	45	46	21	10	45	44	34	47	45
14	43	46	45	26	15	47	49	42	48	46
15	41	48	45	46	20	47	47	45	50	48
27	43	42	44	47	44	39	39	47	48	45
46	42	47	37	47	46	30	30	46	45	46
48	44	40	25	33	49	13	21	44	38	45
46	45	29	14	27	40	9	18	44	38	40
34	42	20	10	13	20		10	44	36	38
38	45	10	8	11	12		6	49	14	40
42	41	7	5	8	11			48	10	38
41	36	11		7	7			45	7	40
42	30	11		6				50		30
47	25	7						50		14
42	16	5						47		8
39	10							46		
45	10							36		
47	5							40		
48	5							48		
39	4							47		
41								41		
37								48		
40								30		
33								15		
35								17		
25										
11										
8										
8										

The difference between the size of the contractions during the periods of power and intervals of weakness was remarkably constant. This is well seen in the following table, in which the highest contraction of each period is placed by the side of the lowest contraction of the following interval. The height of the contractions is stated in millimeters.

TABLE II.

Highest contraction of the period.	Lowest contraction of the following interval.
48	8
45	4
48	5
47	5
47	6
49	7
47	9
50	6
40	7
48	7
47	8
47	8
48	13
48	10
47	8
47	6
48	4
49	4

The regularity seen in this table is the more surprising when one reflects that it depended not only on the action of mechanisms within the spinal cord, of the nerves, the nerve ends and muscle fibers, but also on the ability of the subject of the experiment to give each time the strongest will impulse possible. The fact remains the same, however, that in each of the periods of recovered power the highest contraction was of about the same size, and that it was nearly as vigorous as the contractions which were made at the beginning of the experiment.

It is also noteworthy that during the intervals of decreased force the strength was lost each time to almost exactly the same degree.

On the other hand there was but little regularity in the length of the succeeding periods. Stated in seconds their lengths were, viz.—66, 48, 38, 30, 34, 32, 24, 28, 62, 32, 34, 28, 44, 26, 28, 38, 34, 26.

There was also great difference in the time elapsing before the highest contraction of each of the successive periods was reached. Stated in seconds these times were, viz.—22, 24, 16, 8, 18, 22, 14, 4, 36, 16, 16, 4, 38, 14, 10, 14, 12, 12.

Likewise the time between the highest contraction of a period and the next lowest contraction varied greatly, viz., 44, 24, 22, 18, 16, 10, 10, 14, 26, 16, 18, 24, 6, 12, 18, 24, 22, 6.

It is unnecessary to calculate the work accomplished in each period. A glance at the curve discloses that it was not the same in any two periods.

To summarize these results one may say that nine and one half minutes elapsed before the first interval of decreased power was reached. During the succeeding ten minutes the power to raise the weight was regained and lost fifteen times. The periods of recovered power varied greatly in length. The lowest contractions of the intervals and the highest contractions of the periods were irregularly distributed. In no two periods was the same amount of work accomplished. Finally the highest contractions were of about the same size in all the periods and were nearly equal to the contractions occurring at the beginning of the experiment, though in the intervals of decreased force the contractions had almost no power.

Search for the Seat of the Changes which Produce the Periods.

When a muscle is voluntarily contracted many chains of mechanisms are thrown into action. All these chains are connected with the areas of the brain originating the will impulse. The successive links are formed by the mechanisms within the central nervous system, the centrifugal nerves, the nerve ends, and the muscle fibres. Which of these organs is the seat of the changes which cause the loss and recovery of voluntary power?

The periods do not appear until after considerable work has been performed. The greater the weight and the more frequent the contractions the sooner they occur. Indeed, they seem to be essentially connected with the fatigue of the mechanisms involved in the voluntary movement. It is well known that muscles weary rapidly if deprived of blood, and as Dr. Maggiora has shown they recover their strength with equal rapidity if treated with massage during the intervals of repose. These facts suggest that the periods are the result of circulatory changes in the muscle.

With the hope of ascertaining the truth of this supposition I made the following experiment. I contracted the flexor muscles of the second finger, weighted with 2800 grammes, every two seconds, and each time as vigorously as possible. When fatigue had become great, and the intervals of loss and periods of recovery of force were very marked, the muscle was subjected to massage. The work was continued during the massage with the same regularity. At the end of a few minutes, the effect of the massage was seen in the flushed skin and in the fact that the muscular contractions during the intervals of decreased power were somewhat higher than before. Nevertheless, the periods continued to occur. In other words, the increased circulation caused by the massage, though slightly strengthening the muscle, did not remove the periodicity. Fig. V, Plate II, is a reproduction of the record of this experiment. The arrow marks the moment at which the massage was applied.

Another form of experiment was then resorted to, in order to see if the irritability or strength of the muscle was less at the moment that the voluntary contraction was weakest. The condition of the muscle was tested at the beginning of the experiment by a tetanizing induction current, applied at intervals of two seconds, during about half a second, the muscle raising a kilogramme at each contraction. After ten contractions the electricity was stopped, and the subject began to voluntarily contract the muscle every two seconds, and always with his whole force. When the periodicity had become well defined, the muscle was again tested with electricity. The test was made during an interval when the most vigorous voluntary effort was incapable of raising the weight. It was found that the response to electricity was about the same, and that the muscle was still capable of doing work. Moreover, although the electric stimulations were applied regularly, every two seconds, for some minutes, no recurrence of the periodicity was seen. When the electricity was discontinued and voluntary contractions again commenced, the periods soon returned. It is worthy of note that the periodicity did not appear immediately, however. It seemed as if the mechanism which was the seat of the changes producing the phenomena, had had an opportunity to partially recover during the time that the muscle was contracting in response to the electric irritations. The difference in the form of the record obtained, when the muscle is irritated directly by electricity, and when it is stimulated voluntarily, is well illustrated in Fig. VI, Plate II. The whole curve is the record of one continuous experiment, and contains two groups of periods, obtained when the muscle was voluntarily contracted, and, between them, the series of contractions which were called out by direct electrical stimulation of the muscle. These experiments, and others in which the muscle was stimulated by electricity every two seconds for a long time, and was seen to weary without any sign of periodic loss and recovery of power showing itself, forced me to conclude that the phenomenon did not originate in the muscle.

The nerves and nerve ends were next studied. The record of one of the experiments is given in Fig. VII, Plate I. The median and ulnar nerves were irritated by a tetanizing induction current, applied every two seconds, for about half a second, one of the moist electrodes being placed on the skin over the sternum, the other over the region of the nerves on the inside of the upper arm. The record was taken from the second finger, and the weight was one kilogramme. It was with difficulty that the most favorable point for simultaneously stimulating both nerves was found; at last, however, all the phalanges were seen to move in response to the irritation, and it was evident that all the muscles which help to flex the finger were receiving the nerve impulse.

After the muscles had contracted ten times, (see *a* on curve,) the irritation was stopped and the muscles were voluntarily contracted every two seconds, and always with all the force possible. The periodicity appeared in this case sooner than was usual, perhaps because the subject was tired, on account of the many experiments of the preceding days. After 209 contractions, about seven minutes' work, when the periods had become very decided, the effect of electrical stimulation of the nerves was again tried (see *b* on curve); the muscle contracted less than at the beginning of the experiment, but, though the irritations were given every two seconds for nearly two minutes, no periodicity manifested itself. When the voluntary contractions were begun again the periods occurred as before.

It is worthy of observation, that, in this case, as in that already referred to, of direct electrical stimulation of the muscle the first period after the electrical stimulation was stopped was longer than those which occurred just before the stimulation with electricity, which suggests that the mechanisms which are the seat of the changes which cause the periodicity, had time, while the nerves and muscles were working under the influence of the electrical irritations, to partly recover from their fatigue. That the recovery was incomplete, was shown in the rapidity with which short periods made their appearance.

During this experiment the subject had the curiosity to try the effect of continuous voluntary contractions of the muscles. He avoided looking at the curve lest he should be influenced by it. He raised the weight as high as possible and did his best to keep it at that height. He was conscious of the loss and gain of power, but was not aware, until afterwards, that his finger had written a curve which corresponded to a silhouette of the records of the intervals of loss and periods of gain of power which were recorded when the muscles were contracted every two seconds.

The effect of electrical stimulation of the muscles was tried a third time, and it was found that the muscles contracted higher than at the beginning of the experiment, (see *c* on Fig. VII, Plate I.) The writer lays but little stress on the difference in the height of the contractions obtained with the electric current in the three observations of this experiment, because it is probable that they were caused by slight changes in the position of the electrode on the arm. The important fact demonstrated by this experiment is the absence of periods from the curves obtained by stimulating the nerves by electricity, and, that too, at a time when the periodic variations during the voluntary contractions were very marked.

By chance, the third time that the voluntary contractions were begun coincided with the part of the period when a vigorous contraction was possible and one high contraction was recorded. Immediately after, however, the cause which produces the intervals asserted itself, and the contractions became smaller. The record looks as if part of a period had been cut off; (see the first contraction following series marked *c* in Fig. VII, Plate I.) This chance observation, which was repeated in another part of the experiment not given in the plate, is very important, because it shows, both by its shape and the time of its occurrence, that the changes which cause the periods continue after the voluntary action has ceased.

Although the foregoing experiments suffice to show that the periodic variations were of central rather than peripheral origin, I sought a method of experimentation which would enable me to form a clearer idea of the relative influence exerted on the height of the contractions by the fatigue of the muscles and the changes occurring in the central nervous system. At the suggestion of Professor Mosso the following form of experiment was adopted. The flexor muscles of the second finger, weighted with one kilogramme, were stimulated every two seconds. Two different forms of stimuli were employed, electrical and voluntary stimuli, and they were applied alternately. During the electrical irritation, the nerves and muscles were stimulated by a tetanizing induction current, one of the electrodes being placed over the sternum, the other over the muscle. Fig. VIII gives the results of a part of this experiment, and looks as if the records of the response of the nerves and muscles to electrical stimuli and to voluntary impulses had been superimposed.

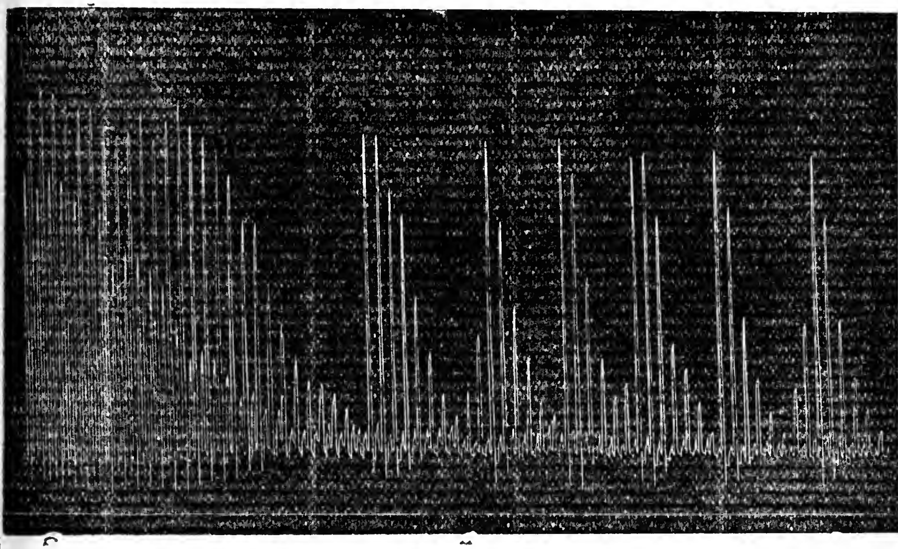


FIG. VIII.

The records of the voluntary contractions differ entirely from those written by the contractions produced by the electrical stimulation of the nerve. The voluntary contractions do not begin to decrease in size as soon, and when they commence they lessen much more rapidly. There is a moment when the response to the two forms of irritation is about the same, but the voluntary contractions soon begin to increase in height, and from this time on, the shape of the two records is as different as possible. The condition of peripheral organs, as shown by the response of the nerves and muscles to electricity, varies but slightly and irregularly, while that of the central nervous mechanisms, as shown by the extent of the voluntary contractions, undergoes marked and rhythmical alterations. The difference in the relative height of the two curves is due in part to differences in strength and effectiveness of the two forms of irritation.

These and other similar experiments convinced me that the changes producing the periodicity, do not occur in the nerves, the nerve ends, or the muscles, and that they take place in the central nervous system.

Which of the central mechanisms is the seat of these changes? The will power seemed to the subject to be unabated, and experiments showed that he was capable of contracting other muscles vigorously at the moment that he was unable to lift the weight with the finger. The result of one of these experiments is to be seen in Fig. IX, Plate I. The letter *f* marks the beginning of the voluntary contractions of the flexors of the finger, and *t* the beginning of the voluntary contraction of the extensors of the thumb. In this experiment two cords were attached to the recording apparatus; one was fastened to the second finger, the other to the thumb. The second finger was then contracted voluntarily at intervals of two seconds, each time raising a weight of 2800 grammes as high as possible. After a few minutes the periods became well developed. In one of the intervals, when the power to move the second finger was lost, the subject ceased to try to move the finger and raised the weight by voluntarily contracting the extensors of the thumb. These muscles responded well, and they were used until fatigue set in, and they in their turn demonstrated the periods. Then, at a moment when the ability to extend the thumb was lost, the work was taken up by the flexors of the finger and they were found to be capable of raising the weight nearly as high as at the beginning of the experiment.

The facts just stated prove that the loss and recovery of the ability to voluntarily contract the muscles is not dependent on changes in the strength of the will, but on alterations which take place in some of the mechanisms between the areas of the brain originating the will impulse and the centrifugal nerves. It also shows that the seat of the changes which produce the periods is different for each of the muscles, and that the change occurs in the central mechanisms which control the different muscles, independently.[1]

The successive periods, though sometimes occurring with great regularity, more frequently show many variations,

[1] Last August I made a few experiments on this subject in the Physiological Laboratory of Leipzig with Dr. Max von Frey. These experiments showed still more clearly that the will power is unabated at times when voluntary contractions are markedly decreased. The results of these experiments will be reported in full hereafter.

which prevent us from attributing them solely to a rhythmical action peculiar to the central mechanisms. See statement at bottom of page 29. In another experiment the lengths of thirteen successive periods were, in seconds, viz., 24, 28, 24, 38, 26, 28, 40, 32, 24, 20, 18, 24, 32.

In still another experiment in which the muscles were voluntarily contracted every four seconds, against a weight of 2800 grammes, the following results were obtained. The first period appeared in about fourteen minutes, and during the next forty-five minutes, forty-seven periods were recorded. The number of contractions forming a period and the number of contractions which failed to raise the weight, during the intervals of decreased power, gradually increased. These changes caused by the fatigue of the central mechanisms displayed, however, many irregularities. There were many moments when it seemed as if the periodic changes had ceased. Thus the 29th and 46th periods contained respec tively 48 and 33 contractions, instead of six or seven, the number found in many of the other periods. The following table will give a good idea of the eccentricities of the phenomenon. It states the number of contractions which occurred in each period, and the number of unsuccessful contractions during each interval. A contraction which failed to raise the weight half a millimetre was considered an unsuccessful contraction. As a matter of fact the muscle always contracted somewhat.

TABLE III.

Number of contractions in a period.	Number of unsuccessful contractions in the following interval.	Number of contractions in a period.	Number of unsuccessful contractions in the following interval.
206	0	1	1
12	0	7	1
12	0	1	2
13	0	6	0
20	0	17	0
18	0	48	4
15	1	7	1
11	2	2	1
16	1	6	2
19	0	12	3
7	3	5	1
11	4	6	1
12	3	1	1
15	0	6	5
4	4	7	1
13	2	8	7
11	1	7	3
11	7	6	3
12	7	6	6
9	2	7	4
6	4	6	5
12	?	7	0
?	?	33	3
7	2	7	1

Summary of Results and Conclusions.

I found that if I voluntarily contracted a muscle frequently, and each time raised a weight with my utmost force, the mechanisms involved in the action gradually wearied, the contractions weakened and after a time scarcely stirred the weight. If, however, I continued, regardless of the result, to strive with the whole power of my will to frequently contract the muscle, sooner or later my force began to return. The recovery, for a short time, might be almost complete. Soon, however, the power began to be lost for a second time and throughout the rest of the experiment intervals of almost entire loss of power to voluntarily contract the muscle were seen to alternate with periods of nearly complete recovery.

Not only are the variations in the strength of the contraction of the muscle wholly out of the control of the subject, but he does not even know, when he wills a contraction, whether the muscle will respond vigorously or not.

The phenomenon was observed in the case of the extensors as well as the flexors; on the muscles of both arms; with weights of 1, 2, 3 and 4 kilogrammes; and when the muscles were contracted at intervals of 1, 2 and 4 seconds.

The alternate loss and recovery of power which has been described is evidently the result of fatigue, because it is well marked only after the work has been continued for a considerable time, and it appears more quickly when the contractions are frequent, and the weight is large.

That the periodic loss and recovery of voluntary control over the muscle is not due to nutritive changes in the muscle itself, is shown by the fact that massage, though strengthening the muscle, does not do away with the periodicity. Moreover, they do not seem to be dependent on variations in the irritability of the nerves, the nerve ends, or the muscle, because at a moment when a voluntary contraction is almost impossible, the muscle responds well either to direct electrical stimulation, or to electrical stimulation of its nerve. Moreover, periodic variations of the force of the contractions are never seen in experiments in which the muscle or its nerve are frequently stimulated with electricity. Further, if a muscle be voluntarily contracted vigorously and frequently, until the periodic loss and recovery of force has become well marked, and then the voluntary contractions be replaced for a minute or two by contractions called out by electrical stimulation of the nerve, the periods immediately cease, although they return again as soon as voluntary contractions are resumed. Finally, it is worthy of note, that, in such an experiment, the periods are somewhat less frequent when the voluntary contractions are first resumed than they were just before the electricity was applied. In other words, that, while the nerve and muscle were working in response to the electric stimuli, the mechanism which was the seat of the changes causing the periodic variations of force had time to partially recover from its fatigue.

It seems almost certain, therefore, that the periodic loss and recovery of power to make vigorous voluntary muscular contractions, which was seen in the experiments that have been described, was due to changes which occurred not in the peripheral mechanisms, but in the central nervous system. The periods do not, however, seem to be due to variations in the strength of the will power, because at a moment when it is impossible to make a strong voluntary contraction of one muscle, other muscles can be contracted with the usual vigor. The alterations which cause the periodicity must therefore be considered as located in some of the central nervous mechanisms, which lie between the areas of the brain which originate the will impulse, and the centrifugal nerves.

The experiments threw but little light on the nature of these changes. As has been said they are the result of fatigue, and they do not cease to occur as soon as the voluntary contractions cease, but their influence may be recognized for some minutes, at least, after the work has been stopped. The fact that the extensor of the thumb worked well when the flexors of the finger refused to obey the will, and vice versa, shows that the changes occurred independently in the mechanisms controlling each of these muscles. Though the periods were often almost rhythmical, they displayed so many variations that one cannot attribute them solely to a functional rhythm peculiar to these mechanisms. Indeed, it is probable that they were the result of a number of conflicting influences.

In addition to the marked periodic variations which have been discussed, there were observed even at the beginning of the experiment, when none of the mechanisms were fatigued, slight variations in the strength of the contractions. These were irregularly distributed, and were probably due, in part, to the inability of the subject to give his whole attention to the work and to always make the strongest possible voluntary effort. On the other hand, it may be remarked that most processes which depend on the activity of the central nervous system are subject to similar variations, and that such irregularities may well be considered as characteristic of the action of the higher nervous mechanisms.

The results here given were obtained from experiments which were made on the writer at twenty-five different times. In the few experiments which were made upon others, the periodicity was found well developed in the case of two strong and healthy young men, but failed to appear with definiteness in the case of six others. There can be but little doubt that the phenomenon is normal. Its absence in six out of the nine men examined, may be explained, in part, by the difficulties of the experiment, but was probably chiefly the result of the functionally different nervous systems of the men examined.

Other Similar Phenomena.

That fatigue should cause the strength of voluntary muscular contractions to vary periodically is less surprising when one recalls that fatigue causes a periodicity of many processes which depend on the action of the central nervous system. If one listens to the ticking of a distant watch, the sound is heard with periodically varying distinctness. If one looks long at a white sky, darkness sweeps from time to time over the field of vision. The intensity of "after-images" is subject to rhythmical variation. If one seeks to count the waves in a curve which record the vibrations of a tuning fork, he finds that, as he wearies, his ability to continue the counting varies more or less periodically. Much the same thing is true of such mental processes as adding a long column of figures, or the following of a long continued exact line of thought. There are intervals when the mind refuses to work, and these are soon followed by periods of almost unusual clearness.

Undoubtedly these phenomena would impress us more if we did not unconsciously yield to fatigue, and did not frequently rest ourselves. Even slight intervals of rest are sufficient to prevent the amount of fatigue which is necessary to reveal the phenomenon in marked degree.

In experiments made by the writer in Leipzig,[1] 1884, he found that if a constant temperature, high enough to cause

[1] Die räumliche und zeitliche Aufeninanderfolge reflectorisch contrahirter Muskelen. Du Bois-Reymond's Archiv. 1885.

reflex movements, but not so high as to rapidly destroy the tissues, were continually applied to the skin of the leg of a decapitated frog, the resulting reflex action was not a continuous tetanus, but a series of tetani, which followed one another with considerable regularity. In the intervals between the tetani, the muscles entirely relaxed, and the succeeding tetani were of nearly the same height. This phenomenon seemed to be dependent upon almost rhythmical changes occurring within the spinal cord, and closely resembles the results obtained in the experiments described in this paper.

Still another process, which naturally suggests itself as perhaps of similar nature to that under discussion, is the "Chene-Stokes respiration."

It is not impossible that the gaining of the so-called "second wind," so well known to runners, may depend, in part, at least, upon conditions similar to those which caused the first recovery noticed in my experiments; further the variation in the amount of difficulty experienced in maintaining long continued violent muscular action, is probably caused by functional changes, the same as those which produced the succeeding periods which have been described.

We have as yet but few and for the most part unsatisfactory tests of the functional activity of the central nervous system. Every new method which enables us to approach this difficult question is, therefore, of great importance.

MINOR CONTRIBUTIONS.

STUDIES FROM THE LABORATORY OF EXPERIMENTAL PSYCHOLOGY OF THE UNIVERSITY OF WISCONSIN.

BY JOSEPH JASTROW, PH. D.

By way of introduction to the first appearance in print of this Laboratory a few words may not be out of place. The Laboratory was founded in connection with the chair of Experimental and Comparative Psychology, established in the fall of 1888, the duties of which, I at that time assumed. The object of the Laboratory is primarily to give opportunity of demonstrating the chief points in a course in psychology, and of allowing students to test for themselves the simpler results of the methods of observation and experiment, and secondly to provide facilities for advanced and original work. In the programme of an American college the former end must stand out more prominently than it would, for example, in a German university. The original work in turn must be more directly under the guidance and control of the director of the Laboratory and the themes suited to the capacities and available time of the student. These, as well as the necessarily slow growth of a somewhat novel department, form the chief,—but I hope and believe constantly decreasing difficulties in the way of giving the actual a reasonable approximation to the ideal. My policy, however, is not to bring the researches conducted in the Laboratory under any one general scheme, but allow them to be suggested by the interest of the student, by the facilities of the Laboratory, or by the fluctuations of interest in the psychological world.

Regarding the present contributions, I have only to say that they will give evidence of some of the limitations under which they were worked out, but that I thought it wise not to delay their publication in anticipation of future results, but to send them forth as they are, to excite whatever interest and encourage whatever research they may. They are directed mostly to points connected with the problems of the psychophysic law, and may, perhaps, contribute a little toward bringing a much desired unity of conception into that vexed field.

Under the appropriate heading are mentioned the names of the students who obtained the experimental results either directly with me or upon one another under my guidance. I trust to be able to continue these contributions at about yearly intervals.

On the Psychophysic Series.

The conformity of the magnitudes of the stars to the series demonstrated by the psychophysic law still remains one of the most striking applications of this law as well as an important piece of evidence in its favor. The stars were arranged in magnitudes on the basis of their naked-eye appearances, and at a time when any objective determination of their brightness was impossible. It is natural to suppose that the astronomers had in mind a sort of series in which the average stars of each magnitude should be separated by equal differences of brightness; i. e., by equal differences of sensation. When, now, we come to compare this psychic series with the physical series formed by the photometric determinations of the average stars of the several magnitudes, we find that this latter is approximately a geometric series with an average ratio of 2.5, for the first five or six magnitudes. To the arithmetical series of sensations separated by equal sensory differences there corresponds a geometric series of stimuli separated by a constant ratio; and this is the relation most closely answering to Fechner's formulation of his law. It is the most direct method of testing whether the sensations increase in arithmetic ratio as the stimuli increase in geometric ratio; i. e., whether the sensation increases with the logarithm of the stimulus. In this Journal, Vol. I, pp. 112–127, I have traced in detail the agreement of the estimations of star magnitudes with the phychophysic law, and in the present study my aim is to test whether this method can be applied to other fields of sensation, (for this, to my knowledge, has not yet been done), and with what results.

A.—Visual Extension.

My first attempt was with spacial relations of vision. A very large number of thin sticks varying arbitrarily in length from a few millimetres up to about 300 millimetres were mixed together in a random order; and the problem of the subject was to arrange these sticks according to length in a given number of classes or, to keep the comparison, of magnitudes. For this purpose I had made a frame with nine square openings, each one foot square, and with a bag hung within each compartment.[1] The whole was conveniently supported so that a person could sit with the sticks next to him

[1] The apparatus was constructed from a grant made me by the Elizabeth Thompson Science Fund, which I again gratefully acknowledge.

and sort them out according to a general impression of size. But one stick at a time was seen, and as soon as it was thrown into the bag it was lost from the subject's view. At first one's idea of the average length of each magnitude is vague, being founded only on the lengths of the extreme sticks that had been shown at the beginning of the experiment; but as one goes on his idea soon becomes clear, though puzzling cases of sticks just on the boundary between two magnitudes will always occur. When several hundred sticks had been thus assorted they were taken out and measured and the average length of the sticks in each bag computed. If the psychophysic law holds true of sensations of visual extension when thus tested, then these averages should form a geometric series with a constant ratio, just as do the photometric determinations of the average star-magnitudes. My results include the records of five persons sorting the sticks into six divisions, and of five sorting them into nine. Regarding the former, one observer declared himself dissatisfied with the result owing to the changing of the standards during the operation so that too many sticks had been thrown into the "longest" compartment. On examination this was found true and I have therefore omitted his result; the omission, however, does not effect the average result. The other four results are:

I.	Number of sticks,	79	133	89	70	56	88
	Average length,	18.5	55.6	97.7	146.8	194.7	251.1
II.	Number of sticks,	122	137	113	57	61	25
	Average length,	25.1	61.8	124.6	195.6	239.0	278.9
III.	Number of sticks,	236	65	59	59	60	37
	Average length,	45.9	106.1	147.5	184.2	231.3	273.8
IV.	Number of sticks,	200	79	103	52	51	50
	Average length,	36.8	90.1	142.3	200.7	239.9	275.2
Ar.	Number of sticks,	159	104	91	60	57	50
	Average length,	31.6	78.4	128.0	181.8	226.2	269.8

The last lines of figures represent the averages of I, II, III and IV. The following is a similar result for the sorting into nine magnitudes by five other observers, and their average:

I.	Number,	116	87	70	43	51	42	29	40	27
	Av. length,	62.8	84.5	111.7	139.5	164.5	187.8	215.5	233.5	252.2
II.	Number,	57	63	35	47	53	57	81	51	63
	Av. length,	44.5	66.6	73.5	92.0	107.4	136.2	164.9	212.8	231.8
III.	Number,	36	85	83	86	71	44	37	41	21
	Av. length,	40.3	65.4	86.6	121.6	156.6	190.3	218.2	235.0	254.8
IV.	Number,	15	27	39	67	86	116	78	69	11
	Av. length,	33.6	41.9	57.6	71.4	95.1	139.0	186.3	235.4	256.3
V.	Number,	56	80	82	63	66	58	56	27	18
	Av. length,	43.2	67.7	91.5	119.1	151.0	177.3	221.0	240.4	256.3
Ar.	Number,	56	68	62	61	65	63	56	46	28
	Av. length,	44.9	65.2	84.2	108.7	134.9	166.1	201.2	231.4	250.3

We need only compare the successive differences of the several magnitudes with their successive ratios to obtain an answer to our problem. Doing this for the average result we have:

Average difference,	46.8	49.6	53.8	44.4	43.6
Average ratio,	2.48	1.63	1.42	1.24	1.19

Average difference,	20.3	19.0	23.5	26.2	31.2	35.1	29.2	18.9
Average ratio,	1.45	1.29	1.27	1.24	1.23	1.21	1.15	1.08

In the division into six magnitudes it is quite clear that we have to deal with an *arithmetical* and not a geometrical series, or that the result is quite different from the result with star-magnitudes. In the division into nine magnitudes the difference between the two series is naturally considerably less, and so a decisive result the more improbable. The averages are considerably more irregular,[1] and the process is in every way more difficult. But if we regard the individual records as well as their average, we find that the balance of evidence tends towards making this also a coarsely approximate arithmetical series. If the series tends to a geometric one, it would be indicated by a tendency of the differences to rise with the magnitudes. Judged by this, test Numbers I, III and V, in the last table, are more or less arithmetical in their tendencies; Number II is very irregular, but can hardly be said to favor the geometric series; while Number IV does distinctly lean to the geometric. By a fortunate chance, Number IV is the only subject who appears in both experiments being the Number I of the "six division" series; and if we refer to that record, we find a very similar tendency there, though in the average it is entirely overbalanced by the "arithmetical" tendencies of the other three observers. We have thus indicated that whether or not the psychophysic law is obeyed in these experiments may be an individual matter. As a further test of this relation, I asked all of those who sorted the sticks into six magnitudes (as well as some of the others), after they had finished, to draw six lines of the lengths, equal to the average sizes of the magnitudes

[1] I shall not discuss the nature of these irregularities further than to emphasize the importance of the *number* of sticks in each magnitude upon the average length; the numbers are irregularly distributed, and it is very noticeable that so frequently when the number of sticks is very much larger, or very much smaller, than the average number, the average *length* of these sticks also deviates from the usual average. Again, the first and the last magnitudes are apt to be irregular, because all very small sticks go into the one, and all very large ones into the other, and the number of such sticks present will evidently affect these averages. When a large number of sticks is placed in the smallest magnitude, its average will be high, and the reverse is true for the highest magnitude. A similar effect is noticeable in star-magnitudes, for which see my paper as above cited.

which they had in mind when sorting the sticks. These estimations agree as well as could be expected with the results of measurements, both in the average (which I here append)

Lengths of lines:	47.5	82.5	120.0	156.7	193.5	244.7

and in the individual records, the subject with the distinct "geometric" tendencies also revealing this trait in the lines he drew. This would indicate a rather more definite and conscious representation of the several standard magnitudes than I for one should have anticipated.

To express the degree of approach of the average results in the two sets of experiments to an arithmetical series, I append these averages, together with the ideal series, to which they most closely approximate:

Real Series,	31.6	78.4	128.0	181.8	226.2	269.8
Ideal Series,	32.1	80.3	128.5	176.7	224.9	273.1

Real Series,	44.9	65.2	84.2	108.7	134.9	166.1	201.2	231.4	250.3
Ideal Series,	35.4	62.3	89.2	116.1	143.0	169.9	196.8	223.7	250.6

We can further express the average deviation of the actual from the ideal series as a percentage of the average lengths, and will find this to be 1.6% for the first set, and 3.8% for the second. These figures may be regarded as measuring the approximation of the result to an arithmetical series.

B.—Tactual-Motor Extension.

With the assistance of Lucien Mason Hanks and James Bremer Kerr.

The above mentioned experiments were made at the Psychophysical Laboratory of Johns Hopkins University, in the spring of 1888. In order to extend the application of the method, and to investigate whether the result would be the same with a less accurate sense, I decided to continue the study at my present laboratory by performing the same operation of sorting the sticks into six magnitudes, but with the difference that the sticks were not *seen* by the subject. The latter simply *felt* their lengths by moving his forefinger along them and announcing the compartments in which he wished them placed. Each was then thrown into the bag by an assistant, who also gave the subject the next stick he was to feel. The process is thus the same, except that this form of tactual-motor sensation takes the place of visual sensation. The test was made with four subjects. The range of sticks in length was a little narrower than with visual judgments (the longest stick being about 25 mm. shorter than the longest stick with visual judgments), and the number of sticks also smaller—about 360 against 500. The number of sticks and their average length for each observer, and their average is as follows :—

I.	Number,	60	69	79	50	50	53
	Average length,	35.2	71.3	112.8	158.2	189.9	235.1
II.	Number,	67	81	69	68	48	27
	Average length,	57.0	76.1	118.6	170.6	206.4	244.3
III.	Number,	55	64	69	66	50	54
	Average length,	35.1	67.5	100.6	148.6	190.6	238.6
IV.	Number,	60	35	56	57	52	97
	Average length,	37.1	63.2	85.9	117.3	162.6	224.0
Av.	Number,	60	62	68	60	50	58
	Average length,	36.1	69.5	104.5	148.7	187.4	235.5

The ideal series, to which the average of the four results approximates, is 40.55, 70.45, 110.35, 150.25, 190.15, 230.05, the average deviation of the two series expressed as a percentage of the average length being 2.6%. With regard to the individual records nothing requires special mention, except the fact that Number IV shows a tendency to follow the geometric series, especially so if we take into account the error in the average length of the lowest magnitude due to its being the lowest. In brief, the result is in every respect essentially similar to that with visual magnitudes, and all that has been said of the latter applies with equal force to the former.

The nature of the result being thus clear, I will at the present time offer nothing more than a few thoughts in explanation of the holding good of the law with star-magnitudes and its failure with extension magnitudes. The two queries that these results suggest are: With regard to what class of sensations can the psychophysic law be expected to hold good? And may the agreement with the law depend upon the method by which it is tested? Respecting the former it seems to me that the law includes such sensations as are appreciated *en masse*, and with not too distinct a consciousness of their intensity; when the sensation is a sort of impressionist reception of the gross sensation without dividing it up into units, or conceiving it as so composed, we may expect the law to hold good. This would be the case with the rough estimations of star brightnesses. On the other hand, when the impression is consciously received and definite in extent, as with spacial relations, the correspondence of the arithmetical with a geometrical series can not be expected, for if I am asked to draw a series of equally different lines, or if I am asked to sort sticks into groups, I have in mind the division of the range into *equal* groups, and I cannot help asking myself whether these groups are to be equally different *absolutely* or *relatively*. The former seems to be the simpler and more natural conception, and it is accordingly adopted, whenever the problem becomes a conscious one; that this is what the subject has in mind, is clear from the lines he draws as the equivalents of his average magnitudes. Again, the individual who follows the geometric series would be one who did not consciously state the problem to himself, but went on a general impressionist view of the matter. At present this is offered merely as a suggestion that brings harmony into the results and emphasises the important part played by consciousness in the estimation of sensations. With regard to the second question I desire only to bring it into relation with the first, by calling attention to the fact that the psychophysic law seems to hold good of this class of extensive sensations when tested by other methods, and that therefore possibly a difference in the mental attitude of the subject may decide whether the sensation will be perceived under the psychophysic law or not. Apart from the interest in the experiments as an extension of a psychophysic method to new fields, these are the points of view from which I trust the present research may be of interest.

The Perception of Space by Disparate Senses.

With the assistance of Frederick Whitton.

In a paper under this title, published in *Mind*, XI., No. 44, I offered the following as a provisional, but perhaps convenient, classification of the avenues by which we could gain knowledge of spacial relations:—

"I. By the stimulation of a definite portion of a sensitive surface:

(1) Of the retina (where the distance of the stimulating object must be inferred.)

(2) Of the skin.

(*a*) By the application of a pair of points, leaving the intermediate skin unstimulated, or

(*á*) Stimulating it by the application of a straight edge.

(*b*) By the motion of a point along the skin (see *Mind*, 40, pp. 557.)

[(*a*) and (*b*) may be contrasted as simultaneous and successive.]

"II. By the perception of distance between two movable parts of the body, *e. g.*, between thumb and forefinger.

"III. By the free motion of a limb, *e. g.*, the arm."

I then proceeded to investigate in detail the space relations furnished by a variety of I (1), of II and of III, deducing a series of relations in part to be referred to in the present study, but for a full account of which the reader must have recourse to the original memoir. In the present study a form of I (2) (*a*) was interpreted by drawing lines with the aid of the eye, in which process the eye is naturally the guiding sense.

The method of work was as follows: Two spots were marked upon the volar surface of the forearm of each arm, one near the elbow, the other near the wrist. One of a pair of points was applied either to the lower (near the wrist), or the upper (near the elbow) of these points, and the other at various arbitrarily selected distances from the former. It goes without saying that the subject was prevented from seeing the pair of points applied to the arm by the interposition of a screen. Ten observations were made in a set, keeping one of the points constant throughout. The subject appreciated the distance between the points, and drew with a pencil a line, the length of which seemed to his tactual sensation, (not to his judgment or actual knowledge of the relation,) equal to it.

Even this was a difficult task, owing to the coarse sensibility of the forearm, and the estimations were made with little confidence and much hesitation and fluctuation. Owing to this, it was allowed to have the points applied (for a moment only) as often as the subject required, and he could correct and recorrect the lines drawn, until he felt satisfied with the result. Again, the arm fatigues very easily, especially at and near the point under constant stimulation, this being mainly due to the rather strong impression of the points necessary to give a distinct sensation. The apparatus employed was the æsthesiometer I described and figured in the proceedings of the American Association for the Advancement of Science, 1887, and also partly in this JOURNAL, Vol. I, p. 552.[1] I again take the opportunity of gratefully acknowledging the grant made me by the "Elizabeth Thompson Science Fund," by aid of which this apparatus was constructed.

The smallest lengths applied were determined by the smallest distance between the two points still felt as two; the largest by the dimensions of the forearm. Four cases were distinguished, according as (1) the right or (2) the left arm was

[1] The only change made was in setting the bar bearing the points upon adjustable brackets projecting at right angles from the uprights, to enable the arm to rest more conveniently beneath it. I will not describe the apparatus further than to remark that it offered great facility in leaving the operator both hands free for work, in applying both points equally well and always in the same way, and in making the setting and recording of distances extremely easy. The only difficulty is in the disposition of the arm to give both ease of application and comfort.

used, and as (*a*) the upper or (*b*) the lower point was kept constant, the latter distinction is necessary, because the sensibility differs at the two points. This was tested as a rule both before and after each set of ten observations; it being found that the fatigue incident to the experiments diminished the sensibility. The results of these observations are embodied in the following table:

J. Jastrow.	Right Arm.		Left Arm.	
	Upper Constant.	Lower Constant.	Upper Constant.	Lower Constant.
Before	58.0	31.7	57.4	33.0
After	68.8	46.0	73.2	42.5
Average	63.4	38.9	65.3	37.8
F. Whitton.	**Right Arm.**		**Left Arm.**	
	Upper Constant.	Lower Constant.	Upper Constant.	Lower Constant.
Before	52.3	32.2	64.8	37.2
After	64.0	41.7	77.0	51.0
Average	58.2	37.0	70.9	44.1

The numbers express in millimetres the distances between two points just felt as two. It would be fairest to consider the average sensibility throughout the experiments as the mean of the sensibility before and after, and this is accordingly added in the table. The table shows: (1) That the sensibility at the lower point (near the wrist) is finer on both arms and for both observers than at the upper point (near the elbow), and on the average the points are perceived as distinct when 25 mm. nearer. (2) That the average just perceptible distance is for the upper point 64.5 mm., for the lower 39.5 mm. (3) That for Mr. Whitton the right arm is more sensitive both above and below than the left, while no such difference is apparent for myself. (4) That the effect of the fatigue increases the just perceptible difference after ten observations on the average by 12.2 mm.

As regards the chief object of the investigation, I have in the following table divided the observations into five groups, aiming to have the averages of the groups separated by about equal intervals, and have placed under each average distance between the points, as applied upon the forearm, the average length of the lines by which it was represented, and under this in turn the ratio of the two expressed as a percentage. This is done separately for Mr. Whitton and myself, and with the distinction of the four cases as already noted.

J. Jastrow.

	RIGHT ARM: UPPER POINT CONSTANT.					RIGHT ARM: LOWER POINT CONSTANT.				
	1.	2.	3.	4.	5.	1.	2.	3.	4.	5.
Real length . . .	64.0	80.0	101.2	120.0	139.5	59.4	79.0	101.7	121.9	145.0
Drawn length . .	15.0	19.7	25.2	38.1	56.4	17.6	23.0	32.7	42.9	53.8
Ratio in percentage	23.4	24.6	24.8	31.7	40.4	29.6	28.1	32.1	35.2	37.1

	LEFT ARM: UPPER POINT CONSTANT.					LEFT ARM: LOWER POINT CONSTANT.				
	1.	2.	3.	4.	5.	1.	2.	3.	4.	5.
Real length . . .	63.0	80.4	102.3	123.0	138.0	60.4	81.3	100.8	121.5	141.0
Drawn length . .	12.7	17.8	29.8	43.7	56.1	14.9	23.0	32.1	41.9	61.4
Ratio in percentage	20.2	22.1	29.1	35.5	40.6	24.7	28.3	31.8	34.5	43.6

F. Whitton.

	RIGHT ARM: UPPER POINT CONSTANT.					RIGHT ARM: LOWER POINT CONSTANT.				
	1.	2.	3.	4.	5.	1.	2.	3.	4.	5.
Real length	64.2	82.7	101.2	120.8	138.3	55.6	79.2	99.8	120.0	137.5
Drawn length . . .	42.8	51.1	70.6	79.2	87.7	39.3	58.2	74.8	82.1	98.8
Ratio in percentage	66.7	61.8	69.8	65.6	63.5	70.7	73.5	75.0	68.4	71.9

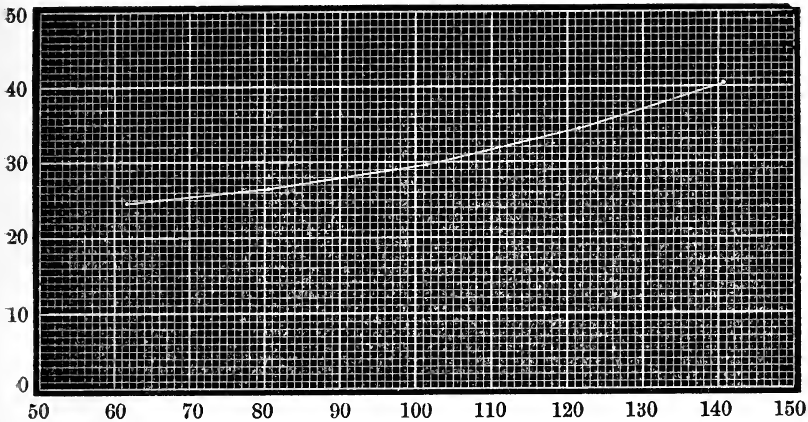
	LEFT ARM: UPPER POINT CONSTANT.					LEFT ARM: LOWER POINT CONSTANT.				
	1.	2.	3.	4.	5.	1.	2.	3.	4.	5.
Real length. . . .	65.0	82.0	102.5	121.7	141.2	57.7	80.3	100.7	117.5	129.6
Drawn length . . .	30.0	42.5	60.5	75.8	97.0	39.7	59.9	70.0	88.5	97.6
Ratio in percentage	42.2	52.0	59.0	62.3	67.2	68.8	74.6	69.6	75.3	75.3

These Tables show: (1) *That the lengths are all very much underestimated*, the lines being on the average 65.6% of the distances between the points for Mr. Whitton and but 30.9% for myself; (2) That for myself throughout *the underestimation decreases as the length increases*, though for Mr. Whitton this is true in one of the four cases only; (3) That the underestimations are less when the lower point than when the upper point is constant, on the average by 7.2 mm. for Mr. Whitton, by 3.9 mm. for myself; (4) That for myself there is no difference between the sensibility of the two arms, but for Mr. Whitton the right arm is slightly more sensitive than the left.

Postponing the further discussion of these results, I will assume that the average sensibility along the arm is that midway between the sensibility at the upper and at the lower point, and that there is no difference in sensibility between the two arms; I then take my own result as rather the more regular of the two and obtain the most typical result by combining the four cases for myself as is done in the following table:

Real length,	61.7	80.2	101.5	121.6	140.9
Drawn length,	15.1	20.9	29.9	41.7	56.9
Ratio in per cent.,	24.4	26.1	29.5	34.2	40.4

The same is expressed graphically in the accompanying curve.[1]



I shall now discuss the relation of this result to the conclusions of my former paper. Such discussion can only include the most general relations, a minute comparison being impossible owing to the difference in the number of subjects and observations. The most general conclusion of my former paper here pertinent is that "*If the eye is the expressing sense all lengths are greatly underestimated*, the error decreasing as the length increases.[2] With this general result this curve is entirely in agreement, although the decrease of the error with the increase of the length is not as marked, owing in part to the smaller range of lengths that the observations cover. Regarding the comparative accuracy of the feeling of tension between thumb and forefinger, the motor sensations of the arm and the skin sensibility of the fore-arm, accurate statement is impossible, but the indication is that the last is a less accurate source of space-perception than either of the others. My general result is thus an additional verification of the conclusions reached in my former study, and an extention of their significance. The space-perceptions of disparate senses are themselves disparate, and whatever harmony there is among them we are warranted in regarding as the result of experience. The

[1] The ordinates express the drawn lengths as percentages of the real lengths, the latter being indicated by the abscissæ.

[2] Though the method of expressing by the eye is different here from what it was in the former study (no pains being taken to restrict the movement of the eye and the hand moving over the space drawn). I do not think it likely that this difference at all seriously influenced the results owing to the supremacy of the eye in all spacial judgments.

spacial notions of one deprived of the sense of sight and reduced to the use of the other space-senses must indeed be different from our own. And the existence of the striking disparities between our visual and our other space-perceptions, without confusing us, and, indeed, without usually being noticed, can only be explained by the tendency to interpret all dimensions into their visual equivalents and unconsciously correct them by the same means. The general law to which the result contributes seems to establish a sort of co-efficient of conversion; the same amount of objective stimulation upon a delicately sensitive surface is interpreted subjectively as the equivalent of a much more extensive sensation than an equal objective stimulation upon a coarsely sensitive sense-organ. There is, as it were, an exchange of the spacial units of different senses, and because the visual units are the smallest it takes a smaller visual space to seem equal to a larger tactual or motor space.

A few points peculiar to the present research remain to be noted. The first is the peculiar fact that when the points are extended a few millimetres there is a sort of jump from the point at which no interval at all is felt (the two points being felt as one) to the perception of the entire interval. The moment we perceive an interval at all, we regard it as longer than the mere separation of two points; it is not that the zero point is at a constant height, but that the sensation changes its character. To my knowledge the theory of dermal sensibility is too little advanced to give an adequate explanation of the fact, nor have I any to offer. The fact itself seems to me important, and must be accounted for by any theory that claims general acceptance. A second point is that while the sensibility at the upper and at the lower points differs by about 25 mm. the difference in their reproductions is only about 5.5 mm. Even if we regard this difference as subject to the same underestimations as the absolute lengths it is strikingly small; but the explanation of the fact is even more difficult than of the foregoing.

On the Pressure Sense.

With the assistance of Sarah Belle Flesh and Helen Smith.

The problem set proved a much broader one than could be profitably worked out in the limited time at the disposal of the experimenters, so that only two aspects of the work can be here described, both of these relative to the methods of testing sensibility. The apparatus used for testing the pressure-sense was a modification of a Fairbanks' post-office balance, in which the initial and incremental weights were placed upon the scale-pan, thus exerting an upward pressure upon the finger situated at the end of the beam. A series of attachments were added by which the pressure could be instantly released from the finger and thus the ill effects of fatigue averted. A comfortable and firm position of the arm, hand and finger was also secured. To obtain a normal sensibility, experiments were made according to the method of right and wrong cases, the subject being requested to answer each time, and doubtful answers being excluded so that half the answers would be correct by chance. At the bidding of the subject a pressure was brought to bear upon the finger; at a second signal the pressure was increased or diminished, and at a third the original weight was restored. The subject had to decide whether the middle pressure was lighter or heavier than the extremes. The two initial weights applied were (A) 315 and (B) 105 grms., and the changes were an increase or decrease by (1) $\frac{1}{7}$ or (2) $\frac{1}{21}$ of these weights. An attempt was also made to record the confidence[1] in the correctness of one's answer on a scale in which 3 signified relative certainty, 0 no preference for one answer above its opposite, and 1 and 2 intermediate grades of feeling. After throwing out certain observations made under distracting circumstances there remain 100 observations for each observer under each of the four cases. These are given in the table, together with the theoretical ratio at which according to the formula given in my paper published in this JOURNAL (Vol. I, p. 308), one-fourth of the answers should be correct.

MISS SMITH.

Initial weight.	Ratio of increment.	Percentage of error.	Ratio at which 25 per cent. errors would occur.	Average confidence
315 grammes	$\frac{1}{7} = 1.143$	4.0	1.053	1.22
315 "	$\frac{1}{21} = 1.048$	19.0	1.037	0.60
105 "	$\frac{1}{7} = 1.143$	3.0	1.049	1.17
105 "	$\frac{1}{21} = 1.048$	20.0	1.038	0.60

MISS FLESH.

Initial weight.	Ratio of increment.	Percentage of error.	Ratio at which 25 per cent. errors would occur.	Average confidence
315 grammes	$\frac{1}{7} = 1.143$	10.0	1.073	0.78
315 "	$\frac{1}{21} = 1.048$	34.0	1.080	0.54
105 "	$\frac{1}{7} = 1.143$	12.0	1.077	1.14
105 "	$\frac{1}{21} = 1.048$	40.0	1.132	0.62

The constancy of these numbers measures the constancy of

[1] This method was used in the research by Mr. Peirce and myself on "Small Differences of Sensation," Memoirs of the National Academy, Vol. III, and also in the paper in *Mind*, No. 44.

the sensibility as well as the agreement of the results with the requirements of the psychophysic law. The law seems approximately adhered to, though with variations depending largely on the small number of observations. The average ratio at which 25 per cent. of errors should occur is for Miss Smith 1.044, for Miss Flesh 1.090, the mean of which is 1.067; and as this measures the most probable error we in a certain sense express the fineness of the pressure sense as here determined, by saying that its probable error is 1.067 or about $\frac{1}{15}$.

A second series of observations was made under the same conditions except that instead of applying and removing the additional weight while the initial weight is upon the finger, the initial weight is applied and removed; then the initial plus or minus the additional weight is applied and removed; and then the initial alone again. The question is whether we can compare more accurately the change of a sensation x with the sensation $x \pm a$ (produced by simply adding or subtracting a), or the entire sensation x with the entire sensation $x \pm a$. The result for Miss Flesh is too much affected by what must be accidental errors to be here cited, but for Miss Smith it is as follows; the result is arranged as in the preceeding:

Initial weight.	Ratio of increment.	Percentage of error.	Ratio at which 25 per cent. errors occur.	Average confidence.
315 grammes	$\frac{1}{7} = 1.143$	11.2	1.077	0.27
315 "	$\frac{1}{21} = 1.048$	30.0	1.062	0.11
105 "	$\frac{1}{7} = 1.143$	12.5	1.081	0.27
105 "	$\frac{1}{21} = 1.048$	31.6	1.068	0.00

We see that this second method is decidedly the more difficult, the average "probable error" rising, for Miss Smith, from .044 to .072. The psychophysic law is well supported, though here as before the subject appreciates differences of $\frac{1}{21}$ relatively better than differences of $\frac{1}{7}$. Regarding the causes of the increased difficulty of the second method of experimentation it may be in point to note that memory has a wider play in it than in the former method, though this is not the entire psychological difference. The result shows too, how essentially tests of sensibility are dependent upon the methods employed.

Regarding the confidence we see that it rises as the proportion of error decreases and falls as this proportion increases; what this relation is I have no means of determining, nor do I think that it is constant or anything more than a subjective but practically useful aid in judging the reliability of the results.

On Just Observable Differences.

With the assistance of Augusta Adrienne Lee.

The usual applications of the method of the Just Observable Difference aim to fix by more or less direct means the point at which two sensations are sufficiently different to have that difference consciously perceived when the attention is directed to it, and to arouse some confidence in the correctness of one's judgment of this difference. I have elsewhere[1] pointed out the uses and the abuses of this method and will here confine myself to the description of a hitherto unnoticed mode of testing the Just Observable Difference. A distinction, the importance of which is not always recognized, is that between the power to tell that two stimuli are different and the power to tell the direction of this difference. In some cases the later is always given with the former, but in others it is not. A great many persons can tell that tones are different without being able to tell which is higher and which lower. It matters much, too, whether the two stimuli are successive or simultaneous; and in the estimation of spacial relations it is important whether the two stimuli are placed side by side, so that their relations are manifest, or not. The form of the method now to be described is certainly a useful variation of it, and yet as far as I know has not been employed. It consists *in having the subject produce a stimulus just longer (more intense) or just shorter (less intense) than a given stimulus;* instead of judging differences presented to him he produces the smallest difference that he can. By this method a knowledge of the direction of the difference is made necessary.

In the first series of experiments fifty lines were drawn, their lengths varying in an arbitrary manner from about 25 to 150 mm.; and after viewing one line it was covered over, and the attempt made to draw a line just longer than the one seen. In the next series the attempt was made to draw the lines just shorter than the original lines; and in a third series (in order to eliminate a constant error, if there be any), the attempt was made to draw the lines just equal. In another set of experiments the same three processes were repeated, but the original line was kept in sight while the second was being drawn, though the two were kept at some distance apart so as not to make a fitting of the ends of the lines possible. The average number of millimetres by which a line differs from the original line under the three cases and when the original line was visible or not is given in the following table. I also give with this, the ratio of the average length of the

[1] See this Journal, Vol. I, pp. 273-277 and 299-302.

line to this just perceptible difference expressed as a percentage.

ORIGINAL LINE NOT SEEN.		
Just longer.	Just equal.	Just shorter.
2.17 mm. = 2.75 %	0.73 mm. = 0.92 % (Total error = 1.20 mm.)	2.50 mm. = 3.60 %

ORIGINAL LINE SEEN.		
2.56 mm. = 4.01 %	0.36 = 0.56 % (Total error = 2.04 mm.)	3.78 mm. = 4.97 %

The conclusions that I draw from these results are: (1) that the error when the two lines are seen is less than when not (the case when the lines are drawn equal is no exception if we count as we ought the absolute error positive and negative; these cancel one another in the latter case and so give an appearance of greater accuracy); (2) the just perceptible difference is greater in drawing the just shorter than the just longer lines; (3) the error in drawing lines equal is quite small, and its effect upon the other results not marked enough to appear in these few observations; (4) the just perceptible differences are considerably larger than those found with the more usual method. This last I would bring under the general law that our powers of execution fall short of our powers of discrimination. If the psychophysic law is true it would appear in this method in the fact that the just perceptible difference would bear a constant ratio to the length reproduced. If I divide the lines into short, medium and long lines, I get three just perceptible differences that are approximately constant ratios of the average lengths. I desire here mainly to call attention to this psychophysic method as a natural and easy method of obtaining a reliable quantitative result, and one easily comparable with the results of other methods.

CHILDREN'S LIES.

During the past few years a small number of accomplished and tact-full lady teachers, finding in even the best ethical literature little help in understanding and in dealing with certain current and more or less licensed forms of juvenile dishonesty connected with modern school-life, have undertaken, as a first step towards getting a fresh and independent view of the facts of the situation, to question and observe individual children, by a pre-determined system, as to their ideals and practises, and those of their mates in this regard. These returns now represent nearly three hundred city children of both sexes, mostly from twelve to fourteen years of age, selected, generally, by the teachers as average or representative children in this respect, and interviewed privately and in an indirect way, most carefully so designed as to avoid all indelicacy to the childish conscience. From the nature of the subject, and from the diverse degrees, not only of interest, but even of trustworthiness of the individual returns, as well from the fact that the experience and opinion of many teachers were also gathered, the results hardly admit tabular statistical presentation. A general statement of them, according to the groups into which they naturally fall, will be serviceable, it is hoped, to thoughtful parents and teachers as well as to psychologists.

I. No children were found destitute of high ideals of truthfulness. Perhaps the lowest moral development is represented by about a dozen children who regarded every deviation from the most painfully literal truth as alike heinous, with no perspective or degrees of difference between white and black fibbing and the most barefaced intended or unintended lies. This mental state, though in a few cases probably priggish and affected, became in others so neurotic that to every statement, even to yes and no, "I think" or "perhaps," was added mentally, whispered, or in two cases aloud, and nothing could prompt a positive, unqualified assertion. This condition, not unknown among adults in certain morbid states of conscience, we will designate as *pseudophobia*, and place it among the many other morbid fears that prey upon unformed or unpoised minds. One boy told of "spells" of saying over hundreds of times when alone the word "not," in the vague hope it might somehow be interpolated into the divine record of his many wrong stories, past and future, to disinfect them and neutralize his guilt. Another had a long period of fear that like Ananias and Sapphira he might some moment drop down dead for a chance and perhaps unconscious lie. As in barbaric lands a score of crimes, though perhaps recognized as of different degrees of depravity, are worthy the maximal penalty of death, so inaccuracies of statement, though distinguished from blacker falsehoods, are still lies, though unintended. This moral superstition, which seemed mostly due to mixing ethical and religious teaching in unpedagogic ways or proportions in home or Sunday school, is happily rare, generally fugitive, is not germane to the nature of childhood, and is likely to rectify itself. Where it persists it begets a quibbling, word-splitting tendency, a *logolatry*, or a casuistic habit resulting sometimes in very systematized palliatives, tricks and evasions, which may become distinctly morbid. There are few children even at the beginning of public school life who need much help in distinguishing between unintentional and premeditated wrong statements, and yet a little aid in so doing, if given with proper illustrations and tact, is almost sure to be serviceable in developing a healthful moral consciousness. Of this state we desire more records of cases with details illustrative of cause and cure, etc.

II. Strongly contrasted with this state, and far more common, is that in which lies are justified as means to noble ends. Children all admire burly boys who by false confessions take upon themselves the penalties for the sins of weaker playmates, or even girls who are conscious of being favorites with teacher or parent, or of superior powers of blandishment, and who claim to be the authors of the misdeeds of their more disfavored mates. The situations, especially the latter, were met with many times, and the act was always approved though often with some rather formal qualifications. One case, which bore traces of idealization, was described in which the quality of the heroism was of almost epic magnificence, and the sin-bearer's gracious lie seemed to have quite passed out of sight. A teacher who told her class of thirteen-year-old children the tale of the French girl in the days of the commune, who, when on her way to execution on a petty charge, met her betrothed and responded to his agonized appeals, "Sir, I do not know you," and passed on to death alone because she feared recognition might involve him in her doom, was saddened because she found it so hard to make her pupils name as a lie what was so eclipsed by heroism and love. Children have a wholesome instinct for viewing moral situations as wholes, but yet are not insensitive to that eager and sometimes tragic interest which has always for all men invested those situations in both life and in literature where duties seem to conflict. The normal child feels the heroism of the unaccountable instinct of self-sacrifice far earlier and more keenly than it can appreciate the sublimity of truth. Theoretic or imagined cases of this kind were often volunteered by the children with many variations. They declare, *e. g.*, that they would say that their mother was out when she was in, if it would save her life, giving quite a scenic setting to such a possible occurrence, adding infrequently that this would not make it *exactly* right, though it would be their duty to do it, or that they would not tell a like lie to save their own lives. A doctor, too, many suggested, might tell an over-anxious patient or dearest friend that there was hope, easing his conscience, perhaps, by reflecting that they had some though he had none. In confronting such cases, it is the conscientious parent or teacher who is most liable to get nervous and err. It is feared, that although the end is very noble and the fib or quibble very petty at first, worse lies for meaner objects may follow. The fondness and even sense of exhilaration, with which children often describe such situations, is often due to a feeling of easement from a rather tedious sense of the obligation of undiscriminating, universal and rigorously literal veracity, under which also very often lurks an effort to find the flavor of exculpation for more inexcusable lies. The teacher may by multiplying, analyzing, or even by too much attention to such cases develop a kind of morbid ethical self-consciousness and precocity. He may, as the history of education shows, make even children into casuists gravely disputing about the grand moral forces that beneath all others make the world of man their revelation or their sport. No two children and no two moral situations are alike. Here human science faces problems still too complex for formulation, where the adult has really very little to teach the child, and where conference and suggestion, and even instruction, should be restricted to specific and individual cases and not lapse into generalization. The special pedagogic utilization of these cases should generally, we believe, be the following. The child who gets really interested in what it deems the conflict of veracity with other duties, may be reverently referred to the inner light of its own conscience. This seems to be a special opportunity of nature for teaching the need of keeping a private protestant tribunal where personal moral convictions preside, and which alone enables men to adapt themselves to new ethical situations or environments.

III. With most children, as with savages, truthfulness is greatly affected by personal likes and dislikes. In many cases they could hardly be brought to see wrong in lies a parent or some kind friend had wished them to tell. Often suspected lies were long persisted in till they were asked if they would have said that to their mothers, when they at once weakened. No cases were more frequent than where, in answer to a friend's question, if some thing or act they did not particularly admire, was not very nice or pretty, they found it hard to say no, and compromised on "kind of nice," or "pretty enough," when if a strange pupil had asked they would have had no trouble with their consciences. The girls in our returns were more addicted to this class of lies than boys. Boys keep up joint or complotted lies which girls rarely do, who "tell on" others because they are "sure to be found out," or "some one else will tell," while boys can be more readily brought to confess small thefts, and are surer to own up if caught, than girls. A question of personal interest with girls is how far etiquette may stretch truth to avoid rudeness or hurting others' feelings. All children find it harder to cheat in their lessons with a teacher they like. Friendships are cemented by frank confidences and secrets and promises not to tell, as adults with real attachments desire to know and be known without reservation, without over-praise or flattery, and to rely on and perform pledges. To simulate or dissimulate to the priest, or above all, to God, was repeatedly referred to as worst of all. On the other hand, with waning attachment, promises not to tell weaken in their validity. Strange children, and especially impertinent meddlers, may be told "I do not know" when one means "none of your business" as a mental reservation. Children say they are not going to a place they intend to visit to avoid unwelcome company, and victimize an enemy by any lie or strategy they can invent. Truth for our friends and lies for our enemies is a practical, though not distinctly conscious rule widely current with children, as with uncivilized and, indeed, even with civilized races. Rural children are more liable to long and close intimacies, and are more shy and suspicious of all strangers. The sense of personal loyalty to those who are admired is so strong that it has produced, not only many kinds and systems of fagging, but inclines children to mistake what pleases their idol as good and true. If their favorites desire or even admit them to lie or cheat for their benefit, as false codes sometimes require, if extravagant vows or protestations are made that cannot be kept, or that must be kept at great moral cost, or if too many secrets are shared that need often to be guarded by prevarications, then children are being trained for corrupt combinations of any sort in adult life. On the other hand it is through the instinct of personal fealty, so strong in children that most men have grown up to a sense of fidelity to God and even of the obligation of scientific truthfulness. It has taken mankind long enough to learn the sublimity of a kind of truthfulness which is no respecter of persons. The best correction of this general tendency of children, we believe to be instruction in science, the moral needs and uses of which alone call loudly for more of it and better. But the teachers of younger children should look well to their friendships, and study, especially, the character of leaders and favorites and try to mould it as well as strive to be loved by all, not forgetting that only children with bad friends are worse off than those with none, and that they will be more faithful to great causes for having been faithful to dear and good friends.

IV. The greatest number of lies in our collections are prompted by some of the more familiar manifestations of selfishness. Every game, especially, every exciting one, has its own temptation to cheat; and long records of miscounts in tallies, moving balls in croquet, crying out "no play" or "no fair" at critical moments to divert impending defeat, false claims made to umpires, and scores of others show how unscrupulous the all-constraining passion to excel often renders even young children. In those games which attract wider attention, where sets of picked players are pitted against one another, and its prizes in local fame are great and immediate, dexterity in cheating is sometimes regarded as a legitimate qualification along with others, the only discredit being, as in the lies Spartan children were encouraged to tell, in getting found out. Lies of this kind, prompted by excitement, are so easily forgotten when the excitement is over that they rarely rankle, and are hard to get at, but they make boys unscrupulous and grasping. School life is responsible for very many, if not most of the deliberate lies of this class. Where the vicious system of self-reporting for petty offenses, like whispering, exists, children confess not showing their hands when they are guilty. If pressed to tell if they saw or did a wrong they lie, and add, perhaps, that it is very easy to lie to get out of school scrapes. Few will not give, and not many will not take prompts or peep in their books, especially if in danger of being dropped or failing of promotion. Children copy school work and monitors get others to do theirs as pay for not reporting them, while if a boy is reported he tells of as much disorder as possible on the part of others, to show that the monitor did not do his duty. As school work is now done, much of it is of a kind that can be bought and sold. One teacher in a large city stated that so much more than they could really do was now required of her pupils that she and her teacher friends were now obliged, in order that their rooms should not be unfavorably reported, to re-write the English exercises of many of their pupils, to be copied again by them before being seen by the examiners who had no time to see the work in process of doing. This could hardly have been a lesson in honesty to the pupils. The long list of headaches, nosebleeds, stomach-aches, etc., feigned to get out of or avoid going to school, of false excuses for absence and tardiness, the teacher, especially if disliked, being so often exceptionally fair game for all the arts of deception; all this seems generally prevalent. This class of lies ease children over so many hard places in life and are convenient covers for weakness and even vice. To lie easily and skilfully removes the restraint of the more or less artificial consequences attached by home and school to childish wrong-doing, and increased immunity always tempts to sin. The facility with which a whole street or school may be corrupted in this respect, often without suspicion on the part of adults, by a single bold, bad, but popular child, the immunity from detection which school offers so much more than home for even habitual lies of this class, as well as the degree of moral degradation to which they may lead, all point to selfish falsehoods — especially when their prevalence is taken into account—as on the whole the most dangerous, corrupting, and hard to correct of any of our species. Excessive emulations, penalties, opportunities, and temptations should of course be reduced, but it should be clearly seen that all these lies are at bottom, in a peculiar sense, forms of self-indulgence, and should, in the great majority of cases, be treated as such, rather than dealt with directly as lies. The bad habits they cover should be patiently sought out and corrected, for those who habitually do ill are sure to learn to lie to conceal it. The sense of meanness this slowly breeds must be met by appeals to honor, self-respect, self-control. Hard and even hated tasks, and rugged moral and mental regimen should supplement those modern methods which make education a sort of self-indulgence of natural interests.

V. Much childish play owes its charm to partial self-deception. Children imagine or make believe they are animals, making their noises and imitating their activities; that they are soldiers, and imagine panoramas of warlike events; that they are hunters in extreme peril from wild beasts; Indians, artisans, and tradesmen of many kinds; doctors, preachers, angels, ogres. They play school, court, meeting, congress. If hit with wooden daggers in the game of war they stand aside and play they are dead. If they step on a crack in walking the floor, curbing, sidewalk, etc., they call it they are poisoned. Protruding spots of earth or land in pools or ponds, or at half-tide in the bay, suggest the geography of a continent, and in one case, for years, Boston, Providence, West Indies, Gibraltar, Brooklyn Bridge were thus designated by all the children of a large school in their plays. In another, a dozen hills and valleys, rills, near by were named from fancied resemblance to the familiar mountains, rivers and valleys of the geography. The play-house sometimes is so real as to have spools for barrels of flour, pounded rotten wood for sugar, pumpkin chairs, cucumber cows, moss carpets, sticks for doors which must be kept shut, sometimes cleaned, twig brooms, pet animals for stock with pastures and yards, all the domestic industries in pantomime, toadstools, lichens and puff-balls for bric-a-brac, while some older boy and girl may play parents with secret pet names, and younger ones as children, often for a whole term and in rare instances for years; all of this of course being almost always in the country. They baptize cats, bury dolls, have puppet shows with so many pins admission, all with elaborate details. They dress up and mimic other often older people, ride on the horse cars and imagine them fine carriages, get up doll hospitals and play surgeon or Florence Nightingale. The more severe the discipline of the play-teacher and the more savage the play-mother the better the fun.

One phase of this is exquisitely illustrated in the life of Hartley Coleridge, by his brother. His many conceptions of his own ego—e. g., by the picture Hartley, shadow Hartley, echo Hartley, etc.; his fancy that a cataract of what he named jug-force would burst out in a certain field, and flow between populous banks where an ideal government, long wars and even a reformed spelling illustrated in a journal devoted to the affairs of this realm, were all developed in his imagination where they existed with great reality for years; his stories to his mother continued for weeks; his reproduction of all he had seen in London, its theater, laboratory, and what he had read of wars, geographical divisions, in a large play-ground appropriated to his use,—these all illustrate this normal tendency, but in a degree of intensity probably morbid, much resembling the pseudo-hallucinations of Kandinsky. Two sisters used to say, "let us play we are sisters," thus making the relation more real. Cagliostro found adolescent boys particularly apt for his training to subserve the exhibition of the phrenological impostures illustrating his thirty-five faculties. He lied when he confessed he had lied, said a young Sancho Panza who had believed the wild tales of another boy who later confessed their falsity. Sir James Mackintosh in youth after read ing Roman History used to fancy himself the emperor of Constantinople, and carry on the administration of the realm, hours at a time and often resumed for months. These fancies of his never amounted to conviction, but doubtless excited a faint expectation, which, had they been realized, would have lessened wonder. Charlotte Elizabeth lived largely in an imaginary realm for years in her youth.

In some games like "crazy mother," younger children are commanded, or older ones stumped or dared, to do dangerous things, like walking a picket fence or a high roof, etc., in which the spirit of play overcomes great natural timidity, and by playing school with other mates, or perhaps parents, they are helped by the play instinct to do hard examples and other hated tasks they had scarcely accomplished in actual schools. The stimulus and charm of the imagination makes them act a part different from their natural selves; some games need darkness to help out the fancy. It seems almost the rule that imaginative children are more likely to be dull in school work, and that those who excel in it are more likely to have fewer or less vivid mental images of their own. Especially with girls, it is chiefly those under ten or twelve who play most actively in our school yards, but those of thirteen or fifteen, who, under the apathy that generally affects girls of that age, walk in pairs, or small groups up and down the yard and talk, are no less imaginative. One early manifestation of the shadowy falsity to fact of the idealizing temperament is often seen in children of three or four, who suddenly assert that they saw a pig with five ears, a dog as big as a horse, or, if older, apples on a cherry tree, and other Munchausen wonders, which really means at first but little more than that they have that thought or have made that mental combination independently of experience. They come to love to tell semi-plausible stories, and perhaps when the astonishment is over to confess. Or, again, all stories of men and things they hear are given a setting in the natural scenery, or far less often, in the houses they know best, and their friends are cast in the rôles. The fancy of some children is almost visualization, and a few will tell at once, e. g., what was the color of Barbara Frietchie's dress, whether she wore glasses and a cap, just where in their father's sheep-pasture the goblin in the Arabian Nights rose out of the bottle, if pictures of these objects have not obviated the normal action of this faculty. Revery which materializes all wishes, and the mythopœic faculty which still occasionally creates a genuine myth among children, boys who amuse their mates with long and often clever yarns of their own invention, girls who make up ridiculous things about others — to all these the school has paid little attention, and Mr. Gradgrind would war upon them all as inimical to scientific veracity. We might almost say of children at least, somewhat as Froschamer argues of mental activity, and even of the universe itself, that all their life is imagination. Such exercise of their faculties children must have even in the most platonic school republic. Its control and not its elimination is what is to be sought in the high interest of truthfulness. The progressive degeneration of the school reader, and the simultaneous development of flash literature for the young, has had much to do with the growth of evil tendencies in this field. To direct and utilize, so far as it needs it, this manifestation of the play-instinct, which, though sporting with lies so gracious and innocent, may lead to so many kinds of divorce of thought from reality and of self-deception, the whole question of how best to introduce the young to the best literature of the world, each kind and grade in fit time and proportion, must, we believe, be pondered, and to this problem we shall turn elsewhere. How much of this can best be appreciated in children, and, if its peculiar quality of fancy is once lost, must remain caviare to it, only those know who have realized in their own experience and observation how youthful minds find and play about the chief beauties of ballads, of Homer properly told in English, and of the radical conceptions and great situations in the choicest English writers, if only put in proper form. Psychologically imaginative literature is a direct development from this variety of play, and into this its unfoldment is natural.

VI. A less common class of what we may call pathological lies was illustrated by about a score of cases in our returns. The love of showing off and seeming big, to attract attention or to win admiration, sometimes leads children to assume false characters, e. g., on going to a new town or school, kept up with difficulty by many false pretenses awhile, but likely to become transparent and collapse, and getting the masquer generally disliked. A few children, especially girls, are honey-combed with morbid self-consciousness and affectation, and seem to have no natural character of their own, but to be always acting a part and attracting attention. Boys prefer fooling, and humbugging by tricks or lies, sometimes of almost preternatural acuteness and cleverness. Several, e. g., combined to make, what seemed, a very complex instrument with cords and pulleys and joints, called an "electrizer." Boys not in the secret were told to press smartly on the knob and they would feel a shock, when there was only a hidden pin. This is the normal diathesis which developes girls into hysterical invalids, deceiving sometimes themselves and sometimes their relatives, most on whom faith-curers work genuine miracles, and which makes boys into charlatans and impostors of many kinds. It is hard for many to believe that certain women who fulfil their social and domestic duties creditably, can, with such placid naïveté, relate long series of occurrences which they know to be utterly false, and that men they meet are indulging a life long passion for deception, that they love the stimulus of violent ruptures with truth, or love lies for their own sake, as victims of other intoxicants love strong drink. The recent literature of both telepathy and hypnotism furnish many striking examples of this type. Accessory motives, love of applause, money, etc., are at first involved, but later what we may designate as a veritable *pseudomania* supervenes where lies for others, and even self-deception is an appetite indulged directly against every motive of prudence and interest. As man cannot be false to others if true to self, so he cannot experience the dangerous exhilaration of deceiving others without being in a measure his own victim, left to believe his own lie. Those who have failed in many legitimate endeavors learn that they can make themselves of much account in the world by adroit lying. These cases demand the most prompt and drastic treatment. If the withdrawal of attention and sympathy, and belief in the earlier manifestations, and if instruction and stern reprimand are not enough, there is still virtue in the rod, which should not be spared, and, if this fail, then the doctor should be called.

VII. Finally, children have many palliatives for lies that wound the conscience. If one says "really" or "truly," especially, if repeated, and most solemnly of all, "I wish to drop down dead this minute, if it is not so," the validity of any statement is greatly reduplicated. Only a child who is very hardened in falsehood, very fearful of consequences, or else truthful, will reiterate "it is so anyhow," even to tears in the face of evidence he cannot rebut, while others will confess or simulate a false confession as the easiest issue. Only young children who mistake for truth whatever pleases their elders, or, occasionally those too much commended for so doing, find pleasure in confessing what they never did. To say yes, and add in whisper, "in my mind," meant no, among the children of several schools at least in one large city. To put the left hand on the right shoulder also has power, many think, to reverse a lie, and even an oath may be neutralized or taken in an opposite sense by raising the left instead of the right hand. To think "I do not mean it," or to mean it in a different sense, sometimes excruciatingly different from what is currently understood was a form of mental reservation repeatedly found. If one *tries* not to hear when called, he may say he did not hear, with less guilt. An acted lie is far less frequently felt than a spoken one, so to nod is less sinful than to say yes; to point the wrong way when asked where some one is gone, is less guilty than to *say* wrongly. Pantomimed lies are, in short, for the most part, easily gotten away with. It is very common for children to deny in the strongest and most solemn way wrongs they are accused of, and when, at length, evidence is overwhelming, to explain or to think, "My hand, or foot did it, not I." This distinction is not unnatural in children whose teachers or parents so often snap or whip the particular member which has committed the offence. In short, hardly any of the sinuosities lately asserted, whether rightly or wrongly, of the earlier Jesuit confessionals, and all the elaborated pharmacopœia of placebos they are said to have used to ease consciences outraged by falsehood, seem reproduced in the spontaneous endeavors of children to mitigate the poignancy of this sense of guilt.

In fine, some forms of the habit of lying are so prevalent among young children that all illustrations of it, like the above, seem trite and commonplace. Thorough-going truthfulness comes hard and late, and school life is so full of temptation to falsehood that an honest child is its rarest, as well as its noblest, work. The chief practical point is for the teacher to distinguish the different forms of the disease and apply the remedies best for each. So far from being a simple perversity, it is so exceedingly complex, and born of such diverse and even opposite tendencies, that a course of treatment that would cure one form, would sometimes directly aggravate another. If we pass from the standpoint of Mrs. Opie to the deeper, but often misconceived one of Heinroth, and strive to realize the sense in which all sin and all disease are lies, because perversions of the intent of Nature, we shall see how habitual falsehood may end, and in what in a broad sense it begins. A robust truth-speaking is the best pedagogic preparation for active life, which holds men up to the top of their moral condition above the false beliefs, false fears, and false shames, hopes, loves we are prone to. The effort to act a part or fill a place in life for which Nature has not made us, whether it be school-bred, or instinctively fascinating to intoxication as it is for feeble, characterless, psycho-physic constitutions, is one of the chief sources of waste of moral energy in modern society, lies, acted, spoken, imagined, give that morbid self-consciousness so titileting to neurotic constitutions. The habitual gratification of all a child's wishes indirectly cultivates mendacity, for truth requires a robust and hardy self-sacrifice, which luxury makes impossible. Much society of strangers where "first impressions" are consciously made, favors it. Frequent change of environment, or of school or residence, favors it, for a feeling that "new leaves" can be easily turned arises. Frequent novelties, even of studies, probably cultivate one of its most incurable forms, viz., that state of nerves where the first impression is strong and vivid and pleasurable, while repetitions are indifferent, if not soon positively painful; a condition which, but for multiplying the already large number of mild manias, might be called *neomania*. Children should be shielded from both the professional mendacity and the false exaggeration of the abnormal of the modern newspaper, and held to long and firm responsibility for their acts and words. When men or civilization, yet capable of it, give up the lie and fall back to their best and truest selves, to be and to be accepted, from what they really are by nature and heredity, one of the highest and most intense of all pleasures is realized, which, though narrowed and conventionalized by many religious and dogmatic systems, is very manifold and may appear as general moral reformation, new intellectual insights, emotional easement and satisfaction, greater energy in action, and perhaps even greater physical betterment in certain forms of disease in certain temperaments, and, in a word, is still from the standpoint of scientific psychology, not unworthy the grand old—but greatly abused term—Regeneration.[1]

ED.

[1] Much of the material here reported owes its value to the tact and indefatigability of Miss Sara E. Wiltse one of the collectors.

A SKETCH OF THE HISTORY OF REFLEX ACTION.

I.

Introductory.

A number of the phenomena, normal and especially morbid, which we now group under the physiological category of reflex action, are noted in the earliest medical literature. The Hippokratic writers not only knew of a general consensus between different parts of the body—such as that existing between the uterus and the breasts—but in their sections on the sacred disease, or madness, it is easy to see that various forms of reflex cramps, although wrongly understood, had been often observed.

Galen even describes correctly the effect upon the aperture of the pupil, of closing and illuminating the eye, and treats of diseases and abnormal symptoms which arise from "sympathy." The history of medical studies, before the great anatomists of the sixteenth century had demonstrated the existence of nerves as distinct from sinews, records many instances of "sympathy," mediated, it was often said, by the blood-vessels. Some of these are purely fanciful, some are due to other causes, but not a few are true reflexes. It is impossible to approach our subject without asking at the outset why the simple rubric of reflexion, which now explains so much, was not suggested by the phenomena so often observed before the second quarter of our own century. The answer is not, however, far to seek. Besides the meagreness of anatomical knowledge, there was a deeper and more generic cause, suggested by the very word "sympathy." It was the belief in an immaterial psychic principle pervading the whole body and mediating freely between its parts, *without necessitating a direct connection of tissues.* This general notion which long prevented any adequate conception of reflex movements, and which, as we shall see later, is still cherished by a few uncritical scientific men, is no less universal and spontaneous than language itself, in the earliest known forms of which it is so manifoldly seen. It is nothing more nor less than spiritualism, or animism, beginning, as it naturally does, in the form of psychological dualism, at first with the suggestion of a refined essence, intangible as a shadow, separable from the body in dreams, vital as the breath, finally surviving death and endowing animals, plants, inorganic things, and even the elements of the world itself, with a distinct animating, if not a free and more or less conscious principle. The supposed subtle operations of this principle have been often characterized. It will answer our purpose here merely to recall to mind a few not unfamiliar historical *motifs*, which we wish might serve to broaden the narrow and conventional lines wrongly followed in the so-called "history of philosophy."

In the rudimentary physiology and pathology of nearly all the Greek philosophers, the *pneuma* or *psyche* plays the chief rôle. Plato, the great protagonist of all modern animistic philosophizing, conceived the soul, as, at the same time, the principle of life, and as independent of the body. It thought in the head, felt in the breast, and desired in the belly. It was closely connected with the world-soul, while over the material world the *idea* reigned supreme. Aristotle, who may be said to have given form to the mediæval Christian philosophy, and especially to its psychology, as well as to have first taught the development theory and the doctrine of the powers or faculties of the soul, recognized a nutritive soul in plants, a sensory soul in animals, and a thinking soul in man. As the principle of life, it was inseparable from the body, while the thinking *nous* was immortal. It was the sufficient cause of all the phenomena of life. Its chief seat was the heart, and it was mediated by fire, air, or ether. The Stoics, the pneumatic school of medicine, and even Galen believed the body pervaded through all its faculties by vital or intelligent forces. The cabalistic systems of emanation, which so effectually extinguished medical knowledge and art after Galen, taught that demons, once united near God, fell, and now pervade all nature, giving it harmony, "as the human body is pervaded by sympathies." Diseases, especially those of the nervous system, were ascribed to the presence of devils. The physician must not so much study magic, which was suspected, as science came to be later, but must struggle up by prayer, asceticism and extasy to gain the theurgic power of exorcism by knowledge of and living union with the omnipotent, spermatic Word of God. Meanwhile, devastating plagues and fantastic neural diseases—lycantrophy, obsession, dancing and self-scourging manias, and the children's crusade, which Hæser, in his history of epidemic diseases, well describes as a "psychic pest," were explained on this principle.

Cardanus taught that there was a sympathy between certain parts of the body and certain planets. Paracelsus, whose vagaries overthrew the authority of Galen, asserted that the soul itself had a soul, and that had another, and so on to the fifth potence or the quintessence. He taught the existence of a sidereal and an astral, as well as a material body, and assumed a conscious vegetative principle or *archæus*, which separated the good and the bad in food, fed the various organs and kept them at work, and must occasionally be roused by medicine or otherwise from forgetfulness of its duties. According to the Rosicrucians, medicine rests on a knowledge of universal harmony. Plants suffer our diseases, and all diseases have their real seat, not in the material organism, but in an animating principle. Thus the sympathy of medicines, of which they wrote, was no mere metaphor to their minds. Not only was the existence of a panacea, as the counterpart of poisons universally deadly, asserted, but it was assumed that all diseases had at bottom one occult, immaterial cause, and must also have one cure, which was to be spiritually sought, discerned and applied. Thus medicine was connected with Christology. Croll asserted that all nature was alive, and nothing was dead. Man is made after the pattern of the firmament. All that exists in the world at large—even minerals and plants—exists also in microcosmic man. Every herb represents a star and every star an herb; and the doctor who is regenerate by the light of divine grace knows the magnetic star-lent influences by which all medicines work, and the mysterious signatures in accordance with which they must be applied. Later it was said that every organ had its vital part. We even read of a vital astronomy; and all nature was animated by sympathies and antipathies. As Geulincx declared that mind and body were so distinct and opposed that they could affect each other only through a divine mediation, so Helmont taught that no medicine could take effect save through "the gracious compassion of God." Disease, it was repeatedly urged, was not merely an accident or a substance, but a struggle of the vital forces against the invasion of a morbid species or principle. Near the end of the seventeenth century, many of these conceptions were combined in the influential theory of Stahl, that the soul must be assumed as the one only immaterial and active principle in the body, the latter, as material, being absolutely passive. Every physiological process and movement whatever is the work of this rational and intelligent, although not always conscious or reflective soul. Fever, e. g., Stahl regarded as the excreting, secreting, circulatory processes of a sound soul resisting some noxious agent or activity, and as impossible in animals because they have no soul.

The influence of such conceptions has, fortunately enough for the human race, ceased for the most part to influence the theory or the legitimate practice of medicine, although they are common and potent enough among uneducated and quackish physicians. In the natural philosophy of Schelling and

Oken, the spiritualistic conception obtained a very strong hold of the popular half-cultured mind, which it still fascinates in the form of Hartmann's exposition of the Unconscious, in Hæckel's speculations about the cell-soul, etc. Here too, as we shall explain later, we believe the theories of Whytt and Pflüger, and their rehabilitation by G. H. Lewes, must eventually be classed. That chapter of it which treats of nervous functions has been longest and most dismally obscured by the same class of superstitions which science has had to oppose in some form at every step of its progress. It is plain that if corporal functions are mediated by immaterial agencies, physiological science is impossible. If, between a stimulus and the reactionary movement in the leg of a freshly decapitated frog, any sort of a sensory or volitional process is interpolated which is different from, or can in the least degree affect the train of mechanical or chemical activities in the tissues, it follows that just in that degree all inferred laws concerning the action of reflex centers can be only conjectured as far as their more broadly philosophical bearings are concerned. These spiritualistic superstitions were indeed opposed not merely to the principles and methods of science in general, but were eminently inconsistent with such fundamental schematisms as sensation and motion, feeling and will, stimulus and reaction, etc., the slow development of which by the Montpelier school and elsewhere gradually paved the way for a neuro-psychology which came to regard reflex action as the element, rudiment, type or unit of mind.

Again, it was frequently said that sympathies were mediated by the blood vessels. This seems like at least an attempt at a physiological explanation. This doctrine was, however, closely connected with early spiritualistic conceptions on the one hand, and with an erroneous conception almost universally held, in some form, for nearly a score of centuries, on the other. In the first place, in dead animals the arteries being found nearly empty were thought by the ancients to be filled from the lungs with air or ether, as their name indicates. Ether, according to the extended and influential Pythagorean school, was the highest and purest part of the air, the medium in which gods, planets and immortal souls live serenely, in eternal motion. Demokritus taught that the psychic nature was inhaled constantly from the air. The soul of man was thus called a product or part of the world-soul. Diogenes made air the first element, and said that life and thought were given in or with it. The Hippokratic school explained, further, that, after reaching the arteries, the ether passed to the brain, where it left the "bloom of its forces," increasing sensibility and mobility, and thence flowed to other parts of the body, which are vital in proportion to the nearness of their vascular relation to the brain. By a curious confusion of the two stand-points, the brain, and not the heart or diaphragm, as many supposed, was made the seat of feeling and knowledge, while at the same time it was regarded as a gland that cooled and tempered the heat of the heart by secreting phlegm which, if its passage downward and outward was checked, caused epileptic cramps, *tetanus*, *spasmus*, *cynicus*, madness, and a disease which seems to have been *tabes dorsualis*.

Hence, it was inferred that such diseases, which have played so important a part in the early history of religion, were no more holy than others, need no expiation and are cured, not by magic, but, like all diseases, by applying the counter-cause. Hence, too, the great influence ascribed to winds, weather, and the location and frontage of houses, to which so much space is devoted by this school, in a fashion so eminently sanitary and in accordance with the customs and climatology of Greece, and which can be traced in astrological vagaries that haunted therapeutics for many centuries. The "powers of the air," the rushing wind or *spiritus*, the higher pneumatic nature of man, concentric airy spheres peopled with more and more heavenly natures as the soul ascends, and many other widely current conceptions of primitive psychology, show how deeply inwrought was the notion of an airy, etherial soul pervading the whole body, no less effectually than the blood-gasses in the processes sometimes grouped together by modern physiology as "internal breathing." Plato thought taste was mediated by small blood-vessels which pass from the tongue to the heart, and hearing by the motion of the air being carried over into the blood. While the brain was spongy, moist, and the seat of cold which tended downward, the heart was the source of heat and fire which tended upward, to prevent the too lavish efflux of which the eye-lids were designed. From the notion of the sacredness of blood as a medium of the soul, came the subtleties of the pulse-feelers, who distinguished a score of fantastic kinds of pulse from which they practiced divination, as was later done with the urine of which nineteen colors were distinguished, as well as the sixty species of fevers described in the fifteenth century.

Again, sympathies were mediated not by the blood directly, but by animal spirits secreted from it in the ventricles of the brain, the systole and diastole of which caused them to circulate along the nerves through the body. One mediæval anatomist describes the optic nerve as having the form of a hollow tube, so that the visual spirits might pass, carrying the ideas from the air and idola from objects to the brain. Such conceptions, gathered almost at random, will suffice to illustrate the general psycho-physic notions which prevailed until Harvey, in the first half of the seventeenth century, demonstrated the circulation of the blood, and which for a long time prevented the acceptation of his theory. Even when he urged that in the embryo, at least, blood and not ether must circulate in the arteries, it was replied that one, as well as the other, could be derived from the mother. It was far easier, one antagonist urged, to conceive fine meshes in the walls of the heart, perhaps closed after death, through which air entered from the lungs, than to imagine the fine, invisible capillaries which Harvey assumed all over the body, connecting arteries and veins.

Toward the end of the sixteenth century, before Harvey had made his observations, the opinion began to gain ground among anatomists, that the sympathies were mediated by the nerves which were beginning to attract great attention. This was in some sense established by Willis, who was the best anatomist of the seventeenth century. Where two parts of the body were in sympathy, he inferred that they were connected by nerves instead of by blood-vessels. This opinion was current for a long time. A glance at the neurology of this period will suffice to show that, although much was done by the great observers whose names are preserved in the nomenclature of the brain, they were very far from attaining to any adequate conception of the functions of a nervous center, or even of nervous fibres. But a few decades before Willis wrote, one observer had urged with great vigor the Aristotelian theory that the nerves took their rise from the heart, because the soul, being one, could have but one seat and that must be the heart, which was the first point of motion in the impregnated egg, and was immediately affected by every emotion.

The arteries, which conducted nervous energy from the heart to the brain, had a nervous envelope, and after their cavities had united in the brain, their walls divided as nervous threads. Although the animal spirits were secreted from the blood of the *choroid plexi*, Servetus said the proper seat of the soul was the aqueduct of Sylvius. The first and second ventricles, he explained, received images from the external world; the third was the seat of thought, and the fourth of memory. The cortex and convolutions of the brain were neglected, the base and centre attracting chief attention, in spite of the old notion that the outer membrane enclosing it, in which it was long thought the cerebral nerves in part took their origin, was essential to psychic processes. When Fallopio urged that only the optic nerve was enclosed by a membrane of the dura mater, it was for a time thought that this was a peculiarity of sensory as distinct from motor nerves. Long, and sometimes bitter, was the controversy, whether the optic nerve was really hollow, that the visual spirits might reach the eye; whether the brain had more veins than arteries; whether it was a gland and the glands nervous; whether nerves contracted and relaxed; whether the cerebellum had nerves of its own; and at what point the soul was most probably located. The *corpora striata*, according to Willis, was the seat of sensation, while the activity of the soul was chiefly concentrated in the *corpus collosum*, on the surface of which ideas were mirrored as on a white wall. A whitish nervous sap is the vehicle of the animal spirits. Others, influenced by Newton's discoveries, argued for a solidary structure of the nerves, and the theory of nerve-vibration, analogous to the undulations of ether, was generally adopted by English physiologists. On the one hand, it was urged that the vessels about the circle of Willis were the centre of sensation, and the *dura mater* was that of motion; while in Italy it was thought that the latter enclosed four ventricles like the heart, and was the centre from which nerves proceeded, like the blood-vessels from the heart; and finally, that it was loose enough to beat like the heart, as its analogous fibrous structure indicated. Thus all the movements in the body which were effected by nerves were ultimately caused by the force imparted to them from the *dura mater*, the movement of which aided the circulation in the brain, secreted the nerve juice and diffused it throughout the nervous system, and the extreme sensitiveness of which indicated that it was the seat of all sensation. It was reserved for Haller to demonstrate that the *dura mater* was immovable, insensitive, and was not the origin of nerves. Thus sympathy or consent, although rightly located in the nervous system, was not much nearer a correct explanation than when it was thought to be mediated spiritually, or through the blood-vessels.

A fourth theory, more important for our theme, took its origin in the epoch-making discovery of the father of German physiology, Haller, which properly dated with his communication to the Göttengen Academy, in 1752. He had tested a great number of tissues and organs, and found that the irritation of some caused sensation, and that of others caused movement or contraction. Only those parts which contained muscular fibres could contract, while nerves were not irritable because they could not move. He found that muscles were irritable some time after they were separated from the body, and compared the contraction of the fibers of the heart caused by the blood, with that of the voluntary muscles, caused by the will. Irritability he found constantly present in the muscles while nervous force worked through the will, the result being the same in both cases. Hitherto every force tolerated in the animal body had been either closely analogous with known chemical or mechanical forces, or else had been regarded as more or less spiritual. Haller analyzed the hitherto inexplicable functions of motion, and found an elementary power inherent in muscular fibres, which was always present and aroused by irritation, and which had no parallel in inorganic nature. Haller was moderate and rational, and regarded irritability only as a power peculiar to and inherent in muscular fibres. The long discussion of his discovery that followed, and which for a time eclipsed nearly every other question in medical science, equals, if it does not exceed, in vagaries the philosophical speculation consciously and unconsciously suggested or fashioned upon the demonstration of magnetism and electric polarity. Whytt declared that all parts of the animal body were sensitive, whether containing nerves or not; and that the so-called irritability was a psychic activity. Some feared a rehabilitation of occult qualities in the doctrine of irritability. Some thought that all muscular action depended on nervous fluid or the *vis nervosa*. One writer said that only nerves could excite the vital molecular activity of contraction, and not a few argued that diseases were caused by means of medicines working upon irritability. Irritation and stimulus henceforth became dominant conceptions in pathology.

Gaub distinguished the soul, to which he ascribed not only the instincts but even respiration and vital force, and defined the latter as the power by which living matter contracted under the influence of irritation. Living matter is matter that can contract and feel, and an irritation he explains as that which, by contact, excites vital force to action. In his Pathology, however, he uses the word irritability in quite a different sense, as increased activity of the vital force, and as such, opposed to torpor. Vital force, he argued, was something unique and not to be sought in the elements of organisms, for these could still subsist when it was gone. It was not even to be confused with the electric or nervous fluids, which two latter some identified. Barthey added to irritability in muscles a "dilatation-force," and regarded their rest as active. Gregory thought irritability was to be distinguished from nervous force only by its seat, and, besides a dead elastic force in muscular fibre, described a third "tonic force," which resisted their relaxation. Schäfer regarded sensibility as independent of its material basis and essentially identical with vital force, while irritability depended upon it. Some located irritability in the solid, others in fluid parts of the body. Many said everything which can react is irritable, thus extending the notion to the whole body; while scores of speculations for which we have no space and the reader would have no patience, were freely indulged in.

Haller's conception of irritability rested upon the phenomena observed in the heart, which he supposed to be without nerves. This error was natural enough when we consider that the nerves of the heart are so small that only the most accomplished microscopists can trace them. Only one observer seems rightly to have understood, and to have effectively contributed to the development of Haller's conception of irritability. Fontana, in his classical experiments, published in 1775, demonstrated the difference between irritability and elasticity (which continued its oscilations after the cause was removed) on the one hand, and the *vis nervosa* on the other. He showed that every stimulus diminished, while rest increased, irritability. He agreed with Haller that the nervous agent was the exciting, but not the immediate and sufficient cause; that in most cases it acted as the external excitor of the irritability of the muscular fibre. By the discoveries of Galvani, near the beginning of the present century, attention was called to the phenomena of nerves acting under electrical stimulation, and the important question whether muscles were irritable without the mediation of nervous fibres, was demonstrated after the effect of *curara*, which destroys the action of nerves upon muscles was discovered, independently and about the same time, by Kölliker and Claude Bernard. This we may regard as a triumphant vindication of Haller, whose work resulted in exorcising from muscles—the last excited element in the "reflex arc"—the mystic notions of vital force, and in opening up the broad and fruitful field of myology to scientific methods.

Although Haller had found that certain parts, such as the pleura, the bronchi, etc., responded to stimulation neither by sensation nor motion, another important result of his experiments was to cause functions and parts to fall into two great categories, one sensory and the other motor. This important dichotomy, which still underlies most conceptions of reflex action, also began at once to play an exceedingly conspicuous part in medical and philosophical theories. The notion of vital force was, in fact, as some complained, divided into two principles. Sensibility was paralleled or contrasted with irritability at every point. The mystics and followers of Stahl substituted motility, or perhaps, like Borden, voluntary motion, as the second term of the two elementary physiological phenomena. Many translated irritability in the freest and loosest way, as the power of reacting upon outer impressions of all sorts. Even subjective phenomena, such as pain, reflexion, etc., were characterized as higher manifestations of irritability. In the system of John Brown, which became so influential on the continent, excitability was said to be located in nerve and muscle substance, and was defined as the property of being called into self-activity by the action of external stimuli; and was made the specific, though otherwise unknown, characteristic of living matter. The latter tends at every point and movement to fall into its simpler elements, but is forced to continue the processes which constitute vitality by external activities ever incident upon it in all directions. Too much of the latter causes hypersthenic; too little, the asthenic diseases. Life is thus reaction, and all its processes are made up of stimuli, excitability and excitement.

The only physiological fact upon which this class of speculations rested was the observation that the stimulation of certain nerves seemed to cause only sensation, and that of others only motion.

The discovery of the Voltaic pile, with its negative and positive pole, was immediately seized upon with the greatest avidity, and became the fundamental category, now in more now in less disguised or conscious form, for a mass of medical and philosophical speculation. Life, it was said, was analogous to, if not identical with electricity, and the intellectual world seemed to fall apart into the quaint electric dualisms of active and passive, male and female, day and night, thought and feeling, acid and alkali, etc., etc. Many preferred to regard the universe as made up of triads. Oxygen, hydrogen, and carbon were often suggested, but under the influence of Blumenbach, and especially of Schelling, the triad, reproduction, irritability, sensibility, as ascending potencies of the absolute, revealed successively in the ascending orders of animal life, gradually unfolded into speculative forms which Humboldt well designated as the saturnalia of natural science. Hegel is preëminently indebted to Volta for his unique dialectic method of affirmation or position, negation, and mediation or indifference-point. Meanwhile, medical art and science gradually decayed in Germany until, in 1830–40, they were, by general consent, in worse condition here than in any enlightened country in Europe, while animal magnetism, cranioscopy, and homœopathic vagaries sprung up, grew rank and struck deep root in soil in which, if anywhere, only minute and painstaking investigations of the physical conditions of health and disease should be cultivated. Only for the fundamental dichotomy of sensation and motion was solid physiological ground won later by the great discovery of Charles Bell, that the posterior spinal nerves were sensory, and the anterior nerves motor.

It will help us to understand another element of the greatest importance for our theme to go back to the seventeenth century and to remember that, as Plato is the philosophic father of most spiritualistic tones of thought, so Des Cartes may be said, in general terms, to have introduced into the modern world that form of dualism which has superseded Platonism, and proposed the fundamental problem with which philosophy has been so largely occupied ever since, viz., the mediation between mind and matter, soul and body, thought and being. We will not here pause to trace out the repressing effect which the metaphysical theories which centre about the theory of knowledge have had upon legitimate psychological studies. It is important, however, not to forget that Des Cartes was led chiefly by the exigencies of his system—according to which mind as thought could have nothing in common with matter as extension, and must, therefore, be brought into a forced union with it—and partly by his physico-mathematical tastes and studies to describe the body as a machine, and that this characterization had great influence upon minds of an empirical order. Great and preponderating as were the powers he assigned to the soul, the limitation of its seat to a single part, and the relegation to it of only those activities within the body not strictly mechanical, was a step of great importance. Besides this, Des Cartes' whole habit of mind, his inability to think, save with visual and mathematical concepts, his physical conception of physiology and the form and nature of particles were, no doubt, of much direct and indirect influence in forming the mechanical, or so-called iatro-mathematical school of medicine. A more direct stimulus to this school was given by the brilliant demonstrations of Galileo, while Harvey, Bacon, the revival of fine arts in Italy, and the unfruitfulness of chemical-humoral conceptions expressed and strengthened the tendency it represents.

The modern mechanical school of physiology was founded by Borelli, whose chief work on The Motion of Animals appeared in 1670. The bones he described as levers, and the swelling of muscles by the nervous fluid propelled into them from the brain was the motive power. He estimated how much force is lost by the unfavorable purchase of muscles, and compared the force used by different muscles. He first demonstrated that the act of breathing was a process in which the lungs are purely passive, and analyzed composite motions with a thoroughness unsurpassed till Weber. The movement of the blood he referred to static and hydraulic principles, tried to estimate the force of the heart's movements, and knew that it was greatest in the lateral walls, while the apex was comparatively motionless. Even digestion, he inferred from

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the stomach of birds, consisted largely of detrition, while he calculated in pounds the powers of the walls of the stomach. Secretion he considered as a process of sifting depending on the different diameter of small vessels. Borelli's pupils, like their master, restricted themselves to the most familiar natural forces and mechanical principles, in their attempts to explain organic processes. Hoffman, who also studied mathematics as a preparation for medicine, in establishing this school in Germany, added to the ordinary material elements the hypothetical ether which Huyghens had just introduced. Besides permeating the blood, ether has its own peculiar circulation through the nerves. This fluid moves and is governed by the central *anima*, strictly in accordance with higher mechanical laws, which are, however, not yet well understood. Hoffman's speculations concerning the animal ether, which he expressly identified with the sensory soul, gave his system a dynamic cast inherited directly from Leibnitz, whom he admiringly studied, and this tended greatly to obscure the mechanical principles, upon which he always insisted, and to give his teachings, which have had great influence in Germany, some points of analogy with those of Stahl, his famous adversary. As the nervous system became known and gradually assumed a supreme position among the tissues, many mechanical conceptions of the processes which underlie its functions were expressed in place of the old idea that nerves contracted and lengthened in occasioning motion. They were sometimes said to vibrate like the strings of a harp; or the molecules within them were thought to oscillate; or their subtle fluids to mingle with others by diffusion. Irritability, one writer explained, was a modification of general attraction; and others thought nutrition and excretion were due to attraction and repulsion.

Part of the energy of the mechanical school went to seed in the shallow writers of the *erclairissement;* some of it can be traced in monographic works on light and vision, etc., while among many wiser observers the conviction gained ground that chemistry and mechanical science were not yet sufficiently developed to explain the more recondite processes of organic life, and they naturally turned, therefore, to the purer and broader forms of theoretical empiricism represented by Bacon and Locke, and to the development of the practical side of their respective professions. During the present century, however, mechanical methods have attained a remarkable development in the German experimental school of physiology which has recreated the art and science of medicine in that country, equipping it with manifold thermal, electric, hydrostatic, surgical and other apparatus and methods, and enriching the world with the multitude of facts grouped under the names neuro and psycho-physics, physiological optics and acoustics, myology and physiological chemistry. Very prominent among the important physiological conceptions of this century is Marshall Hall's theory of reflex action, which first introduced a mechanical principle to explain the functions of the nervous centers of the spinal cord. The discussion of this most important conception we must reserve for a later chapter.

Here, however, belongs a brief reference to one of the most interesting of all attempts to interpret physiological processes by the aid of physical principles. The phenomena of animal electricity were first studied in a part of the reflex apparatus of a frog. If they have not explained all that was once hoped, it was these studies which first introduced exact methods into the investigation of the functions of the nervous system. With the collapse of mesmerism in the French revolution the many speculations which had been rife concerning the relation between the magnetic and vital phenomena were quickly forgotten until in 1791, a new direction was given to physiological physics by Galvani's conception that the animal body, pre-eminently the nerves, was the seat of a peculiar and independent sort of electricity, probably secreted chiefly in the brain. He believed the inner substance of the nerves to consist of a very subtle and fluid lymph peculiarly adapted to conduct electricity, and which was inclosed in a non-conducting substance. This electricity was stored up in the muscles as in Kleist, or Leiden jars, to which the nerves were the conducting wires. The outer surface of the muscles was negative, their inner surface, where the electricity accumulated, was positive. Motion was caused when this fluid was drawn from the interior to the exterior of the muscles along the nerves so that the cause of every contraction is like the discharge of a Leiden jar, the negative surface fibres of the muscles being peculiarly irritable. Although this theory was not strictly in accordance with the facts he had observed, the greatest popular interest was again aroused. "Wherever there were frogs," says Du Bois-Reymond, "and wherever two scraps of heterogeneous metal could be found, every one sought to see for himself the miraculous re-animation of mutilated limbs. Physiologists believed their ancient idea of a vital force had become tangible, and physicians, influenced by Galvani's too facile attempts to explain all sorts of nervous diseases,— sciatica, tetanus and epilepsy,— thought no cure hence forth impossible." Volta, who was already an experienced electrician, easily demonstrated that the electricity which Galvani had at first observed came from metals and not from the animal. The former had the best of the controversy until Galvani found that when the sciatic nerve was brought into contact with the muscle a contraction occurred without metals. Volta still insisted that the current was not pre-existent in the animal, but was developed by the contact of different fluids in the tissues. After repeating the experiments of Volta and Galvani with many variations, Humboldt came to side with the former, and although his observations fill two volumes, they add little that is new in fact or valuable in theory.[1] In 1799, the year after Galvani's death, Volta discovered the pile which bears his name. His erroneous contact theory, (that whenever two heterogeneous substances are brought into contact one of them assumes a positive and the other a negative electrical condition), absorbed scientific interest, and galvanism was forgotten. The frog-pile was discovered, and many attempts were made to explain animal electricity by physical hypothesis.

At last, after applying Ampère's astatic double needle to Schweiger's multiplicator, which gave a far more delicate test for detecting the presence of electricity than had hitherto been known, Nobili, in 1826, demonstrated the frog-current which Galvani lacked the physical apparatus to do. The muscle and nerve, or the head and feet of a frog, each immersed in a tiny cup containing salt solution, into which the wires of the multiplier were introduced, caused a permanent deviation of the needle, demonstrating a constant current from the muscles to the nerves, and from the head to the feet of the frog. This current he believed to be of thermo-electric origin, flowing from the warmer to the colder part.

The subject was taken up and advanced by Matteucci (to whom Du Bois-Reymond, in the historical sketch just referred to, does much injustice), by Valentin and Reymond himself. The electrical properties and processes in nerves and muscles, at rest and in action, has now become one of the most complicated of physiological problems, while the pre-existence of the current in the natural condition of the tissues, which Reymond advocates, and his hypothesis of polar molecules arranged longitudinally through nerve and muscle fibers like a series of magnets to explain the phenomena of electrotonus and the development of the electrical current, are rendered very questionable by the experiments of Hermann and Englemann. In 1850, ten years after the publication of Reymond's investigations, the time of the transmission of irritation along nervous fibers was first measured, and found to be so great that all thoughts of identity or parallelism of electricity and the nervous energy efficient in sensation and motion—a con-

[1] Versuche über gereizte Muskel- und Nervefasern. Berlin, 1797.

ception which had considerable influence in inspiring and directing investigations up to that point—had to be abandoned. The wave of negative variation of the neural current, which moves only about 28 metres per second, is now considered as merely the accompanying sign or exponent—and the only one we have—of a series of processes which constitute every nervous impulse, the ulterior nature of which is as yet inscrutable. Even the nature of the processes of muscular contraction which, besides the far slower negative wave, is attended by thermal, chemical and dioptric, as well as molar changes, is as yet only conjectural.

The application of electrical stimuli to animal tissues has proved the most fruitful of all physiological methods, and it seems at first strange that its use in reflex studies should have been so very recent, and scarcely less so, that, during the earlier investigations of galvanism, the phenomena of reflex action should have attracted so little attention, although it is evident from causual reference that it was often observed. The reasons it is hoped will become apparent as we proceed. Meanwhile we may observe that it is the exact mechanico-empirical method that has accomplished everything, almost without exception, that has been done in the field of physiology. Just so far as experimenters have added explanations and theories to their demonstrations, their work has crumbled and been forgotten, while just so far as they directed and confined their labors to the pure and clear presentation of typical facts and their conditions, in such a way that others could readily find and reproduce them at will, their contributions have been useful and permanent.

A new physical method is the most important contribution that can be made to science, and through it to the sum of human knowledge and happiness. This is no less true of neurological than of other studies. Diseases have been classified in genera and species like plants, according to the medicines which it was thought were salutary, according to the most elaborate schedules of subjective "symptomatic" feelings, according to the organs they affected, according to *apriori* philosophical schemes, but a true natural basis of classification was reached only when the forms of cell-change or decay peculiar to each was known. In a scarcely less rude and uncritical way psychic faculties and processes have long been classified, and if the latter are ever to be soundly based on the varieties of structure and process in the nervous elements or substrata, while we shall then feel surer of our knowledge of them and have a method of study which may reveal much now undreamed of, only those most deeply versed in mechanical aspects of things and in the capability of physical methods, can understand how unaffected they must forever leave all the ideal *goods* which those who comprehend them least profoundly so often think imperiled.

The rapidity with which nervous processes traversed the nerves was thought by the physiologists of the last century to be analogous to that of light or else of lightning. Some said it was as much more rapid than the blood as the nerve fibers were smaller than the aorta, and some argued that it must be absolutely independent of time. Haller falsely assumed that between every two contractions the way between muscles and the brain must be passed and repassed, and estimated this rapidity at 9000 feet per minute. As late as 1844, Johannes Müller wrote "we shall never have the means of measuring the rapidity of nervous processes, because we can never compare immense distances from which the rapidity of a process in the nerves, in this respect analogous to that of light, can be computed;" and again, "the time in which a sensation-process from the periphery to the brain and cord, and the reaction upon the peripheral parts by contraction follows, is infinitely small and immeasurable." One of the earliest achievements of Helmholtz, however, was in measuring these rapidities. Although his apparatus, compared with that now in use, was very imperfect, his result—that irritations are propagated along motor nerve fibers at the rate of 27.75 metres per second—was tolerably accurate. Most of his experiments were made by stimulating the sciatic nerve of a frog at points alternately near and far from its entrance into a muscle, which recorded upon a swiftly revolving drum the movement when the resulting contraction began. The effect of this discovery upon the conception of the nature of nervous action in general was great. Helmholtz wrote "as long as physiologists thought themselves compelled to refer nervous processes to the diffusion of an imponderable or psychic principle, it might seem incredible that the rapidity of the current within the short distances of the animal body should be measurable. Now we know from the investigations of Du Bois-Reymond on the electromotive properties of nerves, that that activity which mediates the propagation of an irritation is at least very closely connected with a changed arrangement of their material molecules, in fact is perhaps essentially conditioned by it. According to this the conducting of impulses in nerves would fall into the class of self-propagating molecular processes of ponderable bodies, such as, e. g., the transition of sound through the air and elastic substance, or the gradual burning of a fuze." ED.

PSYCHOLOGICAL LITERATURE.

I.—NERVOUS SYSTEM.

Ueber Faserschwund in der Kleinhirnrinde. ADOLPH MEYER. Archiv f. Psych. u. Nervenkrankheiten. Bd. XXI, H. 1; mit 1. Taf.

The network of fibers in the granular layer of the cerebellar cortex was the portion examined by the author. The loss of fibers here was found to take place to a varying extent, and for convenience he distinguishes those cases in which it is slight, medium, and excessive; specimens were stained with Weigert's Hæmatoxylin. He then cites fifteen cases which he has himself examined. Dividing these according to the degree of degeneration of the cerebellar fibers into three groups, they form: Group I, Case 1. General progressive paralysis; in which degeneration was slight.— Group II, Cases 2–6 inclusive. Three of these were general progressive paralysis, one melancholia with stupor, one chronic paranoia. Degeneration medium.— Group III, Cases 7–14 inclusive. Seven of these were general progressive paralysis, one dementia senilis. Degeneration excessive.

The 15th case (idiocy) falls outside of any of these groups, being most probably a case of arrested development. The prominent characteristic in these cases was dementia. There was always a loss of fibers in the cerebral cortex—and the loss in the cerebella cortex appeared to follow on that in the cerebrum, and to be a slow process. The cause is entirely obscure, but the course of the fibers involved is taken to be through the middle peduncle of the cerebellum to the pons, and so to the cerebrum. The author looks forward to pursuing the investigation more in detail.

(The apparently close relation thus developed between the cerebral and cerebellar cortex, and association of degeneration of the fibers with dementia in this general way, are both facts of great value.—REV.)

Recherches sur la localization des conducteurs des impressions sensitives dans les diverses parties de l'encéphale et sur la pathogenie de anesthesies de cause encéphalique. M. BROWN-SEQUARD. Archives de physiologie, etc., No. 3, Juillet, 1889.

The author opens with the following propositions:

1. Each half of the brain is able to perceive sensory impressions arising in the two halves of the body. 2. The sensory elements are so distributed in the brain that sensation remains even when a large portion of the two halves of the brain has been destroyed. 3. The transmission of sensations still occurs even when the cord has been completely severed by two hemisections at different levels and on opposite sides, provided they are sufficiently distant from one another. 4. If we attribute the anaesthesia following organic lesions of the brain or cord to loss of function in the part injured, we are compelled to admit absurdities. . . . . As a matter of fact clinical experience shows that anaesthesia may or may not appear whatever the location of the organic lesion. 5. Anaesthesia, due to brain lesions, may occur on either or both sides when the lesion is single, or on one side when the brain lesion is double, or may disappear while the brain lesion at the same time becomes more extensive. 6. In the case of partial organic brain lesion the anaesthesia is therefore not due to the loss of function in the

nervous elements destroyed, but to an action of the lesion on the nervous matter about it causing inhibition of the sensory apparatus. This is a dynamic process, hence subject to great variation, thus giving rise, under different conditions, to very various results.

As evidence for the above from the experimental side, he presents the results obtained from dogs in which lesion of the internal capsule, lateral portion of the base of the brain, or superior part of the cervical cord was followed by hyperaesthesia of the corresponding, anaesthesia of the opposite side. If, now, a hemisection of the cord be made on the side opposite to the initial lesion (at the level of the last dorsal or first lumbar vertebra) the anaesthesia and hyperaesthesia change places. In these experiments anaesthesia is most complete after section of the internal capsule, and diminishes according to the parts operated, in the following order: pons and lumbar cord; cerebral peduncle and cervical cord; medulla. Passing to the clinical data he divides his material (1) into cases with direct anaesthesia and (2) those with both direct and crossed anaesthesia, due to a lesion of one side only. For (1) he gives 59 cases, and for (2) some references to the literature of the subject. He adds that several investigators have found that anaesthesia of cerebral origin disappears on faradization of the skin.

The clinical evidence presented for this view is certainly open to the objection of not being critically collated. Supposing the experimental facts to be correct, the mere statement that the phenomenon is one of inhibition amounts simply to the statement that something does not occur, and as it stands is no explanation at all.

Der Hund ohne Grosshirn. Prof. GOLTZ. XIV Wanderversammlung südwestdeutscher Neurologen und Irrenärzte, Mai, 1889. Original Bericht von Dr. L. Laquer.

Goltz communicated his observations on a dog which had lived 51 days after the removal of his fore-brain. The fore-brain on both sides was removed together with corpora striata, leaving only a small remnant about the brain-axis between the optic tracts. The thalami were of course secondarily involved. The remaining portions of the stem were soft and but poorly sculptured. The important point was that the dog lived so long a time after such an injury, and could, moreover, stand, walk and rise on his hind legs. He could not eat or drink alone but could chew food put well back in his mouth. Waking and sleeping alternated with him as with a normal animal. When hungry he was restless, when satisfied he slept. He could be waked by touching him at any point of the skin. He then opened his eyes, previously closed, and stretched like a normal animal on waking. If the limbs were put in an uncomfortable position he moved back to the normal. As occasion demanded he could whine, growl, bark and howl. Evacuating faeces or urine he took the positions of a normal dog. To sound he did not react. The senses of smell and sight were wanting because the nerves were sectioned.

Ueber das Rindencentrum für die Stimmbildung. ROSSBACH. Jahressitzung des Vereins der deutschen Irrenärzte. Jena, Juni, 1889. Abstracts of communications in Neurolog. Centralbl., No. 13, 1889, by Bruns.

The patient had symptoms of compression in the caudal cervical region, which at autopsy were found as due to a tumor. Further there was on the left side paralysis of the facial, atrophy of the tongue and paralysis of the vocal cord, of ten years standing. The autopsy showed a so-called *encephalitis subcorticalis* of the right inferior parietal lobe, of the posterior central convolution, where it helps to form the operculum, and of the posterior convolution of the island of Reil. In the medulla the nucleus of the hypoglossus was alone atrophied, whereas the nuclei of the facialis, vagus and accessorius with their nerves, also the recurrent and the muscles of the larynx and vocal cords were all intact. The paralysis of the vocal cord and of the facialis on the left is therefore connected with the cortical lesion in the right hemisphere, and that of the vocal cord is associated with the defect in the island of Reil or neighboring portion of the parietal lobe.

Ricerche anatomo-comparative sulla distribuzione delle arterie nella superficie encephalica di alcuni mammiferi. R. STADERINI. Atti della R. Accademia dei Fisiocritici, Siena, Serie IV., Vol. 2; 1889.

For the determination of the superficial distribution of the cerebral arteries, the sheep, horse, dog, cat, rabbit, monkey and man were examined. In man and the monkeys the anterior cerebral artery supplies the two olfactory convolutions, the median portion of the orbital convolution, the entire mesial surface of the hemisphere cephalad of the medial portion of the parieto-occipital fissure, together with the superior frontal and half of the middle frontal convolutions and all of the superior parietal convolution. The middle cerebral artery supplies the remainder of the convexity of the hemisphere including the outer face and extremity of the temporal lobe, as well as the island of Reil. It may further send a branch to the middle portion of the occipital lobe. The posterior cerebral artery supplies the entire surface of the temporo-occipital lobe and the medial and lateral faces of the occipital lobe. In the other animals examined the anterior cerebral supplies the greater part of the olfactory lobe, (except in the case of the horse, in which the cephalic third of the olfactory lobe and a part of the frontal lobe are supplied by a cerebral branch of the opthalmic artery), the portion of the brain to which the cephalic extremity of this lobe is applied, the mesial face of the hemisphere, (except a small portion at the caudal extremity,) and the part corresponding to the sagittal convolution. The middle cerebral artery supplies the lateral and ventral faces of the hippocampal lobe and the entire lateral face of the hemisphere, with the exception of the sagittal convolution and the extreme caudal portion of the hemisphere. The posterior cerebral artery supplies the mesial face of the hippocampal convolution, that portion of the surface which lies over the cerebellum, and finally the most caudal portion of the hemisphere.

Ein Hydrocephalus ungewöhnlichen Umfangs. Dr. F. TUCZEK und Dr. AUGUST CRAMER. Arch. f. Psychiatrie und Nervenkrankheiten. Bd. XX. H. 2. 1889. 1 Taf.

The authors give an unusually thorough and concise statement of the appearance and dimensions of both skull and brain in the case of a hydrocephalic patient, the horizontal circumference of whose head was 75 cm. Patient, a male, was normal at birth, but during the first year the head became noticeably large and the lower extremities failed to develop normally. At the age of 29 years he became an inmate of the Landeshospital Haina, where he remained until his death from decubitus suddenly developed, in 1887. The physical examination made at entrance into the hospital showed him normal and fairly developed, save in the two particulars just mentioned. The animal functions were good. He was cleanly, good-natured, free from delusions, could speak slowly, but at the same time clearly, and could sing, had a good memory, for persons at least, though he had had no mental training, never having attended school. In general was rather weak minded; showed no sensory disturbances and could use his hands well, even for sewing, etc.

The skull was found of considerable thickness. Dura adherent to the roof. The latter was thick and heavy. In removing brain 1850 cu. cm. of fluid were collected, after which the brain, with remaining fluid, weighed 1600 grams. The horizontal circumference of the fresh brain was 67.5 cm., and the greatest breadth 20 cm. Hemispheres with thin walls which collapsed on withdrawal of the fluid. The main portion of the specimen was hardened in bichromate and preserved in alcohol, while small portions of one hemisphere were prepared by other more special methods. The gyri were unusually long and broad, well rounded, though but slightly prominent, the sulci very shallow. The lateral ventricles were enormously enlarged; the hemispheres thin-walled, and showing at places on the internal surface ridges of medullary substance. Corpus callosum and fornix were represented by the merest remnants; the septum lucidum by its pedunculi. The third ventricle was much enlarged, and the soft commissure was wanting. The hemispheral wall was from ½ to 4 cm. thick; the cortex 2—3 mm. thick. A centrum ovale did not exist. Careful measurements are given of the basal ganglia, interbrain, midbrain, hind-brain, and after-brain—all symmetrical. A microscopical examination of the cortex by the methods of Exner and Weigert showed a normal development of the fibers, save that those of the first (zonal) layer were unusually slender. The ganglion cells were abundant and no change in them, even in the motor regions, could be determined. The pathological changes in the crura and parts lying caudad were the complete obliteration of the central canal and degeneration in the pyramidal tracts. The great slenderness of the first layer of cortical fibers is explained as the result of stretching. The cortical speech center was incompletely developed. The secondary degeneration of the pyramidal tracts was associated with the loss of the subcortical medullary substance, as has been shown in other cases of hydrocephalus, with paralysis and contracture. Degeneration in the cord mainly affected the fibers for the lower limbs, as was to be expected, and with this was also associated the very poor development of the central gyri in their dorsal third.

Ueber Hirngewichte bei Geistesschwachen. WULF. XXIII Jahresversammlung des Vereins Hannover'scher und Westphälischer Irrenärzte zu Hannover, Mai, 1889. Abstracts by Bruns in Neurolog. Centralbl., No. 10, 1889.

The result of weighing 205 brains of idiots and imbeciles is given as follows:

1. Average weight in men greater than in women. 2. Average weight in cases of mental weakness is less than in any other form of mental disease, except, perhaps, general paralysis in women. 3. In mental weakness the brain reaches its maximal weight earlier (earlier too in men than in women) than in normal individuals or those suffering from other forms of mental disease; the decrease in weight also commences earlier. 4. The weights of the fore-brain have the same relation as those of the entire brain, both in men and women. 5. The weight of the cerebellum is abnormally small, and small, too, relatively to that of the fore-brain and the entire brain. 6. In relation to the size and weight of the body the weight is as in normal persons, *i. e.*, in general the brain weight increases with the size and weight of the body. On the other hand, there is relatively an inverse relation in that persons of small body weight have a relatively heavier brain and *vice versa.* The same is true in relation to the height. 7. Epileptics with mental weakness have a smaller brain than those not epileptics. Measurements of the head showed that mental weakness was strongly associated with brachycephalic skulls.

Ein Beitrag zur Kenntniss der feineren pathologischen Anatomie der Idiotie. H. KÖSTER. Neurolog. Centralbl., No. 10, 1889.

A brief review of the literature of the anatomy of the brains of idiots is followed by a short account of K. A. S. whose arrested development led to idiocy. Death at twenty-six years. Makroscopically the brain showed nothing abnormal. The cortex from different portions was examined microscopically. The abnormalities here found were: increase of neuroglia substance; distention of the perivascular and pericellular lymph spaces, atrophy of a number of ganglion cells, also pigmentary degeneration and vacuolization of many of them, and especially and particularly irregularity in the position of the pyramidal cells both with reference to the other layers and with reference to one another; finally hypertrophy of the vessels. The hypertrophy of the connective tissue and the atrophy of a number of ganglion cells were certainly pathological changes. The pigmentary degeneration in the case was also pathological for normally there is no such deposition of pigment in a person so young. The vacuolization was present, but whether pathological or not, the author leaves undecided. The displacement of the pyramidal cells certainly existed during life. Köster then balances the evidence in this case for and against the existence of enlarged pericellular spaces during life and concludes from the fact that there is an abnormal tendency for the pericellular spaces in many cases to fuse with one another, thus bringing two cells within one space, that the appearance is pathological and not an artefact. Of all these peculiarities there is only one, namely, the displacement of the pyramidal cells, which is not found in other forms of mental disease. This displacement consisted in a deviation of the cells, without uniformity, by which the long axes, instead of being vertical to the cortical surface and nearly parallel to one another, came to lie in any position with reference to this surface. Such an arrangement has been observed in other cases by Betz and Bernhardini, and the author points out that this variation should be particularly looked for in similar cases in order to determine the constancy of its occurrence. The paper has two figures showing ganglion cells, lymph spaces and vessels. ("*Axencylinderfortsatz*" is the word used to designate the conical prolongation of the pyramidal cells. REV.)

Beschreibung dreier Mikrocephalen-Gehirne nebst Vorstudien zur Anatomie der Mikrocephalie. Abtheilung I. Dr. F. MARCHAND. Nova Acta d. Kaiserl. Leop.-Carol. Deutschen Akademie der Naturforscher. Bd. LIII, No. 3. Rev. in Neurolog. Centralbl., No. 12, 1889, by P. Kronthal.

A careful study of these three cases showed the following abnormalities.

In the first: Forebrain small; great simplification and flattening of the convolutions, especially in parietal lobes. Central fissure running at right angles to the great longitudinal fissure with apparent union of the central fissure on the left side with the fissure of Sylvius. Marked development of the "Affenspalte" *(sulcus occipitalis transversus)* with well developed *operculum occipitale;* rudimentary development of the first and second occipital convolutions, which present well formed bridging convolutions as in the lower monkeys. Union of the *fissura calcarina* with the *sulcus ammonis;* excessive development of the gray matter on the convexity of the forebrain, specially of the parietal lobe and anterior central convolution with concomitant diminution of the white matter. Anomalies in the medulla oblongata in the abnormal arrangement of the gray matter of the olivary bodies in the form of several secondary olives. Moderate distention of the ventricle.

2. This specimen showed the forebrain small; great simplicity of the convolutions; exposure of a portion of the island of Reil, with incomplete development of the operculum. Central fissure nearly at right angles to the great longitudinal. The long axis of the parietal lobe, small; union of the parieto-occipital fissure with the *sulcus occipitalis transversus*, forming a deep depression between the parietal and occipital

lobes. The superior portion of the first *gyrus occipitalis* sunken, with incomplete development of the *tuberculum occipitale.* Cuneus, small. Corpus callosum, dwarfed.

3. The main deviations from the normal here were: Forebrain very small; great simplification of the convolutions. Exposure of a portion of the island of Reil. Union of the right central fissure with fissure of Sylvius; complete separation of the anterior central convolution on the right side from the horizontal frontal convolutions by an abnormally developed praecentral sulcus. Occipital convolutions small and abnormally formed. Presence of an *operculum occipitale.* Abnormal formation of the parieto-occipital fissure, especially on the right side. Shortening of the corpus callosum caudad. Five good plates accompany the text.

Variations of the spinal nerves in the caudal region of the domestic Pigeon. JAMES I. PECK. Jour. of Morphology, Vol. III, No. 1. June, 1889. 1 Plate.

The author first determined that the variable number of caudal vertebræ was not altogether explained by union of one or more with the coccyx, for if this had been the case an inverse relation was to be expected between the length of the coccyx and the number of caudal vertebræ. It was, however, found that the coccyx was longer in those specimens having many than in those having few free caudal vertebræ, and although the relation of the most caudal one of the latter to the coccyx varied, being more or less anchylosed with it, yet the variations in this part of the skeleton are thus shown to be more than relative. Specimens were examined by direct dissection and by sections—dovecote and fantail pigeons being employed. In various specimens from 5 to 8 free caudal vertebræ were found. This gave from 6 to 9 spaces for the emergence of nerves. In general the number of nerves was equal to the number of spaces minus 2, but it was sometimes equal to the number of spaces minus one. In one case, also, the most caudal nerve was present apparently on one side only. Caudad, at the point where the nerves arise, the cord is continued as a filum terminale, the arrangement of the nerves preventing anything like a cauda equina. The conclusion is that the nervous system in this region is plastic, and varies in association with the number of caudal vertebræ.

Anatomischer Befund bei einseitigem Fehlen des Kniephänomens. A. PICK. Archiv f. Psychiatrie und Nervenkrankheiten. Bd. XX. H. 3, 1889.

The spinal cord examined in this case was from a man of 60 years dying of pleuro-pneumonia while under treatment for tabes and dementia paralytica. In the fresh cord there was makroscopically nothing abnormal. When hardened in bichromate of potash the posterior columns were plainly seen to be degenerated through the entire length of the cord. The maximum disturbance was about the juncture of the dorsal with the lumbar regions. Here, as in the other regions, the left side was more involved than the right, and specially the root zone of the left side was more degenerated than that of the right, though there was some degeneration on the right side also. The knee jerk on the left side was absent in the patient, and on the right could be obtained with re-enforcement only. Westphal had already associated the loss of the knee-jerk with disease of the root zone (*Wurzeleintrittzone*) at the level of union between dorsal and lumbar regions; and this case is presented as confirmatory of his results. It will be observed that the localization is of a lesion in a tract of fibers and not of a cell group.

Histologische Untersuchungen am Rückenmark der Tritonen. K. R. BURCKHARDT. Archiv f. mikros. Anatomie. Bd. 34. H. 1, 1889.

Triton Alpestris was the form mainly used in this study, and one principle object which the author had in mind was to determine whether the development of the spinal cord took place in a manner similar to that described by His for man. The conclusions support those of His. The mitoses which give rise to the spongioblasts of these authors take place earlier than those which form the neuroblasts—the first form of nerve cells. The supporting substance of the cord is essentially epidermal, therefore, though, in the adult, cells of a different nature may be found imbedded in it. The ganglion cells are of several sizes, and it is the largest ones that develop earliest. Structures which have been described as "granules" and "free nuclei" are, in some cases at least, small ganglion cells. Triton also shows large nerve cells which are the homologues of the "posterior cells" (Freud) in Petromyzon. The plates that accompany the paper show several cross sections of the cord, and it is remarkable how closely the early stages resemble the developing cord in man.

Ueber den oberen Kern des Nervus oculomotorius. Dr. L. Darkschewitsch. Arch. f. Anat. u. Entwickelungsgsch. January, 1889. H. I. and II. Taf. I.

By the study of cross-sections from the region of the anterior corpora quadrigemina in the human fœtus, between the seventh and eighth months, Darkschewitsch makes out a group of cells to which he gives the name superior nucleus of the oculomotorius. The following is taken from his description: There are in this region two columns of cells on each side, their long axis parallel to the aquæduct. The more ventral and caudal group lies nearer the middle line, the more dorsal and cephalic one being laterad of it. The latter group has much smaller cells than the former. In their relations to the oculomotor nerve fibers and the posterior longitudinal bundle, both groups are alike. It is this dorsal and cephalic group, composed of the small cells, which is the "superior nucleus" of our author. For its relations, see the original paper. (Gudden has already described the several cell clusters which form the oculo-motor nucleus in the rabbit, and it may be that a study of this superior nucleus in the adult human brain will make it possible to homologize the subdivisions in man and the rabbit. In the meantime it must be remembered that this "superior nucleus" is classed with the oculo-motor centre solely on the ground of juxtaposition and its relation to the posterior longitudinal bundle and the oculo-motor nerve.—Rev.)

Multiple Hirnnervenläsion nach Basisfractur. Ein Beitrag zur Frage des Verlaufs der Geschmacksnerven. L. Bruns. Archiv f. Psychiatrie, u. Nervenkrankheiten, Bd. XX, H. 2, 1889.

The patient was a man who had been thrown from a wagon violently on his head; several cranial nerves (from II–VII inclusive) were injured by what was diagnosed as fracture of the basis of the skull. The careful examination showed that in general there existed on the right side, on which there was total paralysis of the facialis, a complete hemiageusia, both at the tip and back of tongue and soft palate, while on the left side, on which the trigeminus was completely paralyzed sensibility to taste was everywhere retained. There was no evidence that the glosso-pharyngeus was injured other than was furnished by the loss of taste. It was further surmised that the trigeminal lesion was intracranial, while that of the facial was in the Fallopian canal. If the hemiageusia had been confined to the anterior two-thirds of the tongue, the case would have fitted nicely with the theory of Carl, which makes the course of the taste fibers from the glosso-pharyngeus—where they arise—through the ganglion petrosum and by the tympanic nerve to the tympanic plexus, from here the main portion passes by the nervus petrosus superficialis minor to the ganglion oticum and so to the lingualis, while the smaller part of the fibers passes from the tympanic plexus by a communicating branch to the geniculate ganglion of the facial, along this nerve to the chorda tympani and by the chorda to the lingualis. In Bruns' case the right temporal bone is probably fractured and the tympanic plexus can very well have been injured by this, thus well explaining part of the facts. The puzzling feature of the case is that the ageusia occurs on the back of the tongue as well, which is generally considered to be innervated directly by glosso-pharyngeal fibers and that there is no other evidence of glosso-pharyngeal injury. Bruns makes the suggestion that if the nervus intermedius is considered with Lussana and Vulpian to contain the nerves of taste for the back of the tongue, in addition to those for the other gustatory regions, as maintained by the above authors, this case may perhaps be explained, but he urges no hypothesis and presents these observations more as a contribution to the discussion than as decisive on any points.

Sur le nombre et le calibre du fibres nerveuses du nerf oculomoteur commun, chez le chat nouveau-né et chez le chat adulte. M. H. SCHILLER. Comptes Rendus. 30 September, 1889.

Under the direction of Forel, Schiller has made some interesting observations to test whether the nervous elements increased in number after birth. The test was made by counting with care the number of fibers in the cross-sections of the oculo-motor nerves of some new-born cats and comparing this number with that found in the cross-sections of the same nerve in the adult animal.

The average number of fibers, taken from 3 cats, new-born, gives,	2942
For 2 cats, 4 weeks old, (same litter,)	2961
For 1 cat, 6 weeks old,	3032
For 1 cat, 1 year old,	3046
For 1 cat, a year and a half old,	3035

The slight increase in the number of fibers for the older animals is fairly accounted for by the greater ease of counting the elements in the adult, for the diameter of the fibers in the new born lies between 1.5—2 μ., while in the case of the oldest specimen—a year and a half old—it varies from 6—20 μ. The conclusion, as pointed out in a note by Forel, is to show plainly that cell multiplication in this nerve centre has stopped at the time of birth. The work is to be continued with the view to finding whether, as the present views demand, each nerve fiber is represented by a nerve cell.

Ueber die Histologie des Centralnervensystems. FROMMANN. Jahressitzung des Vereins der deutschen Irrenärzte. Jena, Juni, 1889. Abstracts of communications in Neurolog. Centralbl., No. 13, 1889, by Bruns.

First concerning the structure of the axis cylinder in nerve fibers. There are three views: Kupffer assumes continuous fibrillae running the entire length of the fiber; Joseph, a network with fibrillae passing between the meshes; Heitzmann, cross anastomoses which interrupt the direct tracts in the axis cylinder. From the study of invertebrates, Leydig supports the last view and explains the cross anastomoses as a supporting structure, which being interrupted cannot conduct. The conductive substance is the hyaloplasma, enclosed by this supporting substance. If this is true, how explain the conducting in the fine terminal branches of nerves where there is no hyaloplasma? Leydig describes in nerve cells, pale stripes and lines of hyaloplasma which conduct the nervous impulse from the cells. Frommann could not find these. He described then in detail the form and fibers of the nuclear framework of the ganglion cell. For the most part these form a network and pass out of the cell as fine fibers. The arrangement is particularly plain in the *ganglion stellatum* of the cuttle fish. These fine fibers unite, in this case, the cell with its capsule and the cells with one another. Against Leydig's view that the life processes are associated with the hyaloplasma is the fact that during life the fibers and their nodal points continually change their form. That such changes represent a normal process is probable.

Nouvelles recherches sur la constitution cellulaire de la fibre nerveuse. L. GEDOELST. La Cellule. T. V., 1er Fasc., 1889. 1 plate.

The discussion in this paper is centred on the reticular portion of the medullary sheath. Gedoelst has previously published on this topic, and has convinced himself on the following points: First, there exists a reticulum which has been described successively by Ewald and Kühne, and by Lautermann. Second, the neurokeratine network of the former is identical with the network of the latter. Third, this network is preformed and not merely a result of the reagents used. Fourth, the threads of the network are impregnated with lecithine, while cerebrine occupies the meshes. The present paper deals first with the clefts of Lautermann. These are not preformed in the sense that they are plainly visible in the normal nerve, but are preformed in the sense that at the points where they appear there are distinct peculiarities of structure in the sheath. These peculiarities point to the existence of a substance which swells with ease, thus separating the myeline into segments and exposing at one stage the threads of the network. As a rule the swelling goes so far that these threads are broken. The surface of the cones thus formed with the encircling ridges Gedoelst identifies with the "spiral fiber" of Golgi and Rezzonico, which he looks upon as an artefact. His second point is the relation of the parts at the nodes. The axis cylinder is continuous, as is also the sheath of Schwann. So far as the latter is concerned the fiber may be considered to have a structure analogous to that of a filamentous alga for example, in which the outer cell wall is continuous despite the fact that from it arise the cross-partitions which divide the filament into segments. This cross-partition in the case of the axis cylinder is a delicate membrane constructed like a cribriform plate through the holes of which the fibrillae pass. Only the most delicate manipulation serves to preserve this plate, and all the other relations of the parts at the node are but deformations of this structure. A good bibliography of the recent works goes with the paper.

Weiterer Beitrag zur Kenntniss der Golgi'schen Untersuchungsmethode des centralen Nervensystems. Dr. L. GREPPIN. Arch. f. Anat. u. Entwickelungsgsch.—Supplement-Band, Nov., 1889. 1 Taf.

The material employed was mainly the human cerebrum and cerebellum. To the silver method of Golgi, Greppin has added a technical point which cannot fail to be useful. The silver stained section is floated in a 10 per cent. solution of hydrobromic acid. By this treatment the silver deposit turns white by reflected light, while by transmitted light it still appears black. The pictures thus obtained are as sharp as with the silver alone, and the preparations, besides being permanent can be mounted under a cover glass, and further can be treated subsequently by a number of methods. So far as staining is concerned, the author finds a final treatment by Pal's modification of Weigert's haematoxylin method by far the most instructive. It is also found that, after the section has been treated with a 10 per cent. solution of hydrobromic acid, if it then be put in a 40 per cent. solution of the same, the silver deposit is slowly dissolved out, leaving the cellular elements more or less clearly marked. From a study of such sections, Greppin arrives at several conclusions of interest. So far as the results of Rossbach and Sehrwald go, he agrees with them in viewing the place where the silver deposit is made as the lymphatic system of the brain. By his method he further finds some coloration of the nervous elements themselves. In matching the pictures of the lymph spaces about the nerve-cell with the cell element itself, he has not observed lateral branches from the axis cylinder process filling the lateral lymph spaces which have been taken to indicate the existence of such branches. He therefore looks on the axis cylinder prolongation as unbranched. Connections either between nerve cells by any of their prolongations or between the nerve cells and fibers he has not seen, though he believes the latter to exist. In the most densely stained specimens there is always a portion not stained, which he identifies with the ground substance of the older histologists. The periglial spaces form a connected system, and he assumes that the contained glia cells thus constitute a network of varying density in the meshes of which the nervous elements are to be found. The general aim of the paper is to show that by the application of Golgi's method no new facts of fundamental importance have been added, but that the older views have been confirmed.

(Greppin does not appear to have examined any nerve cells the axis cylinder prolongations of which belonged to Golgi's second class, and in which the relation of the axis cylinder to its assumed branches is more important, for in these cells the axis cylinder must either pass into the branching lymph channels or else terminate abruptly soon after leaving the cell.—Rev.)

Transactions of the Association of American Physicians. Third session, held at Washington, September 18–20, 1888.

At this meeting of the association one topic chosen for discussion was "The relation between trophic lesions and diseases of the nervous system." From the clinical side the presentation was made by Dr. E. C. Seguin. For his purpose Seguin recast the question in the form: "What are the lesions which may be supposed to be directly produced by disease of the nervous system (brain, spinal cord, and nerves); and what is the essential causal relation between the two factors?" Trophic lesion is understood to mean here a positive histological alteration in the tissue. Seguin distinguishes for convenience two classes. First, those occurring in parts whose sensibility is more or less reduced by nervous disease and which are exposed to the action of traumatic and infectious influences. Second, those occurring in deeper parts apparently not exposed to such influences. In cases of the first class—like ulcerations of the cornea after injury to the trigeminus, the changes in hair and nails and even extensive necrosis and gangrene following section and other injuries of the nerve trunks—it has been found that by careful exclusion of trauma and infection the disturbances can be prevented. Perforating ulcer, arthropathies, etc., which occur in the course of posterior spinal sclerosis, are extremely rare in patients able to avoid over-exertion; while cystitis, which was long considered one symptom of myelitis and injury to the spinal cord, is preventable by the use of aseptic catheters. In the second class, Seguin names neuro-muscular atrophy, and the so-called herpatic lesions of the skin, both he considers as true trophic lesions. The mechanism of these trophic changes is too obscure for discussion. As an attempt to simplify the problem under debate, Seguin calls attention to the following points in his presentation. First: That he has "rejected from the category of trophic lesions all vaso-motor, calorific and metabolic phenomena, as well as mere quantative reductions in tissues and organs; reserving the name for such alterations as are characterized by demonstrable histological changes." In the second place, Seguin shows that the histological lesions, apparently due to nervous disease, may be divided into two classes: "The first as above described being mere complications having a complex etiology, while those of the second class are really trophic lesions due to disease of the nervous system." Third: Without pretending to throw any new light on the intimate nature of real trophic lesions, Seguin points out that the disturbance occurs in continuous tissues, and finally ventures to suggest "that disease of the nervous system produces true trophic lesions when it interferes with the associated or inter-dependent life of continuous tissues."

From the physiological side a presentation was made by Dr. H. C. Wood. He opened with the proposition: "It is physiologically proven that the nervous system directly affects general nutrition." In support of this Wood appealed to the well-known facts of gland physiology. Next he discussed the evidence from the work of Gaskell and others, to show that there are anabolic and katabolic nerves controlling the heart. Finally, he brought forward the results of his own study on fever to show that the heat production, *i. e.*, tissue change, is controlled by a centre somewhere above the medulla. In speaking of the relations of the nerves to muscles, the motornerves are classed as katabolic, and the belief expressed that anabolic nerves, also, will in the future be found. Having presented evidence to show that the nervous system has the power of influencing nutrition, he passed to his second proposition "that various lesions are the immediate result of previous nerve disease, or nerve injury." Here Wood grouped all the cases considered by Seguin in his paper, but without any sub-division, and considered the evidence to prove the proposition just stated. His third point is that a distant lesion may follow a nerve injury or nerve disease without any precedent disturbance of the local circulation. This statement is supported entirely by evidence that decubitus may occur on the side where sensation only is paralyzed. The fourth proposition is the converse of the third. That "alterations in the condition of the vaso-motor centre are not capable of causing many of the distant lesions which follow injury or disease of the nervous system." This being mainly supported by observations on the ear of the rabbit.

In the discussion which followed, Dr. W. M. Ord of London described several cases of disease of the joints, which in his opinion were trophic.

Dr. H. P. Bowditch called attention to the nitrogenous and non-nitrogenous metabolism in muscle, and suggested that limitation of the term trophic to the former would simplify matters. Dr. David Ferrier touched on the question of a double nerve supply to muscle, and thought the study of the heat and other centres, might throw light on the question. Mr. Victor Horsley communicated the results of some work by Dr. Mott of London. Some nerves of the cauda in monkeys were tied and the femur on that side was found the seat of excessive (katabolic) changes. This is particularly interesting since loss of function and vaso-motor disturbances, both of which are often complicating factors, are in this case quite insignificant.

(There are two points in this matter which may be emphasized, namely, that the weight of opinion and anatomical results are against the view that trophic nerves form a separate class, and that the trophic action may be exerted along the nerve in a direction the reverse of that in which the impulses usually travel; witness all the forms of herpes associated with the posterior spinal roots.—Rev.)

II.—HEREDITY AND SEX.

JULIUS NELSON, PH. D.

In this section I shall review certain representative modern discussions that bear upon the theory of heredity. We shall see that the problems involved are very fundamental and of far-reaching significance for Psychology. Here is the ultimate basis to which students of Psychology as well as of Biology must refer their questions for ultimate solution; it is in fact impossible in this connection to separate the two sciences.

A large share of the discussion of the problems of heredity appertains to the various relations of sex. The importance of the latter subject, as indicated by the vast amount of literature of research and thought bearing upon related questions and the great variety of interests that center here, calls for its treatment in a special section to which the present article may be considered introductory.

The reviews will be presented in the following order. After stating the problem of heredity we consider theories of the constitution of protoplasm and of the importance of the cell nucleus to the problem. Then the subject of variation and the relation of the reproductive cells to the other tissues of the body are considered. This leads to the discussion of the origin of death. Then follows a brief reference to the principles of correlated variation, followed by a consideration of the psychic life of cells and the educability of protoplasm. The section concludes with a consideration of the seat of the soul, and metaphysical speculations on the relations of soul and body.

It is important to get a clear idea of the problem of heredity. Consider the following outline of the conditions of the problem. A complex living being is an organization of protoplasmic cells according to the principle of division of labor. All cells performing the same office in the body are nearly alike in appearance, and their aggregate is termed a tissue. Any cell in a tissue can produce its like by simple self-division into two equal parts. The cells of the reproductive tissues are each capable, when separated from their fellows, to build up by continuous multiplication, a new individual, which is a repetition more or less closely of the parent, both in structure and in all characteristics, including psychological ones. More wonderful yet, while this reproductive cell is building up the new individual a very orderly progress is followed, termed development, *(ontogeny)* which shows stages that map out successively the taxonomic character of the group in which the parent is included, beginning with class and ordinal characters, and leaving off with the specific; that is, *ontogeny is a condensed phylogeny*. That apparent divergence from this law may be accounted for by *cenogeny* or secondary adaptation only emphasizes the law, which in popular terms is that the development of the individual is a repetition of the history of its ancestors. Thus the resemblance of a child to its parent is a broad one, including the whole life history, and in this history all the ancestors reappear in a modified form.

But we must go deeper. The reproductive cell, while in its proper tissue, gave rise to cells like itself when division ensued, but in *ontogeny* the offspring, similarly produced, became differentiated into different tissues. For instance, the first division of the egg cell may give rise to the common ancestor of all the ectoderm cells and of the entoderm cells respectively; and subsequent divisions may be the separation of two great sets of organs derived from the ectoderm or entoderm. In fact, the cases are more complex and not thoroughly made out for any organism. However, when any cell has differentiated to assume its final function it has a limited character and apparently can never function in any other capacity, and apparently can not, or, at least, does not act as a reproductive cell. In some way, then, all the different tissues are represented in the egg.

But the modern zoölogist sees progress. Each individual of the line of ancestry transmitted to his offspring more than he received. In the battle with nature, organs became in some way modified and better adapted for their purpose. Use strengthens organs, disuse enfeebles them, and even new organs, or at least differentiations of old ones, or a modification of their function may be acquired. Lamarck is the most famous advocate of the idea that such acquired characters tend to be transmitted. The idea is evidently prevalent that the children of one who has exercised his musical talent are furnished congenitally with increased musical abilities.

We must seek in the protoplasm of the egg (or *germ cell)* for structures that bear the impress of powers that represent the whole body. This is the modern form of the old doctrine of evolution which saw in the germ cell a complete miniature of the adult. But we must add that this structure of protoplasm can vary either spontaneously or in response to stimuli definitely or indefinitely.

Perigenesis der Plastidule. HÆCKEL.

Hæckel conceives protoplasm to be ultimately composed of molecular units that are themselves a complex system of vibrating atoms. Every new stimulus modifies and complicates the system. When a cell divides into equal parts the form of vibration of the molecules of the two cells is alike, but now the two cells are no longer acted on by similar forces and their systems become more and more divergently modified through life. Thus may we explain variation and phylogenetic differentiation. When cells divide into differentiated cells of the tissues in ontogeny, there is a splitting of the wave movements into two simpler systems. The increase of protoplasm by assimilation is the impressing upon the food molecules of an identical form of vibration. Finally, in sexual reproduction, which is simply the union of two germ cells from different parents, usually not too closely nor too distantly related, there is a union of systems that differ slightly, and hence a new combination, a new variety; so that in sexual reproduction the offspring never are the complete copies of their parents. It is evident that the weak point in this theory is that we have not the faintest idea how the wave motion is caused to split up in ontogeny according to so definite laws, nor, what is more important, how the conditions of the environment cause the proper variations to take place, that adapt the body to the environment. Then, too, we know that *the environment is of importance in ontogeny* for *not all* the characters of protoplasm are ever brought out in any case. The same person, if he could be brought back to repeat his life history under different circumstances, would appear as a very different individual in the final outcome. Life is full of "latent characters" waiting the proper stimulus to become active. Yet how does this action of the environment differ from the action which causes variation and new hereditary possession? Here is the field for inquiry.

Hæckel attempts to lay the foundations of Psychology by calling the persistence of these vibration-systems in their respective forms *memory*. Ontogenetic development is a rehearsing of the experience of protoplasm when it was in the ancestors, (for every child is but a portion of his parent, so that all protoplasm that is alive dates back to the foundation of the world). All that has been experienced has been retained in this cell memory.

Hæckel goes deeper than any other speculator upon these problems, and in some respects his theory has the merit of simplicity.

Abstammungslehre. NÄGELI.

Nägeli derides the Perigenesis theory and substitutes the "Idioplasm" theory. Not all protoplasm carries the hereditary powers, but that which does may be termed Idioplasm. This plasm is supposed to be distributed throughout the cell in the form of fibres that reach to the periphery of the cell; and whenever cells divide and remain united, the fibres of neighboring cells are continuous; as, indeed, recent studies in the continuity of protoplasm seem to show. The entire idioplasm of the body is then one immense *reticulum*, and a higher organism is thus related to the outside world as a cell on a larger scale. Any disturbance of the idioplasm at one point is transmitted to distant points. Thus the idioplasm preserves a uniform structure so that all cross sections are similar. But the fibre itself is supposed to be composed of rows of units termed *micellae*. The micellae are alike in a single row, and grow and reproduce in a longitudinal direction only. But different rows are unlike; and the peculiar characteristics of an organism depend on the particular structure which a cross section represents. Furthermore, not all the micellae of the cross section are active at once, but certain layers of them act, and in turn stimulate more internal or external layers to activity, and in this way the orderly succession of the cyclic development of ontogeny may be accounted for. All this has been upset by recent discoveries concerning the cell nucleus. In sexual reproduction the characters of the father appear equally transmitted with those of the mother. These characters are therefore contained in the spermatozoon.

Beiträge zur Kenntniss der Bildung, Befruchtung und Theilung des thierischen Eies. O. HERTWIG. Leipzig, 1876.

Hertwig has shown that the union of sperm cell and egg cell known as fertilization or fecundation, consists essentially in the fusion of two similar nuclei (male and female pronuclei), sometimes the tail of the spermatozoon not even entering the egg. Studies of the production of the spermatozoon *(spermatogenesis)* show that cells (quite similar to those that in the female reproductive organs become ova by growth) in the male reproductive organs after repeated divisions become spermatozoa by direct transformation of the cell protoplasm to serve locomotive purposes, the nucleus remaining in the "head" of the spermatozoon. Kölliker, however, derives the entire body of the spermatozoon from the nucleus. It is certain that a large part of the cell protoplasm is lost, and only that immediately surrounding the nucleus is utilized in the maturation of the male element in the highest animals.

Neue Untersuchungen über den Befruchtungsvorgang bei den Phanerogamen als Grundlage für eine Theorie der Zeugung. STRASBURGER. Jena, 1884.

This observer has shown that in the tube of the pollen grain, when it has sprouted upon the stigma of a flower, a nucleus ("generative nucleus") wanders down and seeks the nucleus of the germ cell of the ovary.

Gruber, and others in studying the sexual unions of the unicellular animals, have shown that there is a dividing up of the nucleus, and in *reciprocal fertilization (conjugation*, or copulation of *ciliata)*, there is a mutual interchange of nuclear material; while in *zygotic fertilization* (similar to the union of ovum and spermatozoon) there is a union of the nuclei to form one nucleus.

Bericht der Naturforchenden Gesellschaft zu Freiburg. Vol. 1, 1886. GRUBER.

Gruber has found that by cutting up stentors, the fragments became regenerated to complete stentors whenever a portion of the nucleus was retained in the segment cut off. This experiment proved definitely that the power of assimilation rests with the nucleus, or at least the nucleus has a necessary control. We may also conclude that the nucleus is not a definite structure like the idioplasm of Nägeli, but is an aggregation of gemmules that are alike; each of which can reproduce itself *ad lib-*

itum, and in each of which, therefore, the hereditary characters rest. *The idioplasmic structure, then, is to be sought for in the structure of the nuclear gemmule.* The above conclusions are much in harmony with many facts observed with reference to cells. Let us more especially recall the complicated phenomena of *Karyokinesis*, or indirect cell-division, in which we see the nuclear granules and microsomata pass through complex evolutions of divisions and conjugations, and, finally separate into two groups so as to give to each daughter cell a similar structure. This is especially seen in the division of tissue cells; and Strasburger and others have supposed that *direct division* results in dissimilar cells, *Karyokinetic*, the reverse. But if we believe the different characters of cells in ontogenetic differentiation are due to a separation of gemmules into corresponding differentiated groups, we should naturally suppose the more complicated process to take place in the latter case. See ROUX: *Bedeutung der Kerntheilungsfiguren.* Leipzig, 1883.

Significance of sex. NELSON. See abstract, this JOURNAL, Vol. I, p. 543.

Nelson has given a different explanation, referring the phenomena to sexual processes. According to this view all reproduction is sexual, but accompanied by different degrees of inbreeding or crossing,—the gemmules being looked upon as descendants of a common ancestor just as are the protozoa that conjugate.

We are now prepared to review the Pangenesis theory of Darwin. (*Origin of Species.*) The germ cells are looked upon as storehouses of gemmules that have come from all the cells of the body. Each sort of cell is supposed to have its special sort of gemmule, and these can indefinitely multiply their kind, and thus build up a cell, but at the same time there tends to be variation in their characters, not in a definite direction nor in response to definite stimuli, but often, of course, through the action of the environment when this is out of adaptation to the animal.

Ontogenetic development is explained as the successive activity of gemmules of the ancestors, which are all represented in the germ cells. Cell-division, resulting in differentiated cells, is accompanied by a conjugation of the gemmules of the next succeeding stage with the gemmules that have developed into the cell protoplasm or are active in the preceding stage. The weak point of the theory lies here. It does not show how the characters of the gemmules, nor how the conjugation of the gemmules, effect the evolution of the so differentiated cells. We should also expect, if the cells are giving off gemmules, that inocculation with the blood of a different animal would be the equivalent of a crossing or fertilization, but Galton's experiments in this direction gave negative results. These experiments, it seems to us, have too hastily been taken to disprove the theory; they appear to give negative proof only. Another objection to the theory has been, that the number of gemmules that must be gathered in an egg must in the higher animals be practically so great as to be unthinkable.

The Law of Heredity. W. K. BROOKS. Baltimore, 1883.

To reduce the number of gemmules needed was the aim of Brooks. If it were not for the fact of variation we could get along with a few gemmules, for then we need not gather up the gemmules from the body, because the germ cells of the offspring are the descendants of the egg of the parent, (true of all tissue cells) and of course have the structure of the ancestral germ cell. If now we suppose that gemmules are given off by cells only when a special stimulus is received, as (e. g., when the environment calls for better adaptation) then these gemmules will vary from their like in the egg and will hybridize the latter, and thus produce (during development) variation of the organ in question. Furthermore, arguments are marshalled to prove the male animal is more variable than the female. We may suppose a division of labor has arisen, by which the male germ-cell has acquired the special function of storing up gemmules of this sort. The egg is the conservative hereditary factor in sexual conjugation, and the spermatozoon the progressive one. Facts are offered to show that in reciprocal crossing the male exerts a more variable influence than the female.

Die Bedeutung der sexuellen Fortpflanzung für die Selektionstheorie. WEISMANN. Jena, 1886.

This author objects to this theory on the ground that when animals are out of relation with their environment the special organ which is weak is not directly affected, and may even be in harmony with the other organs, (if one organ varies all must vary,) and hence will not feel any special strain. For example, what special strain can there be on the green of a moth's wing which does not match the color of a forest leaf, and thus exposes the moth to the attack of birds. His other objection, that the paternal character is as often masked by the prepotent maternal, due to the more rapid multiplication of the maternal idioplasm, does not seem to touch the point at issue. Weismann thinks that in asexual reproduction there can be no variation, and that variation ensues by the sexual union of idioplasms of diverse natures. Consider how multiform must be the variety of characters combined in each individual. The combinations for only ten generations amount to 1024. If now, slight variations in various directions ensue among the individuals of a species, when these variations are compounded the result must be, by algebraic summation, the continuous increase of special characters along definite lines in the course of several generations. But we ask, how can this be, except the minute variations are, in the majority of cases, in the right direction? Here is the very pith of the problem. There is also another factor left out of account, and that is the matter of sexual attraction, either between individuals or more especially between sexual pronuclei producing "prepotency." May there not be definite laws relating the structure of the two idioplasms about to be united, in a way most advantageous? Among human offspring the best and most beautiful offspring have been supposed the result of love matches, (Finck).

This opens up the whole question of the effect of the reproductive cells upon the soma, the reverse of the one we have been considering. The amount of nuclear material present is conceived as helping the process of self division, and when from any cause, as from lack of nutrition, the nucleoplasm is small, a stimulus to development is given by any sudden accession, as takes place in sexual conjugation of cells. This method, of occasional advantage to the protozoa, has been preserved with the metazoa, as it proved advantageous for producing variation, the protozoa not needing it for this purpose (?) as their body is directly changed by the environment. A further discussion of the question follows in the next paper, also by Weismann.

Die Continuität des Keimplasmas als Grundlage einer Theorie der Vererbung. WEISMANN. Jena, 1885.

Are we to conceive of ontogenetic development and reproduction as a repeated cycle starting with the egg, which produces an indefinite number of generations of cells called the soma; and then some of their ultimate generations becoming detached as eggs? Not at all. We must conceive, rather, that the germinal cells multiply like the protozoa, are immortal and direct descendants of each other, and that cyclically when reproduction takes place, some of the germinal cells divide on the plan of successive differentiation, and produce the *soma* as an instrument for nourishing and maturing the remaining germ cells. As a matter of fact, in many animals the cells that are to become reproductive or ancestors of germ cells are early to be distinguished in the development, but we need not confine ourselves to this method, for *we get rid of the necessity of a continuity of germ cells by assuming a continuity of germinal plasm.* By germinal plasm is meant the true idioplasm which can differentiate into all the organs of the body. When once differentiated it has lost its generic character by analysis.

Weismann conceives ontogenetic development to be a series of successive simplifications of the idioplasm that is producing the soma, a successive analysis, as above noted, when speaking of ectoderm and entoderm. *But in any cell some idioplasm may remain undifferentiated*, while the remainder differentiates. There is differentiated plasma as well as undifferentiated, even in germinal cells; for the reproductive cells are tissues, and require "*oogenic*" and "*spermagenic*" plasma, just as the tissues in general require "*histogenic*" plasma. But when any cell which contains undifferentiated germ plasm is to take on itself the function of being reproductive, it must get rid of the histogenic plasm, and this is the significance of the polar globules extruded by eggs and the paranuclei found in spermatogenesis. Not till these bodies are formed will the pronuclei unite. Everywhere the process of extrusion of nuclear material is twice repeated, (the first globule itself also divides.) The first globule is supposed by Weismann to be the histogenic (*oogenic*) plasma, the second to be the equivalent of the spermatozoon. Strangely enough, Weismann later *(Ber. Natf. ges. Freiburg*, III, 1887,) discovered that parthenogenetic eggs (such can develop without fertilization) have only one polar globule. It would be interesting to know what takes place in the case of the queen bee, who fertilizes her eggs at will, the unfertilized ones hatching into males. To satisfy the theory these eggs should all extrude one globule, and then if fertilization takes place a second should be given off.

By saying that the second globule is the equivalent of the spermatozoon, Weismann does not think (like Minot and others) that there is one peculiar sort of idioplasm called "male" in the spermatozoon, and a "female" sort in the ovum, and that we can speak of "hermaphrodite cells." The cytoplasmic parts of germ cells have been differentiated to enable idioplasm essentially alike (as alike as are the male and female oyster) to reach each other and coalesce. In all cells that become reproductive, he would say some undifferentiated germ plasm was present, but in ordinary tissue cells produced by differentiated division he emphatically denies the possibility of such a thing. In this regard he opposes Kölliker.

Die Bedeutung der Zellen kerne für die Vorgänge der Vererbung. KÖLLIKER. Zeitsch. f. Wiss. Zool. Bd. 42.

This author conceives the idioplasm of all cells as similar, or in other words, all cells contain undifferentiated idioplasm; and there is no such thing as a differentiational cell division; not but that cells may start on different lines of development, but this is due, not to internal arrangements, but to external causes. It is, therefore, the action of the environment that determines the rôle of a cell. All cells are fundamentally like the germ cells. The problem is the same as that concerning latent characters; a certain environment has produced a definite result with any given sample of protoplasm; a different environment would have produced a different result. In each sex lies latent the character of the species, and the *sex* was determined during development by external causes. Of course, after differentiation has ensued it is practically impossible for involution and a new start in a different direction to take place. This point is emphasized by Weismann as against Kölliker; but we conceive the principal point at issue between the two thinkers lies in their conception of the relation of cell division to differentiation. To Weismann ontogeny is an analysis, due to inherent mechanical arrangements in the protoplasm. To Kölliker, ontogenetic differentiation, like phylogenetic differentiation, is dependent on external conditions. Kölliker does not push his theory to logical conclusions. He might say: If one of the conjugating pronuclei could be replaced by a nucleus from a brain cell or a liver cell for example, there would be no radical dislocation in the embryonic development. This position appears scientifically defensible; and we could add a second scholium, viz.: That in this experiment any fragment of a nucleus taken without definite shape or size, would do just as well, because the nucleus appears to be an aggregate of a vast number of similar gemmules. But the most important question of heredity, viz., How are the new characters acquired by the germ plasm? is still unanswered. Weismann emphatically disbelieves that acquired characters can be transmitted, or that the germ cell receives anything except food from the body. He is forced to the conclusion, that the germ plasm must vary indefinitely, and that adaptation is due to natural selection simply. It seems to be rash to deny that the body has a definite action on the germ cells. The researches of Gaule and his pupils tend to show that something more vital than food wanders from cell to cell. In this line we have to await further developments. Gaule believes that gemmules make the circuit of the tissues to finally lodge in the reproductive organs. The following author dwells on this aspect of the problem.

Ueber Vererbung. NUSSBAUM. Bonn, 1888.

Nussbaum seems to mediate between the positions of Weismann and Kölliker. He admits that like can produce only like, but germinal matter is probably more widely spread than Weismann believes. In the protozoa, Weismann has admitted that the environment causes characters to be acquired that are transmitted, because here is asexual reproduction by division. But we have seen that the nucleus governs the formation of structures in *stentor*, etc., hence the environment must first affect the nucleus, and we naturally conclude that as the germ cell has the power to produce a soma for its own nutrition, that the same soma is an instrument of mediation between the environment and the germ cell. The fact that the character of the father of the first offspring affects the subsequent offspring of the same mother, but by a different father, (ignored by many theories of heredity) shows that sexual cells are capable of marked and definite modification. In this connection we may mention Sequard's experiments upon rabbits. By artificially produced lesions of the cord, epilepsy was caused; and the offspring of such epileptic rabbits suffered from congenital epilepsy.

Ueber die Vererbung. WEISMANN. Jena, 1883.

By Weismann we are reminded that no disease is inherited, but only the tendency to diseases; this is only a particular statement of a more universal law, that our characters are the particular modes of reaction the body has taken with reference to particular circumstances, and thus the particular form of our features only partially represents our hereditary or idioplasmic characteristics. Epilepsy is not a good disease to experiment with, because it may be caused by a certain weakness of nervous organization due to general malnutrition of the embryo caused by epilepsy (or the nervous disturbance of which epilepsy was the symptom) in the mother. The experiment should be repeated, on the males only, to be valid. Weismann does not hesitate to declare that there is not known a single authentic case of the inheritance of acquired characters. The pamphlet contains in general the ideas noted above.

Die Thatsachen der Vererbung. ROTH. Berlin, 1885.

We have no opportunity to review the older theories of heredity, and simply refer those desiring abstracts of the more important to the above. The author intersperses critical notices of his own.

Ueber die Dauer des Lebens. WEISMANN. Jena, 1882.

A curious but interesting discussion has arisen between Weismann and Götte concerning the relation of reproductive and somatic cells to the length of life and the causes of death. The former calls attention to the fact that protozoa are essentially immortal. We have a continuous growth of protoplasm, and the multiplication of individuals is due to continuous self-division. Of course myriads of individuals are continuously destroyed, but this is not due to any inner principle of senescence, but to other accidents. In metazoa, however, we have, besides "catastrophic death," a "natural death," which is not original, but has been acquired for the good of the species. Natural selection has fixed the length of life for each species at just those limits that admit of the fullest amount of reproductive activity needed to maintain the species. Slow breeders are longest lived; this law is correlated with a second law that the fecundity of the species or the number of eggs or young produced is dependent in direct ratio upon the liability to their destruction before maturity is attained. Protozoa became metazoa by the products of division remaining in contact to form a colony or mass of cells, among which differentiation of labor was instituted and a certain proportion of the cells were modified to serve the reproductive cells. It was clearly of no use for any but reproductive cells to remain immortal, and hence the power to divide so as to pass less and less germinal plasma into the somatic cells was advantageous and was preserved by natural selection. Weismann also thinks that the somatic cells were impressed with power of limited production, those in long lived individuals having the power to produce a greater number of generations than in the short lived. This appears as a weak point in the theory, for it would be difficult to prove that what is called natural death is not in all cases due to inner catastrophic causes, usually the failure in proper functioning of some vital organ. The fact that tissues can indefinitely regenerate themselves shows that their cells, if they receive proper conditions of nutrition, are practically immortal.

Ueber den Ursprung des Todes. GÖTTE. Leipzig, 1883.

Weismann's paper called forth this by Götte. His thesis is, that death is in all cases fundamental, that protozoa even have to die. The organization of the protoplasm breaks up and is reconstituted in the process known as *rejuvenescence*, in which the unicellular being, after having secreted a case or cyst about itself, lies dormant for a time as if in sleep. In the formation of a colony the cells may be alike *(homoplastic)* or unlike *(heteroplastic)*. The metazoa all belong to the latter group. In the first group reproduction of the body-colony is accompanied by the dissolution of the units, each of which continues its life, and by self-division produces a new colony-individual. But the parent individual has ceased to exist. Is this to be termed death? If so, where is the corpse? The dissolution is to be considered as dependent on the fact that each of the cells undergoes *rejuvenescence*, that they may recontinue to divide, and in so doing produce the new individuals. Among the heteroplasts only the reproductive cells have the chance to form new individuals, but the colony, as in the lowest metazoa, (mezozoa=*orthonectida*, etc.,) breaks up during reproduction, and the few somatic cells are left as a corpse. In many insects death accompanies reproduction; but in cases where the two phenomena are separated in time, Götte supposes such a separation to have been secondarily acquired. A corpse is a secondary affair and not a necessary adjunct to the process that produces the corpse, and which we ordinarily call death. The individual is not to be looked on alone as the sum of the activities of its constituent units, but rather as the *interrelations* which these units sustain. The same number of cells engaged in the same amount of physiological work may be so differently arranged in two cases as to constitute two very different individuals. *Death is the breaking up of the relations*, and the units may survive. Or, if as in the metazoa, many units depend for their life, on the integrity of the relations subsisting between the different parts of the whole, their organization, too, may be destroyed. Tissue death follows individual death as a secondary or accidental consequence.

We may illustrate Götte's idea by an analogy. Essentially, there is no difference in the idea of death as applied to biology, and as applied to the death of a literary society, when the members agree to disband, possibly to found new societies. If we could feel sure that the analogy is something more than a mere analogy, but at bottom is a universal principle of life, we could gain immensely by a mutual comparison between sociology and biology. There are many terms and ideas common to the two sciences, such as division of labor, development, atavism, colony, etc. Reproduction by self-division might be illustrated by the splitting of a tribe into two. Budding by the founding of a colony by emigration of individuals representing different trades needful in the new colony. Sexual reproduction by the emigration of a single couple, and the gradual *development* (embryology) of a colony, with the differentiation of labor, as the individuals increase in number. The individual in this illustration represents the gemmule. The integrity of the state does not depend on the number of persons, though the amount of its activity and wealth does. Similarly, in the cell, the gemmules may be of like nature and vary much in number. Here the illustration favors the view of Kölliker rather than of Weismann. Although the work of two persons may be different, they are essentially alike in characteristics, and the descendant of any person in a state, could found a similar state if forced to do so by emigration.

Ueber Leben und Tod. WEISMANN. Jena, 1883.

Götte's paper was attacked by Weismann as follows: First, there is no evidence favoring Götte's idea of rejuvenescence in the protozoa. Death can only ensue when cells no longer immortal are produced by ontogenetic development of the germ cells of metozoa. Nothing else deserves the name. Death accompanying reproduction is in all cases catastrophic and due to the strain. This sort of death cannot be inherited and so cannot be established by the action of natural selection. Development is the result of a peculiar method of reproduction (the sexual) that has been acquired because of its advantages. Death itself has been secondarily established as a further advantage. The species is still immortal so long as the germ cells are, and the soma or individual is a subordinate and temporary (cytic) affair, constructed by the germ cells.

We have dwelt on these questions because the interrelation of reproductive cells and body is the most vital in every question concerning sex and sexual functions. Weismann's idea that the whole body stands over against the reproductive organs as the equivalent of one reproductive cell, seems to explain the fact that the extirpation of the reproductive organs, does not destroy the integrity of the individual, or cause death as happens, when for instance, the excretory organs (kidneys) are extirpated. Still, no sharp line can be drawn here, for some organs like the spleen, can be extirpated without causing essentially different effects from those seen to follow castration. The presence of the reproductive organs, on the other hand, exerts a profound influence on the body. From the standpoint of Kölliker all the organs of the body are morphologically homodynamous while physiologically related as chief and subordinate groups.

In this connection we may briefly refer to another matter which has engaged the attention of morphologists, viz., the question of homologies. It is well known that in the segmented animals the organs of the body are (typically) repeated for each segment so that there is a certain independence in the segments. In many worms a detached segment or segments may reproduce the whole body, and similarly the detached segments are reproduced in the animal from which they were taken. The number of segments also is often indefinite and increases with age. There are animals with the segments alike and others where differentiation has taken place. In all these latter cases, the segments cannot reproduce themselves and their number is fixed. Just as there are cell groups that dissolve to allow each cell to enter upon its reproductive work so there are segmented forms, like the Hydroid *Strobila*, and the Tape-worm in which the segments become separated for reproductive purposes. In the embryology of segmented animals, the segments appear successively as in the *Strobila*. Now if we conclude that metameric segmentation is of the nature of zooid reproduction by division (*strobilisation*) we can easily account for correlated variation, for the egg is the ancestor of a typical first zooid, which is ancestral to all the others, and any hereditary peculiarity of any part of this zooid must appear in all the other segments. If we adopt this view, can we apply the Weismann dictum? Which is the segment that remains undifferentiated and is the equivalent of all the others? Here again, Kölliker has the better of the argument. A study of the growth of *Chara* seems to point to a compromise between the two positions and also serves as a model to show how complicated a structure may be built up by the *repetition of a single mode of division*, of which the law in *Chara*, is: The continuous production, from an apical cell of cells that are each capable of division into two cells, one with the characteristics of the apical cell, the other (the internodal cell) with the powers of indefinite growth without division.

Article "Sex" Enc. Britannica; and Proceedings of the Royal Society of Edinburgh, 1886. GEDDES.

Geddes attempts an explanation of a division of this sort, by considering, that two sets of forces *Katabolic* (those that destroy protoplasm, liberate energy, and effect external work, resulting in cell multiplication) and *Anabolic* (those that build up protoplasm, absorb energy, and effect internal work, or growth) are in a certain balance in life; and there is an alternation between the ascendency of the two sets of forces. An *ovum* is a cell in which anabolism is in the ascendant, and a spermatozoon is one in which katabolism reigns. It is easy to see how the fertilization of the *ovum* leads to its segmentation, on this view. But theories of this nature are only partially explanatory. No theory can be true or even of temporary value, unless it harmonizes with the majority of known facts, and when no one fact is fatal to it.

We have yet to enquire how a division of this sort is determined in exactly the mode needful for the good of the species. Not only do we enquire how are cells divided so as to be different, and what causes this difference, but the great question is how is the response of protoplasm to the action of the environment such as to intelligently adapt the being to the conditions of the environment. When an amœba ascertains from certain conditions that the pool of water in which it lives is about to dry up, it proceeds to envelop itself in a cyst in which it lies preserved until the next rain. Now we could easily imagine some being *endowed with intelligence* making an automaton that would respond in a similar manner to set conditions. But the amœba can do what no automaton could possibly do. It can adapt itself to new conditions if not too violent a change is made. It can *learn*, it must *experience*, and evolution is its account for the powers already acquired by ancestral experience. Ultimately, in all explanations of heredity, the powers of mind are tacitly conceded and if consciousness and mind in the higher animals are the results of evolution, it must be conceded that mind is present wherever there is protoplasm; and it may well be asked, are not all the properties exhibited by protoplasm (aside from such chemical and physical properties as it possesses in common with all other matter) of such a nature as to require terms borrowed from mental phenomena (*e. g. experience* and *idioplasm*). It is true that the activities of protoplasm are all of a physico-chemical nature and obey the law of the conservation of energy. But the problem of heredity is not primarily concerned with the physiology of protoplasm, but with problems of the origin of species, phylogenetic and ontogenetic questions that are totally foreign to chemical and physical phenomena. It is because of this that the problem of heredity becomes a psychological one, and for this reason psychology and biology are so intimately related; just as soon as phychology becomes a matter of research, rather than speculation, it needs the prefix *physiological*. In this connection consult:

"*La vie psychique des micro-organismes*" in *Études de psychologie experimentale*. Paris, 1888. Also translated by Thomas McCormac. Open Court Publishing Company, Chicago, 1889.

As higher animals are congeries of cells and we may believe that the psychological phenomena of higher organisms are the resultants of the activities of the cells, it behooves us to study the psychology of the unicellular animals. We are wont to think of several cells as needful for a psychic process in man, but here we see all the psychic processes taking place without nerves and ganglia, as responses of protoplasm to the direct action of the environment. Perhaps it would be more proper to say that the protoplasm reacts, where it is useful or needful for it to do so, in *intelligent response* to the conditions of the environment. The environment is always acting upon the cell whether there is a response or not. Protozoa exhibit exquisite sensibility without sensory organs. Pigment spots (*chromatophores*) and lenticular bodies are usually present in forms that manufacture starch from carbon dioxide by means of the energy of the sun's light, so that these "eyes" appear to be nutritive rather than sensory organs, though possibly both. The maximum amount of absorption of the sun's energy corresponds with the bands of the spectrum complementary of the colors of the protoplasm, and at the same time the maximum amount of oxygen is excreted, as proved by the bacterial test. Besides touch, there must be smell or taste for great delicacy of choice of food is often experienced as in those forms that prey on a single species of plant or animal. Some of these (*Didinium nasulum*) throw darts ("trichocytes") at their victims at a distance to paralyze them. Preudopodia and cilia are organs of motion. Some of the latter are automatic and others are under the control of the will. In sexual reproduction or conjugation there is exhibited a certain choice of certain individuals for each other. Then follows a series of evolutions or dancings about that may last for days; there is apparent a conflict between two impulses, one seeking union, the other a desire to escape; yet finally conjugation ensues. The spermatozoa and ova of higher animals are unicellular and unite under similar laws. The generative products are mutually attracted by the same impulses that bring the adults (gametaphores) together. It has indeed been shown by Pfeffer that malic acid has an attraction for spermatozoa; malic acid is present in the neck cells of *Antheridia*, but this fails to explain the mutual attraction of the pronuclei in the egg. A spermatozoon will overcome considerable obstacles, or pass by round-about paths, to reach an egg. Weber's law has been found applicable to the sensibility of spermatozoa. The threshold is a solution containing $\frac{1}{1000}$ of malic acid. If spermatozoa are placed in a solution of this or a higher strength they require a solution thirty times as strong to attract them; this ratio is constant. In the case of the spermatizooids of mosses the constant ratio is fifty for cane sugar.

If we now reflect on these facts, together with facts presented earlier, with regard to the rôle of the nucleus, the following conclusions appear safely deducible. The seat of consciousness, or at least of mind, is in the nuclear plasm, i. e. *the gemmules (chromatin granules) are endowed with psychic powers, and because of this they properly constitute the idioplasm.* We cannot leave the subject at this point, for we have premises from which very important conclusions may be drawn, and here the importance of the difference between the Kölliker and Weismann theories appears in its real light. According to one view there must be a very perfect localization of idioplasmic functions throughout the body, and this favors the localization of mental functions of a more advanced sort in the central nervous system. While according to the other view we have one part of the body as much the seat of the mind (or soul) as the other, while the apparent localization which we find is of a more extraneous nature and due to the position occupied by the cells. The gemmules of the eye and liver cells could be interchanged without interfering in the least with the functions of their organs and similarly for any ganglion cell in the center of apperception. In society this would be illustrated by taking the rail-splitter and placing him in the presidential chair, and the ex-president retiring to his farm. To Kölliker the soul of the state is the sum of the common consciousness of its citizens; according to the other theory it is the consciousness of the chief person in the realm. Every one realizes the fact that mental traits are as hereditary as physical ones; but that the learning acquired by the father is not congenital with children is simply because the reproductive cells were not concerned in the matter, but only certain brain cells. It is a special case of the non-inheritance of acquired characters. The mental acquisitions of the youth are retained by the man even though the cells concerned have multiplied in the meantime. This illustrates the law that whatever is acquired by cells is passed continuously on to their descendants. This law holds with the protozoa, *and with the germinal cells as well.* The conclusion to be drawn is that whatever is hereditary must have been the experience of the reproductive cells. If we could learn the nature of this germinal education we should be enabled to educate the unborn generations through our germinal cells. The Principles of Pedagogy have their roots in the study of the Biology of the Protozoa.

What is really done by the cells in a psychic process? Certainly a set of acts more special (*i. e.*, not of so great a range of variable work) but of the same nature as that performed by the protozoa. All is reduced to stimulus and reaction, and the same process may take place with or without consciousness. The enquiry then becomes: Where is the seat of consciousness and what physiological processes condition conscious states? Is the egg conscious? All that appears in the body was in the egg. Are the reproductive cells, are the protozoa conscious? Probably one as much as the other. These metaphysical questions are biological questions at bottom, and do not seem to be incapable of solution with a little careful thought and experimentation. The solution of all questions of this nature can come only when the various lines of biological research indicated in this paper are completed.

Origin of the Fittest. COPE.

In this connection the final chapters of this work offer many suggestive ideas. The earlier part of the work calls attention to the important phenomenon termed "acceleration," by which is meant that every time an ontogeny is repeated the characters appear at earlier and earlier periods, or in other words the developmental history is compressed to give room for the later added acquirements.

Begriff und Sitz der Seele. SCHMIDT. Heidelberg, 1887.

What is the seat of the soul? Is it a point or in a special portion of the body? If so, where? Or is it diffused wherever there is idioplasm? We first consult Schmidt. There are three forms of biological force, contends Schmidt, more and more unified, or active at a point, as we ascend the scale, viz., unconscious mind in the plant, consciousness in the animal, and self-consciousness in man. If the soul is the life of the body there must be a central point of life, and this he finds to be the *Nœud vital* of Flourens, because a destruction of the gray matter at the point of the *calamus* causes instant death. Here is the center to which cell sensations are carried, and from which all mandates of will are sent forth. He even indicates the paths by reference to Fick's "Phantom Brain!" Organisms begin in a mathematical point; the embryo is not formed from all the cells of the morula, but from a central point corresponding with the central point of the *germinal vesicle*. In the adult the *Nœud vital* is the center of the body, (the head representing concentrated segments). It is scarcely necessary to comment upon this theory. The author is not well enough versed in anatomy, embryology or physiology to know that not any of his statements are significant, and most are sadly erroneous. Death from the destruction of the structures in the *Nœud vital* ensues because the heart and breathing movements are innervated from these points. There is no proof whatever that consciousness resides here.

Von dem Materielen der Seele. HITZIG, 1886.

This is a popular address calling attention to such facts as the increased circulation in the brain during mental work, the effect of drugs on conscious states, the effects of the removal of parts of the surfaces of the hemispheres, etc., to show that there is a material substratum for mind. The difference between man and animals lies in the power of the former to reason abstractly, while the latter depend on direct sensations. This difference is probably due to a difference of organization of the brain. If we are evolutionists we can look hopefully to the future, when the soul shall have made as great an advance beyond its present position as now it stands above the animal stage, then it may be able to understand itself.

Das Körperliche Gefühl. KRÖNER, pp. 220, Breslau, 1887.

This is a treatise on the development of the soul, and is based on biological laws. The mental protoplasm, out of which all mental powers have been evolved, is general bodily sensation or feeling. This includes simply the sensations of pleasure or of displeasure. Soul is declared to be wherever sensation intervenes between the stimulus and the reaction. A first group of bodily sensations are those not localizable, such as weariness, sleepiness, hunger, thirst, appetites, modesty, etc., all dependent upon general states of nutrition. This class of common sensations *(Gemeingefühle)* are first in ontogenetic and phylogenetic development. In the child the sensations received through the special senses are probably transformed into *Gemeingefühle.* The effects of various states of the bodily organs on the feelings of this class is next taken up in order, after which the same effects from stimuli of the special senses. To take an illustration, the flesh of animals is out of flavor during the breeding season. This is due to the absorption of odors. The effects of certain odors may spread very rapidly through the body; this is due, he thinks, to the chemical action of the substances upon the cells. An objection seems possible here that in some cases this effect is so instantaneous as to bar out all idea of the circulation spreading the substance. The effect can be due to nervous radiation only. The effect of odors may be quite soothing or the reverse. The great rôle of sexual odors in arousing passion is referred to.

In the chapter on the Emotions, the result of associations formed by coincidence of certain states and certain objects, it is shown that they may be quite individual, an object inspiring feelings of disgust with one person and of pleasure with another. The effect of ideas in producing bodily changes is dwelt upon. Emotions can't be kept up, the higher the pitch the shorter their life. Temperaments depend on the nature of the *ease* of emotional change, and on the *strength* and the pitch of the resultant feeling. The sanguine temperament is quickly moved to a high pitch, but with little strength in the emotional states. The phlegmatic is slow, low and weak; the choleric, quick, high and strong; the melancholic, slow, high, or low and strong. Even animals have temperament. Common sensations depend on chemical or nutritional changes. Irradiation of pain is due he thinks to the formation of poisonous substances at the spot of injury that spread by osmosis. The cause of sickness when viewing the sun is due to the production of products of disorganization in the over-stimulated cells. This must be taken for a rash conclusion, for reasons similar to those advanced when speaking of odors above. Once the author had occasion to use some dog grease, and no sooner had his dog come near than he was seized with a paroxysm of fear, perhaps says Kröner the dog whose fat was smelled had died in agony, and the chemical products of fear were absorbed by the fat. The effect of smells is often such as to cause the recall of forgotten scenes. Panics may be caused by a sort of odorous contagion. Here we may ask why is it necessary to have a material substance, that is conceived to act by chemical methods. In physics electric vibrations produce inductive effects, and shall we rule out the possibility of similar effects between living bodies. In acoustics we have sympathetic vibrations. A panic is a case of sympathetic action. This view if true will give the basis for an explanation of those cases of thought-transference not otherwise explainable. But thought-transference is a term not applicable, but rather emotional transference or sympathetic response. The case of the mother who after a severe fright nursed her babe and it soon died of convulsions, and all similar well-known cases are of course to be explained on the chemical theory. The effect of the emotions on the secretions of other glands, as tears, sweats, etc., is well known; sad news destroys the appetite. When stimuli are repeated they do not affect protoplasm as did the first one, this is not due to a general weariness of the nerve, for if a different sort of stimuli is used we get a greater effect. This is due to a sort of adaptation, similar to that which takes place in opium usage and other habits where the dose must be constantly strengthened to produce its effects. Tickling offers some curious features that are not easily explainable. Only the *Culturmensch* can be tickled (?) It is a species of shuddering. Pain may be defined as an unusual stimulus, one which the cells have not learned to interpret or meet with proper reaction.

But there are also special paths for pain that give ideas of injurious effects that the body as a whole can control. Natural selection has evolved ideas and memory in those lines only where such psychic activities are useful. For the body in general it has been found sufficient to retain the common sensation of protoplasm.

Change of Life. TILT.

Tilt advocates the view that the visceral ganglia are the seat of the emotions and brings much matter of observation of disturbance of these ganglia by the involution of the ovaries. The effects of "gangliapathy" are such as to profoundly disturb the body and cause even insanity. A blow at the pit of the stomach may kill as quickly as a puncture of the *nœud vital.* Note the disturbance of sea-sickness, the vomiting of pregnancy, nightmare and of *globus hystericus*, which latter begins by a sensation rising from the pit of the stomach. This may be caused by continued pressure on the ovaries, and end in convulsions. Hysteria is the "keystone of mental pathology," and if he were lecturing on insanity he would begin with an accurate study of a complete case of hysteria and show the regular steps by which it may culminate in mania and other forms of insanity. "The epileptic aura radiates from the ovaries. Between haziness of intellect and idiocy there are all gradations, between a girl's temper and mania there is no break, and fidgets may pass through hysteria into convulsions. We must go back to Hippocrates who thought the abdominal viscera caused insanity. There is no passion without ganglionic or visceral sensation." These are pregnant words but in extending the realm of the soul from the central nervous system to all nerves, why draw the line here? Nerve cells are part of the same protoplasm, have a common germinal ancestor with all other cells. The fundamental properties of cells are alike. If a cartilage cell does not play so important a part in the psychic activities of the body as a ganglion cell, neither is it situated favorably for such a purpose,—it is not connected by a nerve to an end-organ. Even in the nervous system itself it becomes necessary to distinguish parts that act outside of consciousness. The intellect is indeed produced through the experiences of a special portion of the central nervous system, but this is only one organ of the soul. The greatest philosophers have seen the necessity for extending the realm of the soul. Leibnitz for instance considers every atom to be souled. What idea is denoted by this term soul? The word stands for a philosophic necessity rather than for a definite idea. The problems of science are always pushed back to a threshold where something different from matter must be postulated, something that does not suffer from the limitations of three dimensional space, the law of the conservation of energy and other ideas inseparable from the sensible universe. With reference to such a realm thought must work without images, as for example is the case in the consideration of *non-Euclidian geometry* (geometry of more than three dimensions). From such a standpoint it becomes rational to say that all the hereditary characters are conserved in the egg, though only a few are actually manifested in its structure at any one period of development, and again, that each gemmule contains all the characters of the complete being of which it is a part, often only a transitory part.

The Soul, or Rational Psychology. SWEDENBORG, pp. 388. New York, 1887. Translated by Frank Sewall from Dr. Tafel's Latin edition, Tübingen, 1849, from posthumous MS. Upsala, 1742. (Part VII of "The Animal Kingdom.")

The preceding leads us logically to consider the last work on this list for review, which though only relatively modern, is chosen for its representative character. It is probably the ablest exposition from a transcendental standpoint we have. The author is not in repute among scientists of to-day for obvious reasons. He is purely a speculator, and still worse, in his later life became subject to hallucinations that were incorporated as the keystone to his system, and which like the Comtean system became the creed of a religious sect.

This "Aristotle of the North" informs us that the great purpose in all his studies has been the discovery of the soul. "There is no other field of exploration than that of the anatomy of the organic body." This was before the time of cell theories, embryology and physiological experiment. In his dissections, Swedenborg found the fibre (muscle, nerve, arterial, etc.,) making up most of the body. The fibre is considered the unit of structure, but the fibres of the brain end in "glandules" (ganglion cells, undoubtedly). All fibres are conceived as hollow, and as carrying a blood. There are three degrees of fibres. The tunic of the blood vessel is composed of fibres of the same grade of organization as the constituents of a nerve. The tunic of the nerve fibre is composed of an organization of "simple fibres," (nearly corresponding to our idea of *fibrillae*.) The last carry the "supereminent blood" (nerve force), and are themselves composed of molecular constituents called "pure intellectories," which are "vortical forms" (cf. "vortex rings" of our physicists) and are the soul in its first spatial manifestation. These are incapable of dissolution, are not affected even by fire, and hence not subject to death, which last is only a dissolution of the coarser grades of organization down to these monads. In each is a special determination of the soul so harmoniously interrelated as to constitute the "form" of the individual or species, from which the spatial relations of the parts of the body become derived during devel opment. When death dissipates the monads in three dimensional space, heir relations in the soul-form are undisturbed. The organic relations f the intellectories is the "pure intellect," present as the life (or heredtary nature) of all biologic beings; it constitutes the celestial body of the soul, and unless a coarser body is formed, the soul remains out of relation to the environment of the world. This coarser body constitutes apparently what we know as protoplasm. It can receive impressions from nature only by means of different forms of vibrations. Each form of vibration is received by the cells as such, and is transformed into sensation in which the relations or qualities of the different forms of the vibrations are preserved, and hence the specific energy of nerves. The constituent units of a derived organization are termed the "internal;" the derived unit the "external." The internal of one form is itself at the same time the external of its units. The units are always each the complete image ("effigy") of the derived or greater unit. Each brain cell is a brain in a less form, and its units the "brain in a least form." Now, when a change is produced in the external, the "harmony" of the external and internal causes a correspondent change in the internal. But if we could see the changes it would be impossible to compare the two sets, they differ so radically in their nature. This is the celebrated "doctrine of correspondences," by which Swedenborg sought to explain all things celestial and terrestrial. There is therefore no commensuration between a physical vibration and a change of consciousness which arises coincidently; and hence there is no psychic localization in the brain. Every stimulus received, radiates to all parts; but by the laws of corresponding harmonies the qualities and relations of the external stimulus, as for instance the different parts of a retinal image, affect the monads with the relations completely preserved. For in the soul is a "pre-established harmony" corresponding to all possible modifications that may arise. These harmonies are affected (like sympathetic vibrations) in this manner, viz., the harmony or relation of the vibrations causes sensations. The relations of the sensations affect the next "internal" and cause the "affection" termed perception (images). The relation of images affects corresponding harmonies in the "pure intellect," and these changes are *thoughts*. What is the difference between the human and the animal soul? Here, as elsewhere, Swedenborg is obscure and extremely difficult to comprehend. We feel sure that he is logical and has definite ideas on the subject, even if we see as "through a glass darkly."

The life of the sensations constitutes the animal soul or "animus," also called the "inferior mind." In the animal this is completely dominated by the "superior mind," (pure intellect) and has no independence of its own. In man there is interpolated between the two, a "rational mind," which exists at first as a power of attention or free will. This is the "man proper" as to his self-consciousness. He can turn either to the sensations or to the superior mind and establish the relations existing in the animal by allowing the superior mind to control the animus. But failing in this, the animus asserts its control, and being blind like Schopenhauer's Will, works destruction. This is the Fall of Man. This rational mind becomes organized in time (ontogeny) out of the experiences of life. Every cell is both sensory and motor, both receiving and giving stimuli. Each cell has its own will, and hence wills must be distinguished into genera and species. Will is simply the effort to break forth into act, and action ensues when the tension overcomes the obstacles on the reception of appropriate stimuli.

This is a meagre outline of salient points of a system that goes into complete details of all phenomena, and seems to compare favorably with the systems of other great philosophers; it is remarkable that all notice of Swedenborg is wanting in histories of philosophy. Besides this the man himself, with his thirty years' record of orderly daily hallucinations offers a wonderful problem to the student of psychology. This work closes the pre-hallucinatory portion of Swedenborg's literary career, and one cannot help thinking that had he died then, his fame would have been greater. Now, nobody thinks of him except as the "seer," or "madman." The following words from the Rational Psychology, sound quite sane. "When we live as souls perhaps we ourselves shall laugh at what we have guessed at in so childish a manner."

If this review shall suggest a closer sympathy between Biologists and Psychologists in the effort to solve the problems of life, it will have accomplished its mission.

III.—CRIMINOLOGICAL.

By Arthur MacDonald, Ph. D.

Criminal anthropology is one of the most recent sciences. In 1885, the "First International Congress" was held at Rome. The second congress met at Paris last August. At first the scientific study of criminology was looked upon with suspicion. At present, interest in the subject is greatly increasing. Like every new science, it is in its polemical stage. The Italians are the innovators. The criminologists are divided into two parties: one emphasizes the pathological or atavistic causes; the other, the psychological and sociological. The latter are subdivided into socialists, who would account for everything by the inequality of economic conditions; and those who take into consideration all social phenomena. The literature is almost wholly new.

The divisions of Criminal Anthropology and its relations to other sciences might be indicated as follows:

Criminal *Embryology* would consider the equivalents of crime in the vegetable and animal kingdoms. The *Anatomy* of Criminology includes more especially the Craniology, Brainology, Histology, Anthropometry and Physiognomy of the criminal. In Criminal *Psychology* one would study the entire psychical life: Intelligence, Sentiments, Sensibility, Ethics, Æsthetics and Religion. Criminal *Sociology* comprehends the association of criminals; their relation to the state; economically, and in connection with poverty and misery. Criminal *Jurisprudence* takes into consideration all criminal laws, and their underlying principles. *Penology* treats of the principles, degrees and methods of punishment. *Statistical* Criminology has for its object, the arrangement, classification and summary of all criminal data; and their interpretation. Criminal *Hypnology* concerns those hypnotic and partially hypnotic conditions, in which crime is committed; especially in the case of hysterical individuals. Criminal *Epidemiology* considers those conditions, where through imitation, or by a sort of contagion, crime suddenly develops. Criminal *Teratology* treats of Pathological Sexuality, Onanism, Pederasty, Sodomy and Saphism. Criminal *Prophilaxy* considers the methods of prevention; through alterations of social condition, physical, intellectual, moral and religious education; by means of prisons, transportation and deportation. The *Philosophy* of Criminology takes up the more disputed questions and theories: as Atavism, Infantilism (natural depravity of children,) Degeneracy, the interpretation of psychical and physical characteristics, and crimino-psychiatrical cases. We may add, that the whole study of pathological humanity may do for humanity what pathology has done for medicine.

Les criminels, charactères physiques et psychologiques, par DR. A. CORRE. Paris, 1889; pp. 412.

The real criminal is he who does not recognize the rights of others; he is not a simple offender, but a hypocritical one; not like the man who opposes society openly. Every great man who establishes the supremacy of his country, and under the pretext of maintaining it, in the name of public safety, commits the most detestable acts solely for his own interests and caprice—such a one is a criminal. However, admit two groups, those who are imprisoned for their misdeeds, and those who are free. Does this opposition correspond to the particular aptitudes in the groups which present it? Does criminality lie in the individual or environment? If in the environment, in what measure can it be modified? The answers to these questions are based upon anthropological and statistical documents.

In regard to the brain, the author does not find anything strictly peculiar to criminals. In respect to the cranium, the following points are noted: 1, the more frequent persistence of the metopic or frontal median suture; 2, the effacement, more or less complete, of the parietal or parieto-occipital sutures in a large number of criminals; 3, the notched sutures are the most simple; 4, the frequency of the Wormian bones in the regions of the median posterior fontanelle, and in the lateral posterior fontanelles; 5, the development of the superciliary ridges with the defacement, or even frequent depression, of the intermediary protuberance, the development of the mastoid apophyses; 6, the backward direction of the plane of occipital depression. General sensibility is lower in criminals; left-handedness is common; imperfection of sensitive activity; this lack of sensibility to pain and to disagreeable sentiments explains the want of pity and the cruelty of criminals. The true criminal has something of the incompleteness of the beast; he is a man who has remained animalized; he is an opponent of altruism, is lazy, likes wine, gambling and debauch; in general he is afraid of the thought of death, indifferent to religion; without remorse; he is extremely vain. Intelligence does not develop his altruistic feelings; although very cunning, the criminal is inferior in intelligence.

There are criminals of genius; some are honored by the world. They are egotistical monsters; if possessed with power, they commit crimes under other names; the slang of the criminal is rich in words for drunkenness, wine and money; educated men among criminals are rare. In the majority the notion of the act is so persistent as in a certain measure to take away legal responsibility. In many impulsiveness is sudden and irresistible; onanism and sodomy are common. Recidivists are increasing in number. The physiognomic characteristics are in general: small cranial dimensions, receding forehead, absence of beard, abundance of hair and dull eye, (women criminals are almost always homely); thick lips, projecting eyes and large jaws. These characteristics, while common, are by no means absolute. An individual always considered of sound mind, who does things, the motive of which is inexplicable or out of proportion to his appetites, is to be regarded rather as insane than criminal. In delicate and disputed cases those with most experience and intelligence should decide, and not the jury. Among the cases of doubtful criminality are giddy, epileptic, hysterical women with hereditary taint, who, commencing with eccentricities, go into crime. The legislative idea of premeditation is to be replaced by that of the degree of intensity or duration of the solicitation. Criminals from sudden passion are more excusable than those who commit crime under the influence of drunkenness by alcohol, ether, morphine or hashish; for the latter, although far less conscious of their deeds, know that these drugs expose them to such acts. The highest grade of criminals are so by profession, who are knowingly and deliberately rebellious against society. The last class are the false-honest men, who, by the cloak of wealth, power, position or honor, utilize society solely for their own disordered appetites.

Rejecting the criminal type in the sense of anthropological unification, the author believes that the cerebral inferiority of the criminal has its origin in a sort of arrest of development in childhood. Admitting a subordination to the acts of the organization, and the want of liberty society should not punish the less, as it is her only way to maintain herself; but should keep within the strict limits of self-defence. The death penalty is a relic of barbarism; the ideal is not repression, pain for pain. A wise code should reprimand by bettering, not by destroying; it should diminish the intensity of the solicitations to crime; it should remember that society is in a great measure the cause of criminality. The author, while stating his own views without reserve, shows a broad spirit towards the views of others; on the whole he is not extreme, but takes a medium course. The first part of his book, which treats of the physical organization, we regard as the most valuable.

L'Homme criminel, étude anthropologique et médico-légale par CESARE LOMBROSO, traduit sur la IVe édition italienne, avec préface par M. Letourneau. Paris, 1887. pp. 682.

The first motive in our savage ancestors was the necessity of self-defense, reflex action, blow for blow. In plants we find the equivalents of crime, in the case of certain species which entrap and kill insects. In animals acts are more similar to those of man, are more mechanical, having slight traces in consciousness. In men continual aggressions gave rise to balancing wrongs, and vengeance appeared, giving the law of primitive justice, retaliation, which became a duty. But as some of the particulars of this law were overlooked, the legal power became a sort of revindication; the punishments were of the most cruel nature. To-day there is a vague feeling, an echo of ancient retaliation in our punishments. If punishment rests on free will, the worst men, the criminals by nature, should have a very light punishment or none. Penal repression should be based on social utility scientifically demonstrated; instead of studying law texts, we need to study the criminal. The criminal by nature has a feeble cranial capacity, a heavy and developed jaw, a large orbital capacity, projecting superciliary ridges, an abnormal and asymmetrical cranium, a scanty beard or none, but abundant hair, projecting ears, frequently a crooked or flat nose. Criminals are subject to Daltonism; lefthandedness is common; their muscular force is feeble. Alcoholic and epileptical degeneration exists in a large number. Histologically, their nerve-centers are frequently pigmented. They blush with difficulty. Their moral degeneration corresponds with their physical, their criminal tendencies are manifested in infancy by onanism, cruelty, inclination to steal, excessive vanity, impulsive character. The criminal by nature is lazy, debauched, cowardly, not susceptible to remorse, without foresight; fond of tattooing; his hand-writing is peculiar, signature complicated and adorned with flourishes; his slang is widely diffused, abbreviated and full of archaisms. In their associations they return to primitive social forms. The general cause of the persistence of an inferior race-type is atavistic. As the born criminal is without remedy he must be continually confined, and allowed no provisional liberty or mercy; the ancient tradition of vigorous initiatives should be upheld; the more we diminish individual responsibility, the more we increase that of society, which is still more severe. Nature is responsible for the born criminal, society (in a great measure) for the criminal by occasion.

The work is full of facts, it shows the sincerity and patience of the author, who is an expert experimenter, and a person of philosophical acuteness. He has given an extensive description of the born criminal considered physically, morally and intellectually. The author seems to us to go too far in holding to the incorrigibility of the born criminal, and in not allowing him provisional liberty; the incurability of the recidivist is pushed too far, for neither of these positions are supported by a sufficient number of scientific facts.

La Criminologie, étude sur la nature du crime et la théorie de la pénalité, par R. GAROFALO, agrégé de l'université de Naples. Paris. 1888. pp. 420.

The science of pœnology must not rest on the idea of freedom, which is in contradiction with scientific facts; on the idea of freedom the hardest criminal should go free as he has least control over his acts. The pœnological criterion is social necessity, abandoning the idea of moral responsibility of the individual. The present system has neither cured, nor terrified the prisoner; after his sentence is served, he is as dangerous as ever. The laws should be changed so as to be in accordance with criminological facts. Crime is a harmful action, that injures at the same time the moral sense of aggregate humanity. Murder, parricide, infanticide, robbery have not always been crimes; but the analysis of the sentiments and not of actions is the basis for a criterion. The race possesses innate moral instincts as it does a physical type; when the moral sense becomes psychical, it is subject to alterations, diseases, can be lost or wanting, a parallel to any other organic monstrosity. The moral sense of aggregate humanity consists only in the altruistic sentiments which can be reduced to benevolence and justice. A crime is the violation of the elementary altruistic sentiments of pity and probity. In Europe the relative increase of crime has advanced with civilization which shows that the present methods are almost a failure. Punishments have become less severe; moral responsibility is more considered and capital punishment is rare.

A criminal type is as well established as an Italian type; not a single characteristic constantly distinguishes this type, but the proportion of congenital anomalies is larger in any given number of criminals than in an equal number of non-criminals. Recidivation of the criminal is the rule, reformation the exception. The absence of elementary moral instincts is not an infirmity; instinctive criminals are not sick nor insane; perversity is natural. The criminal is a being at present unadapted to surrounding circumstances; he is a monster, and presents the traits of past racial regression. All criminals are born, but predisposition does not exclude the influence of surroundings. One class of criminals are those with regressive, arrested moral development, innate criminals; for these society has but one remedy: elimination. Another class are those somewhat deficient in the feeling of pity; and a third class lack the sentiment of probity. Atavistic perversity exists in spite of the best surroundings; the influence of intellectual instruction is almost null. In Spain, where two thirds of the population are illiterate, criminals are few. Religious instruction, if begun early, and if its purpose is moral teaching, has good influence, except in the graver cases. Crimes due to cupidity will not cease by bettering the social conditions. Economic conditions may change the form of crime, but they are not a cause of crime in general. In the first half of this century a high degree of criminality was greatly reduced, in the second half (1828–84) crime has increased enormously and punishment has been made milder, the increase of recidivists is greater than that of all criminality; this points to a concentration which should render its prevention easier. Murder severely injures the moral sense of the community, a reaction in the form of desire of exclusion from society is produced, through lack of adaptation. The only absolute means of exclusion is death, but this applies only to the criminal by nature. It is the duty of society to eliminate those who are utterly unadapted to society. Punishment is not to punish the criminal, but to eliminate him absolutely or partially. The death penalty has given England the fewest criminals of all Europe. The common ideas, that there is no crime without moral responsibility, and that punishment should be in proportion to the gravity of the crime, are incompatible with scientific facts. It should be first determined to what class of criminals the culprit belongs; a man, who hires an assassin to kill the individual who outraged his family, is quite a different criminal from the assassin. The cause of a murder, and the absence of any grave injury on the part of the victim are the criterions to be substituted for premeditation. The worst criminals commit murder without premeditation; but in the case of the criminals by occasion, premeditation indicates a cruel nature, and elimination may be necessary; for the other classes of criminals, deportation, fine, removal to another environment, agricultural colonies, work for the state, etc. etc. The controlling ideas of the author are social utility, and the natural reaction against crime.

The author's extensive experience as a magistrate gives peculiar interest to his views on the pœnological side of criminality. He seems to us to draw too sharp a line between abnormality and disease. The born criminal is wholly teratological, a moral monster; but a teratological characteristic may arise from a deviation in utero—a real disease of the egg. His insistence on the absolute elimination of the born criminal is extreme; first, because it assumes the criminal's utter want of adaptation to society, which is not warranted by a sufficient number of facts; second, admitting his want of adaption, we fail to see why a society in which the public conscience is highly sensitive, might not substitute perpetual detention; for it is a question of social utility, whether the hardening of the public conscience is not morally injurious.

Concetto e limiti della sociologia criminale. CALAJANNI NAPOLEONI. Rivista di filosofia scientifica. Novembre, 1888.

The writer is the standard-bearer and the principal authority among Italian socialists. In human society development is not always normal;

it as a whole suffers from disease, just as the individual organisms; hence the necessity of the study of the morbid or abnormal state—a pathological sociology. This comprehends the study of the anomalies opposed to nature, showing their co-existence and their derivation one from the other in the social organism. Criminal sociology occupies itself with the criminal manifestations. Romagnosi, the statesman, says, that crimes are the diseases of the social body; sometimes they are general, sometimes local, now permanent, now transitory. Criminal sociology reaffirms the analogies between biology and sociology. The difference in the laws and respective characteristics is shown, not only in the fully developed organism, but in assigning to sociology the principal characters of the evolution in all the phases of one society. The utility of social criminology is direct and indirect: (1) By the study of the pathological alterations, the knowledge of the normal functions is increased; thus one is better able to determine the relation between cause and effect in diverse social phenomena; for as Drill says, delinquency is a sensible measure of the degree of health, strength, and prosperity of a given society in every given moment of its existence. (2) The direct utility of the study of social pathology, especially of criminal sociology, is intuitive; it directs one towards the care and prevention of crime; in lessening pain by gaining a just and free exercise of law, which results in the diminution of crime. But what is the place of criminal sociology in the hierarchy of the sciences? Lucchini, Fulci and Puglia, three famous Italian statesmen, maintain the superiority of the law to that of sociology. Others hold that legal science is only a chapter in sociology.

Now, sociology is a study of the whole life of the social organism. Liszt would divide biology into anthropology and criminal psychology. Moleschott thinks that sociology should be included in anthropology. But anthropology should be an introduction to sociology. Garrandi's division is: (1) Study of the world of criminality in its actual state and in its history; (2) Investigation of causes which produce crime; (3) Indication and organization of the means of combating crime. But a more practical division is this: (1) Genesis and etiology of crime; (2) Treatment of crime, (a) prevention, (b) repression; (3) history and course of crime.

Dégénérescence et criminalité, essai physiologique, par Ch. FÉRÉ. Félix Alcan, Editeur. Paris. 1888.

This book contains short chapters treating the subject generally, and is critical of the results of those (Lombroso, Garofalo, and others,) who are more specialists in criminology. In addition to the general interest of the book, it may be useful in guarding one against the exaggerated inferences that specialists sometimes make in connection with the facts they present. The author introduces some physiological conditions of the emotions. The physiological conditions of crime are more frequent with the feeble. The author considers the atavistic origin of crime as a pure hypothesis. Anatomical and physiological characteristics are not sufficient to establish anything; cerebral anomalies point merely to the fact of complexity and irregularity in brain morphology in general; there is no criterion of criminality except the material proof of the crime. Whatever one thinks as to the moral responsibility, there is no doubt as to legal responsibility, the main object of which is to preserve society; that is, to treat dangerous criminals as dangerous sick persons. Society is responsible for the conditions which breed criminals. Education and instruction work with a limited number, who are not prone to evil through an organic defect, and with whom it is possible to develop general utilitarian motives; the principal cause of misery lies in organic inferiority.

Some etiological conditions of criminality are : abuse of alcohol, and example; thus, as to the latter, the idea of an act is already the act which commences; thus the publicity and minute descriptions of criminal acts develop similar tendencies. The only curative process which experience seems to favor is assistance, by which is meant, to help the criminal, in his struggle for existence, to gain an equilibrium between his needs and his power of production. The analogies between the practical treatment of the insane and the criminal may indicate a natural method towards the solution of the question.

Zwei Kriminalpsychologische Fälle. Ein Beitrag zur Kenntniss der Uebergangszustände zwischen Verbrechen und Irrsinn, von Dr. AUG. FOREL. Professor der Psychiatrie in Zürich. Bern, 1889.

In spite of opposition, determinism, based upon evolutionism, is becoming more prominent in contemporary philosophy. Contradictions between legal ideas and legal punishment will vanish so soon as punishment is for the correction of the prisoner and the protection of society, and not an expiation of the deed.

Those persons known to have a lawless disposition should be taken care of before they can do injury to society, and, on the other hand, inmates of prisons, should be psychologically studied, as to when and whether they should be given freedom, instead of holding them a certain length of time, according to the nature of the deed. The time is to come when the treatment of criminals will belong in part to psychiatry and in part to psychology. A normal psychical state is an adequate adaptation of the mind to the forces in the outer world. A normal free will is nothing else than an adequate reaction of the mind. A criminal act is an inadequate reaction. The writer cites two cases, giving the details at some length; one exhibits a high degree of weak mindedness, with an inborn ethical defect, weak judgment, liable to repeat similar acts. In this case the person was found guilty of kidnapping a child, and sentenced to ten months in the work-house. The second case is that of a person shooting his friend without warning, and then shooting himself; a case of hereditary insanity, of deep ethical defect, contrary sexual feeling, hysterical fanaticism, etc. There are all kinds of transitions marked by constitutional and chronic disturbances of the mental equilibrium, the disease can appear as almost natural to the organism, merely as an individual peculiarity, an inadequateness. Thus there are no sharp limits between the inadequate character of a criminal and that of a normal man, just as there are none between bodily anomalies and health in general. Moral training, safeguards and principles are the best means for forming a habit of life that will endure.

Reflections on the Theories of Criminality. Rev. W. D. MORRISON. Journal of Mental Science, April, 1889.

It is by careful study of individual criminals, as has been wisely said, that advance in real knowledge of criminal psychology is to be made. Mr. Morrison's paper is one of this desirable sort. A laborer turned out of his lodgings with his family, somewhat the worse for liquor (though not actually intoxicated) and passionately excited, takes revenge by dashing out the brains of his two-year-old son. The author summarizes his personal and family history, his anthropological characteristics (including craniometric measurements) his mental condition, (senses, intellect, emotions and will), and the active and potential causes of the crime. He concludes that the murder was "the result of adverse social circumstances acting on a criminally-constituted organism. . . . The circumstances alone or the organism alone would not have sufficed to produce the deed."

Le crime et l'épilepsie. G. TARDE. Rev. phil. Nov., 1889.

M. Tarde subjects the views of Lombroso on the epileptic affiliations of crime, as brought out in the second volume of his *L'Uomo delinquente*, to a thoroughgoing examination and finds them far from demonstrated. But if Lombroso has failed in establishing his thesis, his error was not in supposing a common bond in all kinds of crime, but in naming it. Epilepsy is only the extreme type of a periodicity which marks all psychic action and which may be observed in the most normal. A psychic state once experienced tends to repeat itself periodically, and most of all criminal states, for they are, at first at least, most striking and impressive because out of the usual order. But periodicity, because it is universal, cannot stand as a test of responsibility; it is those whose periodicity carries them through psychic extremes, whose orbit is cometary, that are the irresponsibles. Tarde himself gives an important place to the social principle of imitation. It is self-imitation (habit) and imitation of others, that makes criminals recidivists, and carries honest men along the lines of uprightness.

Die Psychologie des Verbrechens; ein Beitrag zur Erfahrungsseelenkunde, von Dr. A. KRAUSS. Tübingen, 1884. pp. 421.

The author gives the results of a long and active study on the phenomena and conditions of crime. The standpoint is that of empirical psychology. Physiology is touched upon only so far as is necessary to the understanding of the question at hand. The author does not think that the time has arrived to unite these two sciences; their separation must be considered as yet a scientific miscarriage. The causal connection of criminal phenomena is sought out and traced back to a common ethical principle. The following are some of the main points: Self-consciousness is the source of morality and immorality; of morality, so long as it postulates the clear knowledge of the moral law; of immorality, so long as it leads to self-exemption, and the emancipated "ego" becomes itself law. The degrees of moral consciousness are the criterion of guilt and responsibility for every moral failure; childhood represents an unripeness; idiocy a potential incapacity of moral development. Old age postulates a weakening of the moral power of resistance, since it is accompanied with a certain dullness of self-consciousness. Conscience, the substance of moral feeling, fulfils in man that spiritual normality which makes him responsible for all his acts. This moral freedom is nullified by two organic conditions, insanity and abnormal sleep, on account of the formation of illusions. The love of pleasure and the aversion to labor are by far the greatest sources of crime. The weakening of moral consciousness increases with the number and organization of societies of criminals. An irresistible force, outside of pathological conditions, is not recognized by an earnest administration of justice. Strictness is throughout more rational than mildness. The penitentiary is perhaps the high school of crime; the only rational method is deportation, not only because society is freed from a pest, but the criminal through new conditions is better enabled to self-reformation. The death penalty is the only form of punishment for a cold-blooded and premeditated murder.

War with Crime, by the late T. BARWICK Ll. BAKER, Esq., edited by H. Philips and E. Verney. London, 1889. pp. 299.

The book consists of a selection of reprinted papers on crime and reformatories. The author was a magistrate of experience, and had much sympathy for the poor and unfortunate. He makes crime due to a form of mental disease, for which the prisoner is not the only one responsible. The disease must be combated rather than the individual. In the war with crime, prevention and not retaliation is to be carried on by cumulative punishment, that is, the penalty should be apportioned rather by the antecedents and number of repetitions, than by the heinousness of the crime as judged by itself. There should be a steady increase in severity of convictions after a second conviction; yet the door to reformation should always be kept open; and this could be done by adding to sentence of imprisonment a term of police supervision. While enthusiastic for reformatory work, the author was opposed to reformatory schools under the exclusive control of a committee of magistrates. Reformatories should be limited to cases of confirmed criminality. In case of boys arrested by policemen, a short stay in prison (fourteen to twenty-one days) should precede the entrance into a reformatory school. In the case of vagrants a distinction should be made between the man who travels in order to live, and the man who lives in order to travel. There is no fear from over-education. The book is valuable from its practical nature. While some of the methods of reform may be outgrown or generally accepted, an account of them has historical importance in giving a practical insight into the development of reformatories.

Penological and Preventive Principles, with special reference to Europe and America. By WILLIAM TALLACK, Secretary of the Howard Association. London, 1889; pp. 414.

Notwithstanding the variety of opinion among those of long experience in the charge of criminals, there is a preponderance of experience in certain directions. It is the special design of this book to aid in recognizing these converging lines and approximate conclusions. The author is a strenuous upholder of the necessity for the effectual separation of imprisoned criminals, as opposed to the system of classification and association of criminals. The author appeals to the penal experiences of different nations: France, almost despairing in legislation, had the Récidivist Law for the extension of penal deportation; also the number of imprisonments increased threefold in half a century, from 41,000 in 1836, to 127,000 in 1888; and the "recidivists" increased from 31 to 48 per cent in the more serious offences, and from 28 to 43 per cent in the minor ones. In the United States there has been a steady increase of crime to population, and a shocking development of corruption in the county jails. In Italy we find almost the worst predatory and homicidal classes in gangs of contaminating villany among the prison population. In Germany the prisons are largely schools of crime. In Australia the system is condemned on all sides; it led to conspiracies, insubordination, vices, increase of expenses, contamination, and no possibility of reforming the criminal. In England, with its cellular local jails, and in Belgium and Holland, with similar central prisons, where separation is secured or approximated to, we find the criminals most effectively held in check. In this system there should be added a re-arrangement of sentences; that is, short, but sharp ones; more really penal, but more mercifully deterrent and reformatory. But another purpose of this book is, to show that the efficacy of prisons in the repression of crime is immensely exaggerated, in comparison with other methods of reformation. As to legislation, a reasonable cumulation of penalties is desirable. The element of certainty is very important. Judiciously administered substitutes for imprisonment, including conditional liberty or probation, fines and moderate corporal punishments, are merciful and economical alternatives for prolonged incarceration. These views are held by the majority of penologists. As to preventive influences, too little attention is given to the restorative agencies of religion and morality, (including under the latter head, the wise encouragement of temperance, chastity, thrift,) systems of education and training children to a self-supporting industry, the influence of piety, fostered mainly by denominational schools, where their faith is kept from being needlessly assailed—all these factors are too much neglected. It is generally admitted that the prevention of offences and the development of society is forwarded by reverence for law and order, and a wise use of fear and hope, reward and penalty. Now it is pre-eminently in the Gospel that we find these principles most authoritatively embodied and exemplified.

Prison Statistics of the United States for 1888. By ROLAND P. FALKNER, PH. D. Philadelphia, 1889; pp. 34.

This brochure presents many interesting facts. There is a homogeneous convict population in our prisons. The county jails and houses of correction have a continual change in their population, owing to short sentences. The percentage of colored prisoners is much greater than that of the colored population. As to age, the prisoners are as a rule in the prime of life; the higher age classes are less represented than in the general population. The foreign element furnish a larger number than the native-born, but they stand relatively lower in the grave offences than in the less serious ones. The British-American element makes a bad showing; in Michigan, 38.14 per cent. of the foreign prison population; and in Maine, New Hampshire and Vermont combined, 60.85 per cent. of it. The Germans have the same ratio in crime as the native-born. Interstate emigration is common, so that those born in other states are represented more strongly than in the population generally. The unmarried show relatively a large percentage, especially in the western states. Manufacturing, mechanical and mining occupations show a large percentage of crime. Those having no religion are large in number. The percentage of Catholics is quite high, caused mostly by nationality and economic condition. The Hebrews show a very small percentage relatively. Crimes against person have the largest percentage in Maine, Michigan, Nevada and Alabama. Why it should be so high in Connecticut, New Jersey and Southern Indiana, is not clear. In the South there is a large percentage of crime against the person.

Sur le fonctionnement du service des signalements anthropométriques, par A. BERTILLION. Archives de l'anthropologie criminelle. 1888. pp. 19.

This is a report addressed to the director of penitentiary administration in France. The repertory of anthropometrical descriptions commenced in January, 1883 had reached the number of 60,000 in November, 1887; and has brought about the detection of about 1,500 recidivists inscribed in the jail books under false names. The author describes the manner of obtaining uniformity in results, the classification of measurements and the distinctive characters of recidivists under a false name, giving some curious examples of detection. It seems to us that this is a direct step toward the detection and subsequent control of a most difficult class of criminals.

Physical Training of Youthful Criminals, by HAMILTON D. WEY, M. D. Reprint of a paper read before the National Prison Association at Boston, July 18, 1888. pp. 14.

Physical training and athleticism are to be sharply distinguished. Physical education should precede mental; it aids the slow and irregular movements of the criminal, gradually giving him better control of himself; the mind is quickened along with such training. Bathing and dietetics are adjuncts to physical training. Physical education should be carried on in a three-fold line: physical development, muscular amplification and structural enlargement. Let the physical man be trained to reach the highest attainable degree; the brain coincidently will participate, and the mind will afford a basis for the principles of morality. The brochure is valuable in giving many practical details from the more advanced point of view of criminologists.

"*Inside Out.*" *Present Prison Systems and their Effects on Society and the Criminal*, by RICHARD VAUX. Philadelphia, 1888. pp. 31.

The writer expresses in a popular and vigorous way the following ideas: For certain crimes, as murder, arson, burglary and obstructions on railroads, in which life is lost or put in peril, the *penalty* should be death — not the *punishment*, for such crimes are beyond the limits of those violations of law for which punishment should be applied. Crime is largely the outgrowth of vicious social influences. State trade-schools with no locks, bars and bolts is a practical preventative to crime. There is a morbid humanitarianism — too much sympathy for the criminal, and too little for the friends of the victim. The state is tired of supporting individuals who ought to have been hung. The intermediate sentence, and qualified discharge before expiration of sentence, is not good; for the oversight after the discharge is not practical. However, in the case of first offenders with whom the prison authority is thoroughly acquainted, the prisoner might be released. The present system is administered by force. It should be turned inside out to discover what is bad, and to gain what is best.

The Chronicles of Crime, by CAMDEN PELHAM, Esq. London, 1886. 2 vols.

The author gives a series of memoirs and anecdotes of notorious criminals in Great Britain from earliest times to 1841. He thinks that the representation of guilt with its painful consequences is one of the best means of warning the young against the danger of temptation. To carry out this purpose, care has been taken to omit matter unfit for general reading. The earlier pages have been taken from sources peculiarly within the reach of the author. In comparing the offences with those of later date the dreadful crimes and brutal punishments are rare. The following are a few cases: execution for high treason; guilty of manslaughter, burnt in the hand; guilty of stealing a horse or cow, executed by having the beast pull out the peg that allows the ax to fall; 1921 women strangled and burned for counterfeiting; burnt alive for murder of husband; convicted of rape, not punished through influence of friends; executed for attempting to poison; executed for robbing the mails. Most of the cases are those of murder. The benefit of reading details of this nature seems doubtful in the case of the young. The less the young read about or witness cruelty, the better.

Report of the Standing Committee on Crimes and Penalties, to the National Conference of Charities and Corrections held at Louisville, Ky. 1883. pp. 15.

The report is especially valuable on account of the consensus of opinion. The general conclusion is: To make the laws such, that the criminal must either reform or be kept under restraint; to make prison structures roomy enough to allow of classification and efficient educational work; to permit conditional release; the reforming of the prisoner, and not the production of revenue should be the aim. Inefficiency of punishment is largely due to the spirit of retaliation in penal law, for this causes a counter retaliation on the part of the criminal. The professional criminal regards penalties as a business risk; the criminal by occasion forgets them at the moment of the act; the cranks are too absorbed in their wild ideas; the criminal by nature will commit crime in spite of them, because he likes to. Some existing defects are: Bad condition of station-houses and jails; Pensylvanian system of separate confinement is the only true plan; want of graduated prison system with conditional release; contract system bad; "Piece-price plan," where contractor furnishes machinery and material is a good substitute for public account plan, where the state furnishes the capital. There should be a graduated compulsory educational system; in addition to the common branches, physical geography, political economy, ethics, natural and moral theology, and technical instruction should be given. Pardoning power should be rare; release should occur only when there is reasonable security against further crime. There are about 46,000 penitentiary prisoners in the United States, and from a quarter to half a million of ex-convicts abroad in the community, which is the cause of most of the current crimes.

De la suggestion hypnotique chez les criminels, par le DR. EM. LAURENT. Revue de l'Hypnotisme, 1er Août, 1889.

The writer takes up in detail a hysterical individual accused of complicity in theft, and shows how that hypnotization is negative in results as to gaining a confession from the accused. The following conversation took place while the accused was in the hypnotic state:

Laurent. You are accused of complicity in theft. Patient. I am innocent. L. You knew however that the horse and carriage had been stolen? P. No, no. I didn't know anything about it. L. You knew it. P. I swear to you, I did not. L. I tell you, you did know it. P. No (already more softly). L. I assure you that you knew it, you knew it. P. Yes, I knew it. L. Are you sure you knew it? P. I knew it. L. (again). You did not know that the carriage had been stolen? P. Yes, I knew it. (Thus it is evident, that the will of the patient has been conquered by the will of the hypnotizer.) Dr. Laurent continues: You did not know that the carriage had been stolen. P. Yes, I knew it. L. No, I tell you, you did not know anything about it. P. No, I did not know anything about it. At this moment we do not know whether the patient knows it, or not. Dr. Laurent says that the present state of our knowledge does not permit us to know whether the person hypnotized obeys his conscience or his will, which holds him under its dependence. We may add that little children on the witness stand can be made through the overbearing manner of the examiner to confess things about themselves or others that have been solely suggested at the time.

Dr. Laurent has an article in the same review for November 1st, 1889, considering the influence of suggestive action over hysterical prisoners. A hysterical person is often wholly at the mercy of his surroundings. At one time he loves to engage in prayer, at another to go on a debauch. It is evident that such a person coming out of prison will be more dangerous than ever. The doctor cites cases from his own experience, where the prisoners have made their hysterical comrade believe all sorts of absurdities about himself. He terms this a sort of suggestion *(à froid)*, a hypnotism in the waking state; without doubt the suggestive action is less than in sleep, still it has its forces. He gives also an illustration of self-hypnotization in the case of a hysterical prisoner, who within a few days after his entrance into prison learns the customs, language and tastes of the place, and believes himself to be one of the greatest of criminals; he can be made to injure other prisoners. The practical conclusion of the article is, that all hysterical prisoners should be isolated, and placed under the charge of a physician, on account of the pernicious moral influence the prisoners have over them.

Should Inebriates be Punished by Death for Crime? By T. D. CROTHERS, M. D., Superintendent of Walnut Lodge, of Hartford, Conn.

Although this is only a leaflet of eight pages, it contains many facts and practical ideas. Criminals are found who are not deceitful, but desperately wicked. The inebriate is defective and diseased—the death penalty for inebriates is opposed to all teachings of science and experience. Ten per cent. of the estimated half million inebriates in the United

States are yearly convicted of crime; two per cent. commit capital crime, and one per cent. of this number, or about one hundred persons, are executed every year. Inebriacy is not a voluntary condition within the control of the person. In one thousand cases confined on Blackwell's Island, nine hundred and thirty-five had been returned for the same offence from one to twenty-eight times. The inebriate murderers are subject to delusions, morbid impulses, epileptic explosions, sometimes alcoholic somnambulism; the death penalty has no horrors for them; the first sentence causes others. Inebriate murderers should have a private trial, should be confined for the rest of their life in a military workhouse hospital.

Archives de l'Anthropologie Criminelle. Tome troisième. Paris, 1888. Chronique anglaise et anglo-américaine. Par H. COUTAGNE. pp. 702.

The writer refers in brief to the innovation of electricity in capital punishment. There are two objections to execution of the criminal by electricity: First from the frequent inconstance of electric currents. In England, in 1865 it was tried at the slaughter houses, and in spite of the energy of means employed they succeeded sometimes, but were compelled to resort to more certain methods. The second objection is more serious and will hold even if electricity in the hands of the executioner is made certain; it is, that the punishment by death can produce its preventative effect against crime only by virtue of a brutal method, which does not permit the least doubt as to its reality. Electricity will not produce this preventative effect, and will permit a suspicion of simulation. The writer's second objection is well taken. It may be said, however, that the cruel method, should it prevent a few murders, hardens at the same time the finer sentiments of the great mass of the people; on this basis the taking of life at all has an evil effect; also why should it be taken, if the method of doing it defeats the very end for which it is done? But a thorough statistical investigation rather than arguments may point towards a solution.

De la mort par l'électricité. D'ARSONAL. Archives de l'anthropologie criminelle. 1887.

Arsonal's experiments show that electricity can kill in two ways: (1.) By direct action of the discharge which causes instantaneous and irremediable death by the destruction of the tissues themselves. When a nervous, vascular or muscular tissue is excited by a discharge sufficiently intense to be compared to a thunderbolt, the tissue is completely disorganized, and loses forever its physiological properties. But (2), Death can take place by reflex action in exciting the bulbular centers, as a mechanical irritation would do it. This germ of excitation is accompanied by all the phenomena of action at a distance, studied by Brown-Sequard under the names of inhibition and "*dynamogénie*." This is why the lesions are not regular, and can present an infinite variety, according to the variable point of the nervous centers excited. Death, artificially caused, is almost always due to an arrest of respiration, which being prolonged causes death definitely by asphyxia. The practical conclusion of the author is, that in the great majority of cases life can be restored on immediately afterwards applying artificial respiration.

IV.—EXPERIMENTAL.

Psychophysiologische Protistenstudien. Experimentelle Untersuchungen von DR. MAX VERWORN. Jena, 1889. pp. 217.

After an affectionate introductory note to his former teachers, Hæckel and Preyer, the author laments that while it is everywhere recognized that the cell is the morphological unit of life physiology is more and more dwarfed and one-sided because it not only does not penetrate back to the cell, but is not yet even comparative. Of all branches of physiology this is most the case with psychology. Modern physiology rests almost solely upon studies made upon men, dogs, rabbits, guinea-pigs and frogs. Even lower vertebrates are neglected. Only by the study of the strangely fascinating lowest forms of life can we hope to reach fundamental knowledge of psychic phenomena and not by the study of single groups as the insects. Hæckel's consequent monistic ascriptions of an "*atom-soul*" to the final elemental factors of all physical and chemical processes in whatever form conceived, giving these force-centers the most rudimentary sensations and motions, and of a "*plastidule-soul*," endowing the smallest uniform part or molecule of protoplasm, and of a "*cell-soul*," as the total tension-force stored up in protoplasm, is a fundamental assumption of Verworn. Taste and touch mediate the instinctive movements of the lowest organisms. The copious literature of his subject to which one chapter is devoted shows that few zoölogists have assigned elemental psychic functions to protists, while some have ascribed to them very highly developed soul-life.

Movement is of course the only observable expression of psychic life. The many organisms were first collected mostly near Berlin, and their spontaneous movements systematically observed under the microscope and described for each group. Five grades of intensity of light, up to sunlight from a concave mirror, and also spectral colors were then applied as stimulus. Some protists showed no effect; on some light seemed to be inhibitory, in some it caused motion. Strasburger's "photometric" protists seemed tuned to a distinct intensity of light. Some protist varieties are "phototactic" to other colors or wave-lengths. It is doubtless true that selection strives in general toward kinds or intensities of light favorable to chemical processes that advance life and tends to avoid those that are unfavorable, although this tendency was not demonstrated in individual protists.

Temperature stimulation affected not only the power, but seemed in some cases to affect the direction of motion. These phenomena may be called thermotropism, as analogous to heliotropism, and may be best seen in *amœba limax*. Increase of temperature attunes to an higher, decrease to a lower intensity of light. Increase of heat is far more effective than decrease. Both after effects and adaptability are affirmed, but without details. The mechanical stimulus of jarring is still more effective, and thigmotropism (τὸ ϑίγμα = contact) and rheotropism are affirmed of rhizopods and ciliates. The great difference in sensitiveness of different forms to this stimulus is illustrated by numerous wood cuts. Acoustic stimuli had no distinct effect.

The number of chemical substances effective as stimuli is very large. Positive and negative chemotropism and Pfeffer's chemotaktic movements are very marked and are named chemometrie. Not only nutritive but indifferent and even noxious substances are attractive. Some substances are entirely without effect, however concentrated, and the threshold intensity of this form of stimulation varies greatly with different bacteria forms and different substances. Myxomycetæ are distinctly hydrotropic, while curara produces no effect upon ciliary motion; chloroform causes complete narkosis, destroying the power to react to otherwise effective stimuli. Most remarkable is the chemotropism for oxygen for which most protists have a passion. Galvanic currents cause distinct movements, and ciliates turn toward the cathode along the current lines. Geotropism or sensitiveness to gravity is doubtful.

Protists have no demonstrable "organoids" for any of the above forms of stimuli unless ciliae, pseudopodia, etc., aid in the sensations caused by mechanical stimuli.

The last third of the book is devoted to a brief analysis of human psychic activities and an argument that from the automatic movements of protists, something like faint rudimentary unconscious concepts may be assumed, and from their reflex movements unconscious sensations may be inferred, or at least are probable. The parts of divided protists make nearly the same movements in response to all the above kinds of stimulus as the entire animal, only the smaller the part the greater strength of stimulus is needed. Hence the nucleus is not the psychic centre, and "every elementary part of protoplasm has its own independent psyche." Ciliates are physically highest, rhizopods lowest among protists. The movements described, our author believes, are "identical with the molecular processes in protoplasm." There is no distinction between psychic and physiological movement. It is impossible to separate the idea of psyche from the idea of life. While it is proved that this molecular psychology is the most primitive, it remains to demonstrate what is already undoubted, that these processes are the bridge to connect the chemical processes of inorganic nature with the soul-life of the highest animals. As the vital processes in man are related to those of a cell, so are the latter to those of elementary parts of protoplasm, and so again are these last to the processes in any molecule whatever. This is the lofty monism which Demokritus, Bruno, Spinoza and Hæckel have attained, for which all differences between organic and inorganic, between psychic and material processes have vanished, and is to all dual or manifold ideas of the universe as of old monotheism was to all polytheisms.

Der Heliotropismus der Thiere, und seine Uebereinstimmung mit dem Heliotropismus der Pflanzen, von Dr. J. Loeb, Assistent am physiolog. Inst. zu Strassburg. Würzburg, 1890. pp. 118. Preis 4 mark.

In his *Vorlesungen über Pflanzen-Physiologie* (2nd ed., Leipsic, 1887.) G. v. Sachs has summed up his remarkable experiments on heliotropism and kindred topics of plant life. Loeb (taking Sachs as his model) attempts to demonstrate all the same laws on lower animal forms, mostly insects. He began with a spinning species of caterpillar (*Porthesia Chrysorrhœa*), of which he put 100 in a reagent glass, and found however often the direction of the glass was reversed they always crept towards the light. If the end towards the light was covered by an opaque sheath they crept light-wards as far as the first edge of the sheath, and there paused. They will leave a lighter part of a tube and pass a long darker passage which opens towards light. They pass out of a ray of direct sunlight into shadow, or vice versa, to get nearer a source of light. For these, as for nearly all insects tested, red and yellow light are much less effective than blue and even violet, and ultra violet has little effect, and all these experiments work only at certain temperatures. Each insect showed the all-constraining tendency to bring the median plane of its body in the direction of the ray at a certain intensity varying with the species, and every insect showed the tendency if proper conditions were observed, so that there was no laborious counting of "parliamentary majorities," as with Lubbock's and Graber's ants. The effect of this stimulus was constant and the insects remained for days as near the light as they could get, and constantly "pointed" at it. Heliotropism is best studied in nearly horizontal directions to eliminate geotropic influences, the latter being however far weaker.

Why moths that only fly by night love the light is made no less a paradox by Romanes' anthropomorphic remark that a candle is a strange object they would examine. By artificial day and night Loeb could change their daily time of flight or rest but a few hours. All night flies so far as studied, are *positively* heliotropic, and never shun light itself. What seems the passion of so many creeping insects for corners, cracks, and edges, and their dislike of open surfaces, is another confusing element to be eliminated, though weaker than heliotropism, and is named contact-irritability, or stereotroprism. All these experiments are in general very simple and require almost no apparatus beyond glass cups, tubes, a window that can be partly darkened, and a prism.

Leaf-lice at rest usually turn the oral pole toward the stem, the aboral to the apex of a leaf, or lie in this sense along its veins if at rest. As soon as their wings grow, which may be caused artificially by gradually drying up the leaf, their orientation becomes heliotropic and independent of the leaf and very serviceable for these experiments. At the time of sexual maturity, or at the time of the "wedding flight," many insects become strongly heliotropic, when they are not so before or after. The tendency is to get the axis of the body in the direction of the ray of light, rather than to seek the strongest light. In one case with a rotatory polarization apparatus turning 3-4 times per second with a radius of 30 cm., a fly went round with the ray several times, thrice repeated. This observation of Mach, Loeb thinks, illustrates the constraining power of heliotropism. It might readily be carried further by a centrifugal machine. The protoplasm in the background of the human eye is positively heliotropic; pigment and cones press forward, if illuminated. The heliotropic conception of retiual space-sensations pre-supposes the *continuity* of protoplasm as the irritable substance, and rejects the theory of distinct visual elements—rods and cones. Heliotropic changes determine space-sensations, and this new view simplifies many problems. Heliotropism cannot rest on any specific properties of a central nervous system, for it is common where there are no nerves.

This pamphlet is very interesting, abounds in facts and suggestions and must be read to be fully appreciated. The work was undertaken to show—so we are told at the outset—that in all these phenomena there is no evidence whatever of sensation, instinct, preference, or anything whatever of a psychic nature. All heliotropic, geotropic, stereotropic, or thermotropic motions whatever are in their nature absolutely identical with analogous movements of plants, and he who wishes to see any rudiment or analogue of a bank of intelligent Raphael faces gazing on a central glory, as mediæval artists often dreamed of, in a mass of maggots or larvæ or caterpillars, every one flush with the edge of glass or beaker-rim nearest the light, and staying there for days, should here learn the far higher lesson of law and mechanism, such phenomena properly inculcate. The view of Loeb is in fact as speculative on one side as the anthropomorphism of Verworn (above) is on the other. The violent polemic tone of Loeb and his dogmatism on this old and purely theoretic, and as yet unanswerable question, the entire absence of all morphological or anatomical considerations, especially with the author's mechanical predilections and the *very* meagre evidence suggested to even countenance his revolutionary view of retinal space-perception, are each in different ways to be regretted. His work, however, opens up still wider a new and attractive field, wherein we hope to see psychology gradually strike many strong and deep roots into the rich soil of general biology.

Der Zeitsinn. MÜNSTERBERG. Beiträge zur experimentellen Psychologie. H. 2. 1889.

The second number of Münsterberg's series of psychological studies opens with an article in the much-confused field of the "time-sense." After résuméing the results of previous experimenters, from Mach to Glass, and presenting at length (three-fifths of the whole paper), the theory to which he has been led by self-observation in the course of experimentation, he finally gives in a brief section the results of an experimental test of his theory. This theory is nothing less than a complete denial of the existence of a "time-sense;" that is to say, our estimates of time, short intervals as well as long, are not made by an independent sense, but by more or less completely unconscious observation of internal physiological states, especially muscular tensions. Time judgments rest on a kind of psychic synthesis of the sensations that mark the intervals and those that indicate the state of muscular tension, as visual space judgments on the synthesis of visual and muscular sensations. Take a simple example. The subject is given three distinct sounds, the first and second beginning and ending a standard interval with which the subject is to compare that marked off by the second and third. The entrance of the first sound calls up reflexly an adjustment tension in the muscles of the sense organ, which reaches a maximum and declines. At some stage of the decline the second stimulus enters, causing a renewed tension, followed in turn by a decline like the first. Now, if the third stimulus comes at a stage of decline corresponding to that at which the second came, the interval is pronounced the same; if it comes when the decline is less or greater, the interval is judged shorter or longer than the first. For very brief intervals a similar rôle seems to be played by the sensory "memory-after-image," and for longer ones by the widely irradiated tensions and relaxations accompanying respiration. Into the author's extended exposition of the last, and of the complications introduced into it by attention, etc., we shall not enter here. Suffice it to say, that by his theory he explains the very great variety of "intervals of least error" found by different observers (from .4 sec. to 1.25 sec.), the occasional anomalous series reported by some experimenters, and the striking periodicity of the "intervals of least error" observed by others.

The experimental section (only one fifth of the whole, and then not unduly compressed), presents three series of experiments made upon Münsterberg himself; those made on other subjects are only referred to. They were all made with the time-sense apparatus of Wundt, somewhat bettered, and by the method of average error. In the first series the subject was given two sounds marking an interval (6—60 secs.), and required to make a third when the interval after the second sound had become as great as that before it. When the first two sounds were so given that the second always occurred at the same respiratory phase as the first, the average error was 2.9 per cent.; when this was not regarded, it was 10.7 per cent. In the second series three sounds were given, the first and second beginning and ending the standard interval; and the third, at a varying time from the second, beginning the comparison interval, which the subject observed and closed as before. This time the error, when respiration was regarded, was 5.3 per cent; when it was disregarded, 24.0 per cent. In the third series, Münsterberg consciously withdrew attention from the sensations of tension and relaxation, to the complete confusion of his time-judgments, making 4 seconds seem like 12, and 9 like 3.

Münsterberg is certainly right in looking for the explanation of the "time-sense" in the effect on consciousness of physiological processes, and his contribution is an interesting and suggestive one, especially as regards the discordance of previous experimenters. At the same time most of his experiments have to do with considerable intervals, (his explanation of the judgment of short intervals by tension in the sense organs, is left still in the theoretical stage), and are not numerous nor varied enough to exclude other possible influences in addition to that of respiration.

Schwankungen der Aufmerksamkeit. MÜNSTERBERG. Ibid.

When one attempts to observe a very faint sensation, the barely audible ticking of a watch or the line of separation between the faintest gray ring of a Masson's disk and the adjacent wholly white one, the sensation comes and goes at somewhat regular intervals. After an experimental study of the phenomenon, N. Lange came to the conclusion that the cause was central and the variation a rhythm of apperception. (*Phil. Studien*, IV, 390 ff.) This view is vigorously attacked by Münsterberg. The experiments upon which he rests his attack were as follows. The subject fixed his eyes and attention on the line of demarkation of a Masson's disk 2 m. distant, and recorded the ebb and flow of sensation by moving with his finger a lever adjusted to write upon a revolving drum, the finger rising as the sensation intensified and falling as it faded, through a period of from 60 to 80 secs. In the first series the average length of time from the beginning of one disappearance to the beginning of the next was 6.9 secs., (Lange, 3.1–3.4) with a mean variation of 1.1 sec. The subject noticed faint sensations of motion in the eyes accompanying the fluctuations. In the next series, prisms were brought before the eyes and removed alternately for periods of two seconds, causing a deviation of the eyes without disturbing the vision of the rings; the result was a lengthening of the period to 12.3 secs. Voluntary closure of the eyes every second or two seconds generally prevented the fluctuations, while the interposition of a gray screen before the disk, though interrupting vision for a slightly longer time, increased their rapidity, making them now recur in 5.8 secs. More rapid interposition and removal of the screen caused a lengthening of the periods; and when the disk was covered continuously for a full second out of every four, the continuity of the sensation was broken up and no fluctuations were found. Observations with indirect vision gave a rate of 8.2 secs. Continuous movements of the whole disk up and down or from side to side at the rate of 10 cm. per second, bringing it to its original position every four seconds, caused total suspension of the periodicity. Very rapid breathing quickened it to 5.1 secs.; slow breathing slowed it to 8.5; but the periodicity did not seem causally dependent on respiration. Several of these tests were also tried with similar results by the observation of a black dot on a large white field. The chief points in the interpretation of these experiments, to which a long section is devoted, are as follows. The whole group shows the phenomenon in question to be of peripheral and not central origin, (else why the profound effects of purely peripheral changes?) and in particular from the fatigue of the muscles of fixation and accommodation. The prisms lengthened the period because the deviation of the eyes which they caused relieved the fatigue of fixation and lessened that of accommodation; the winking experiments relieved the latter and so prevented the failure of accommodation, and thereby the disappearance of the demarkation line on the disk. The interposition of the screen had the contrary effect because it did not relieve accommodation, but rather made it more difficult. In a similar way the other experiments support the muscle-fatigue theory; and what is thus demonstrated for the muscles of the eye, Münsterberg carries over to the less accessible muscles of the ear. The experiments form a valuable contribution to the subject and are demonstrative on the point immediately in question, to wit, the very important function of the periphery in the variations of faint visual sensations. Some portions of his critique upon Lange, however, seem to us less sound, and indeed in explaining Lange's experiment with faint stimuli to two senses at once he introduces central processes (in a secondary position, to be sure) not unworthy the name of changes of attention.

Augenmass. MÜNSTERBERG. Ibid.

After the usual historical and critical review the author makes preliminary report on the results of a comprehensive study of the conditions affecting visual estimation of the separation of points and the length of lines. Besides this immediate object the author explains the aim of his experiments to be the examination of how far eye movements, or rather variations in the intensity of the sensations accompanying them, are responsible for visual judgments, all this forming part of a plan for demonstrating that the comparison of sensations, etc., (generally conceived to be an act of consciousness as opposed to a content of consciousness,) is in reality itself a content and not an act. The 20,000 observations already made by Münsterberg are distributed in groups of from 400 to 800 among 36 variations of condition. The apparatus used was simple and convenient; the method was a modification of that of average error; the 20 standard distances used ranged from 1 to 20 cm., by differences of 1 cm.; the experimenter worked on himself. The variations included the use of empty spaces and horizontal and vertical lines, seen monocularly and binocularly, with and without motion of the eyes, and in the indirect field, with reproduction at different time intervals after seeing the standard, etc., etc. A bare statement of the final figures in these 36 cases would unduly lengthen this notice; some of the more general conclusions are as follows. The experiments show decidedly that changes of motion, position or use of the eyes produce marked changes in the estimate of distances, to be explained only by the participation of sensations of motion or their memory images; these cannot be given a secondary place in any theory of vision. Empty distances on the right were under-estimated, on the left over-estimated, a fact which the author connects with common practices in reading and writing. The eyes when used separately each over-estimated extensions on its own side. Extensions reproduced after an interval were generally over-estimated, especially the smaller ones; the reproduction was much more accurate if the reproduced lengths occupied exactly the same position as the original. Lines did not seem greater than equal empty spaces, a seeming contradiction of the commonly recognized illusion which Münsterberg, however, explains. Broken lines seemed as usual too long. Lines, unlike empty spaces, were reproduced smaller in both halves of the field, because, as it seems, the eye does not traverse the whole of the standard line, judging partly by indirect vision, and does traverse the whole of the line reproduced, thus giving the latter more sensation of muscular effort. Münsterberg finds the commonly accepted over-estimation of vertical distances only on three conditions, namely, when the distances are empty, the vertical is above the horizontal with which it is compared, and the eyes are free to move. Distances above the horizontal seem longer than equal distances below, if both are of considerable length. Turning from the constant to the variable error, the true measure of the differential threshold, the experiments show it much greater when the eyes are fixed, the difference being due to the fact that in the first case the judgment is based on motions actually executed and in the second on the remembrance of such motions. The variable error is increased or diminished by one and another of the conditions examined; but, other things being equal, Weber's Law holds with a reasonable exactness for the distances experimented upon. What it really applies to, however, is not the estimation of visual extensity, but to the changes of intensity in the motor sensations of the eye.

Raumsinn des Ohres. MÜNSTERBERG. Ibid.

The author's theory of the auditory perception of space, arrived at in the original after an examination of previous experiments on sound-localization, and on the functions of the semicircular canals, is briefly this. Sounds differ according to the direction from which they come, independently of changes in quality, intensity, etc., in the disturbance which they produce in the semicircular canals. With these different disturbances are reflexly connected the movements necessary to bring the point, from which the sound comes, into the median plane of the head where hearing is most distinct and the cause of the sound may be best investigated by other senses. By a synthesis of the motor sensations thus produced, or their memory images (not necessarily conscious), with the auditory sensations, similar to the synthesis affirmed by the genetic theory in the case of sight and touch, an auditory space arises. Münsterberg's own experiments only remotely touch the question of the organ by which these variations of sound are mediated, and in our opinion he would have greatly improved his paper, as he certainly would have shortened it, by giving a very subordinate place to this whole phase of the question. The immediate point of his experiments was to determine the least observable change in the direction of a given sound. Most of the experiments were made at different points on the circumference of three circles about the head, one lying in the horizontal plane passing through the line connecting the ear-drums, one in the vertical plane passing through the same line, and one in the median plane of the head; the radius of these circles was 1 meter. The stimulus was the clicking of the head of a stem-winding watch, and was given three times at a chosen point (16 equi-distant points were tested in each circumference), then after a second's interval three times again at a slightly different point till the just observable change was determined. The general results were as follows. In the horizontal circle the point of greatest exactness was immediately in front where a change of less than 1° was recognized; the sensibility declined continuously to the point of least exactness immediately behind the head where the least change was nearly 6°. On the frontal-vertical circle the points of greatest exactness were directly opposite each ear, and directly above and below the centre points of the head. On the median circle the point of greatest exactness was 45° below the horizon (and horizontal changes also were here recognized with great exactness), thus coinciding with the point of vision when the eyes are, as commonly, somewhat depressed. Other points of maximal exactness were directly over the head and directly behind it. When one ear was stopped and tests again made in the horizontal circle the exactness was decreased not only on that side, but also on that of the open ear, showing that normally both ears co-operate in localization. When the outer ear was covered inside and out with wax, the sensibility to changes in front was decreased, but for changes in the rear was uninfluenced. The connection of the results with the theory is simplest in the case of the horizontal circle, though the author traces it in all. There the sensibility to change falls off as the muscular tension required to bring the place of sound into the median plane becomes greater; no change of place is perceived unless sufficient to produce a perceptible change in muscular tension. If the discrimination depends on the sensations of muscular contraction, it should follow Weber's Law; and, though no exact quantity can be assigned to the increasing tension, there is a striking correspondence.

Ueber Contrasterscheinungen in Folge von Einstellung; Eine vorläufige Mittheilung. Dr. F. SCHUMANN. Nachrichten v. der k. Ges. d. Wiss. und der Georg-Augusts Universität zu Göttingen. Dec. 3, 1889. No. 20. pp. 5.

In the course of a research upon memory after the general method of Ebbinghaus (now going on at Göttingen), Dr. Schumann noticed certain illusions of contrast, which he has interestingly described and brought into relation with similar effects in other fields of sensation. Nonsense syllables are cut out, fastened to a strip of paper, and rotated on a drum; they are viewed through a slit in a screen allowing just one syllable to be seen at a time. A normal rate of rotation is chosen, so that the syllables can be conveniently read for committing to memory without haste or delay. Dr. Schumann observed: (1) That when the drum was going too rapidly and he set the rate to reduce it to the normal speed, this latter then seemed too slow; (2) that if the subjects were mentally tired the normal speed seemed unusually fast, while if they were fresh it seemed slower than usual. They are both due to the carrying over of mental impressions to changed conditions; when the drum is going a little too fast it takes a greater strain of the attention to follow the syllables; a lessening of this strain seems by contrast to reduce the speed more than it really does. So when tired we interpret difficulty of keeping the attention as increase of speed of impressions. So in time experiments in passing from one normal interval to a longer the second seems unusually long, and vice versa; we seem to have a time (.7 seconds) in which impressions are conveniently attended to. When they come more rapidly we have to strain the attention to follow them; when more slowly we have to wait for them. A similar fact was observed in the motor field. If one hand moves over a normal space of 20 cm. and the other hand moves over a space of 17, 18, 19, 20, 21, 22, or 23 cm., to judge which is longer, then in moving over a space of 23 cm. the hand will frequently move rapidly the first 20 cm. and then slowly, the space moved over seeming unusually long. Here a certain motor innervation is ready and if exceeded makes the space seem unusually long. More extended observations are in progress.

Zur Lehre von der Willensthätigkeit. J. ORSCHANSKY. Archiv für Anat. u. Phys. 1889. Phys. Abth., 3–4, p. 173.

What is the nature of the difference between the two distinct kinds of exercise of the will,—the act of impulse and the act of inhibition? Is the one a setting free of energy, the other a storing of it up (Wundt)? Do they take place in different parts of the nervous system (Sietschenow)? Is it a case of simple interference of waves (Cyon)? Do these waves proceed in different directions (Goltz)? Does the struggle between the two take place in the nerve-center, the nerve or the muscle; or is the suppression of the action of one set of muscles brought about by the action of the antagonistic set (Munk)? This latter view seems plainly untenable on account of the fact that some muscles, as those in the region of the N. faciales, have no antagonists. The experiments of Orschansky were performed on the M. masseter on account of its being among the autonomous muscles, strong, of constant attachment, and admitting of easy registration of its action. They seem to show that the reaction-time of inhibition does not differ, after a brief period of practice, from that of the direct impulse. But the reaction-time of the impulse consists of four moments: (1) The passage to the sensory center, (2) the sense-perception, (3) the act of will, (4) the motor impulse; and it would be very improbable that the reaction-time of the inhibition should be wanting in any of these stages and should still be of the same duration. Moreover, very different reaction-times were obtained by varying, separately, the tension and the amplitude of the muscular excursion, and in every case the change in the inhibition-time follows closely upon the change in the impulse-time. (The author's explanation of the seemingly anomalous effects produced by these two moments does not seem to be very clear.) The effect of pathological conditions is also the same upon both. From this it seems natural to conclude that the anatomical circuit is the same for both species of exercise of the will. C. L. F.

Untersuchungen über die Empfindlichkeit des Intervallsinnes. IWAN SCHISCHMÁNOW. Philosophische Studien. Bd. V., H. 4.

Schischmánow subjects the entire problem of the sensibility to intervals of tone to a thorough and independent re-investigation. He prefaces his account of his results with an interesting historical introduction, forming an admirable résumé of the topic. His own experiments consist in setting a movable weight upon a tuning fork, so that the resultant tone forms just a given interval with a constant fork; and, again, in finding the point at which the falsity of the interval is detected above and below. He then groups and averages the results, expressing the sensibility as the just perceptible portion *of a vibration per second* from the true interval. For Schischmánow, who is musical, and a fellow student K., who is not, the results for the different intervals thus expressed are: *Octave* (2:1), S 0.220, K 0.356; *Fifth* (3:2), S 0.332, K 0.374; *Fourth* (4:3), S 0.419, K 0.403; *Third* (5:4), S 0.485, K 0.559; *Major sixth* (5:3), S 0.502, K 0.506; *Second* (9:8), S 0.548, K 0.716; *Minor third* (6:5), S 0.607, K 0.640; *Minor sixth* (8:5), S 0.672, K 0.740; *Minor seventh* (9:5), S 0.678, K 0.763; *Major seventh* (15:8), S 0.861, K 0.902. While practice and individual differences play some part, the order as presented by Schischmánow, especially for the four best and the three worst appreciated intervals, may be taken as normal, and agrees very well with the order determined by Helmholtz, on the basis of the relative consonance of overtones, though Schischmánow does not regard this as the sole factor in the sensibility.

Die Seelenthätigkeit in ihrem Verhältniss zu Blutumlauf und Athmung. Prof. Dr. ERNST LEUMANN. Philosophische Studien. Bd. V, H. 4.

This "lay" contribution is suggestive rather than positive, its object being to call attention to the desirability of noting pulse and respiration rates in connection with psychometric determinations. The failing of words to speak, as well as power to speak them, when out of breath, or physically weary, the slowing of pulse and respiration in drowsiness and sleep, illustrate the general relation in question. As suggesting the kind of relation experiment may establish, Prof. Leumann found in one subject a pulse of 77 when scanning at the rate of 113 feet per minute, and 83 when scanning 140 per minute. Of two gymnasium students, one with a pulse of 85 read 107 feet per minute normally, another with a pulse of 98 read 129 feet per minute. In a rather more accurate test the pulse rate was found to increase as the rate of reading increased. If pulse and respiration rate were noted, we might explain small variations now regarded as accidental. Again Prof. Leumann brings the pulse rate into relation with association times, with the indifference point in the time sense, and the respiration time into relation with the waves of attention, *i. e.*, the periods in the appearance and disappearance of a very faint sensation, but the relation is only a distant analogy. It would be interesting to know whether the waves of attention are larger in slow breathers than in rapid breathers, and so on.

Recherches sur les mouvements volontaires dans l'anesthésie hystérique. A. BINET. Rev. phil., Nov., 1889.

Binet continues his interesting studies in hysterical hemianæsthesia, this time reporting experiments on voluntary motion. By the use of the dynamometer and the dynamograph he has compared the voluntary movements on the sound and diseased sides in respect to intensity and duration, and by reaction-times as to rapidity. The following are the general results found in the case of the subjects on which he worked, for which, of course, he does not claim universality. Two types of activity can be traced, one generally found on the sound side, the other generally on the anæsthesic. The curves representing the first type differ from those representing the second in their greater height and their more rapid rise and descent. In that type also the reaction-time is shorter. Fatigue, however, appears more quickly, betraying itself by irregular respiration and tremors in the acting member. This last is in marked contrast to the other type of action; the anæsthesic type can sometimes be maintained for long periods in fatiguing positions, (if the muscles are not put to a maximum exertion), without fatigue. Points of resemblance in the long continuance of moderate contraction are shown between this second type and suggested catalepsy and contractures. These types were not found in all subjects, nor must they be too closely connected with sensibility and anæsthesia. From the detailed observations of the article we cull the following. In hysterical hemianæsthesia the sound side is generally increased in power, in hysterical hemiplegia even more so. The dynamometric pressure is greater in each hand when acting by itself than in conjunction with the other, (a fact which Binet explains by the difficulty which hysterics experience in dividing their attention); the bilateral dynamographic curves are longer and flatter than the unilateral; and the reaction-times are much longer for both hands, especially on the anæsthesic side, when reaction is made with both hands than when each reacts by itself.

Recent experiments in crystal-vision. Proc. of Soc. for Psych. Research (Eng.). June, 1889.

The first half of this paper is devoted to an interesting historical account, from which it appears that "crystal-vision," under various names and making use of various reflecting surfaces, (bowls of water, gems, mirrors, pools of ink in the palm of the hand, sword blades, and even finger-nails), some times to communicate with the gods, some times with devils, openly or under ban, has been practiced for 3000 years in Europe, Asia, Africa, and the ends of the earth. The crystal-gazer looking into some one of these polished surfaces sees more or less elaborate visions. The lady who contributes the article has herself this uncommon faculty, and speaks from personal experience of upwards of 70 cases. If she has a grain too little skepticism as to telepathy, she nevertheless approaches the subject in an eminently matter-of-fact and open-minded fashion. Her experiences fall into 3 groups: "1. After-images or recrudescent memories, often rising thus and thus only from the sub-conscious strata to which they had sunk. 2. Objectivations of ideas or images (*a*) consciously or (*b*) unconsciously in the mind of the percipient. 3. Visions, possibly telepathic or clairvoyant, implying acquirement of knowledge by super-normal means." Under the first come casual impressions *e. g.* of objects seen on a walk, completely forgotten, later seen in the crystal, and with difficulty traced to the original circumstances. Under the second are classed (*a*) the images called up by the gazer, (*e. g.* groups of figures that, once voluntarily projected into the crystal, go on to actions quite unexpected by the gazer), or things that lie "on the mind," though not actually in consciousness; (*b*) odds and ends of images from the unconscious, to which the author refers as in general "so grotesque and commonplace" as "not to administer greatly to one's self-esteem." Of the third class not very many are reported, and none of these have reference to important events, unless it be one, which may be taken as a sample of all, where the crystal revealed a man with a muffled face looking into a small window from the outside, an image which was realized a few days later in the case of a fireman when the house was on fire and a muffled-face fireman looked into such a window. Some of these visions were so fully objective that their parts could be enlarged with a magnifying glass. The author confesses to more than ordinary powers of visualization without her crystal.

Versuche über den Einfluss des Schlafes auf den Stoffwechsel. H. LAEHR. Allg. Zeitsch. f. Psychiatrie. 1889. p. 286–317.

While the amount of nitrogen given off does not change, it is known that in sleep less carbonic acid is given off and less oxygen is taken up by the system, or less fat but the same amount of albumen is decomposed. Laehr divided the day into three equal periods of eight hours, at the beginning of each of which he urinated, was weighed and took food of exactly equal kind and amount. By these more constant conditions than have been hitherto observed, he slept from 11 to 7. From these experiments which have been repeated at intervals for more than eight years, the following results were reached: Sleep is attended by a decrease (not an increase as Quincke had said) in the amount of urine secreted, its acid reaction is greatly reduced, its chloride is much decreased, and urea and sulphuric acid are slightly less. A recumbent position causes slight increase of urine and of the above substances, as well as of phosphoric acid. The latter, as well as lime and magnesia constituents of urine are unaffected.

V.—ABNORMAL.

Beitrag zur Lehre von der Infectiosität der Neurosen, von Dr. B. Herzog. Arch. Psychiatrie, 1889., p. 271.

In psychic infection, induction, or contagion, which Werner has lately denied, while Wollenberg ascribes to it a greater rôle than was ever suspected before, is predisposition all, or is there a very specific effect, and if the latter, does it work upon the secondary subject while he is only passive or has his imitative instinct causal action? From two interesting cases the writer concludes that imitation is a part of the disposition, or a symptom of already existing disease. The second individual is as passive in his imitation as in hypnotic suggestion.

Ueber das Symptom der Verbigeration, von Dr. C. Niesser. Allg. Zeitsch. f. Psychiatrie, 1889, pp, 168–232.

Although first described in connection with Katatonia by Kahlbaum in 1874, this symptom has been little studied. It is a " speech-cramp " which may occur with very diverse, but not with all dysthymia. It is a symptom of as great dignity and independence as idea-flight, or auditory hallucinations. Its characteristics may occur in the writing of the insane as well as in their speech. It is very diverse in its manifestations. A fragment of prayer, a single word, or interjection hissed between the teeth, whined, mumbled, low or loud, fast or slow, perhaps with florid gesticulation, are long repeated; or discourse and even writings with frequent repetitions mark these cases. It is more often associated with states of motor inhibition. From many heterogeneous cases an unitary etiological conception is sought.

Die Hallucinationen im Muskelsinn bei Geisteskranken und ihre klinische Bedeutung. Dr. A. Cramer. Freiburg, 1889, pp. 130.

Centripetal nerves from muscles, whose specific energy it is to bring motor sensations to the brain, play an important rôle in paranoia. Their disorders may excite hallucinations in the locomotor apparatus, causing imperative motions, attitudes and acts; in speech mechanisms, causing loud-thinking and imperative speech; or in the eye muscles, causing illusions concerning motions, direction of motions, size of objects, etc. These rubrics are illustrated and confirmed by well selected and treated clinical histories.

Les agents provocateurs de l'hystérie. G. Guinon. Paris, 1889, pp. 392.

This work is full of most carefully selected and interesting casuistic material. The causes are: 1. Moral, as education, imitation, hypnotic experiments; 2. Shocks, like wounds, earthquakes, lightning; 3. Infections, as typhus pneumonia, malaria, scarlatina, rheumatism; 4. Weakness, from loss of blood, anxiety, masturbation, intoxication, etc.; 5. Diseases of the nervous system. The only true cause of hysteria is heredity, and the above are only provoking agents. All the neuroses due to these causes are hysteria only, which is not complicated in such cases with neurasthenia, as is often held in Germany. The disease may follow the exciting cause at once or after years. Its genesis may be either auto-suggestion or mal-nutrition. Charcot's mechanical jar and Westphal's toxic encephalopathia saturnina are not admitted.

Les Névroses et le Pessimisme, par le DR. A. DESCHAMPS. Paris, 1888. pp. 37.

"La Névrose" is now almost a religion, of which Schopenhauer is the father, Charcot the high priest, and a well known French female tragedian [S. B.] the living ideal. Neurotics are those suffering from moral malaise. For some every sensation, even those called pleasant, is a cause of pain, and every movement fatigues. Their state is a sad *supplicium neuricum*, the fluctuating humors of which fill the neuropathic autobiographies with their morose, irritable, bizarre and sometimes, alas, contagious states, feelings and sensations even in gay Paris. Neurosis democratizes, but far more truely does democracy neuroticize. Liberty and equality modify profoundly conditions and habits. Desires and ambitions are enormously expanded, and the type of Obermann, Werther, Manfred and René, has been followed by the type of Schopenhauer, Tourgeniew, Tolstoi, Darwin, Mill, Spencer, and that by a still more serious type that kills, and now calls loudly for the doctor. Men are declassed, pleasures too easy—in a word, sensibilities are too distracted and will too enfeebled, and pessimism and nihilism are but the grand neuroses of our period. Children are too tenderly reared. The father, instead of being an object of silent respect, is the playmate, if not a slave of his child. Religion, politics, society, marriage, everything is an open question. Everything is criticized and, worst of all, analysed. General ideas are cheapened by cheap philosophical teachers who tend if they do not try to make their pupils Amiels and Bashkirsteffs, and who deserve the woe Goethe pronounced upon "every sort of culture which destroys the most effective means of all true culture." This wretched neurosis of irresolution makes *aboulia* the dominant note of this castrated age, best described, not in text-books on vesania but in the masterly pages of P. Bourget, himself severely afflicted with the distemper. It is seen in the poetry of Baudelaire, that dandy of spleen, paradox and subtlety, who passed his life in the hunt for new sensations; in Lecomte de Lisle, whose vaunted desolation would be a trifle magnificent, were he not a pure dilettante; in Verlaine and Mallarme, the Siamese-twins of decadence; in Maurice Rollinot, Albert Wolff and E. Haraucourt; in Goncourt, whose heroes are all without will and force, and martyrized by their impressionability; in Flaubert, who cries out that he would he were matter. Vague thoughts, aimless longings, despairs without cause, reveries that become passions, educations that stultify, instead of develop instincts and heredity; these are the marks in modern music, painting and life. A great crisis is upon this age, and is to be met somewhat as Caro has suggested as follows: The illusion of liberty must be eradicated at every point; an absolute must be insisted upon in state, church, society, science, which no supersubtle analytic mind must be allowed to touch. The ideals and faith in something transcendent, abiding and too mysterious for definition, must be cultivated, and a new education must arise, which will not teach more method than matter, and which will not culminate by teaching a philosophy which makes young men anxious about either the moral or the logical character of the universe, or the reality of their own ego or of the external world.

VI.—MISCELLANEOUS.

Die psychologische Forschung und ihre Aufgabe in der Gegenwart; Akademische Antrittsrede von DR. H. SPITTA. A. o. Prof. der Philos. Tübingen, 1889. pp. 36.

The lofty object of such inaugurals is, we are told, to state matters of deepest interest, and what serious and long work has disclosed as the most worthy good of life. The specialist must turn to philosophic thought, the fountain of perpetual youth for all sciences, where all these latter have their root in the natural psychic life of man, as all art must occasionally look back to its foundations in nature. Every science now shows a psychological side, and formulates its own basal problems in psychological terms. This progress is in part conditioned upon their penetrating further into the "why of why." Metaphysics has least interest in psychology and has declared war upon her late declaration of independence, but metaphysics is a product of individual thought about experience, and a somewhat aborted, branch-product of psychology. Cause, purpose, worth, good, and all the root-ideas of ethics, now that it is going into the large sociological field, need more or less radical psychological reconstructions. Man and his faculties are not only the measure of all things, but are becoming the burning questions of science. "Know thyself" is a psychological and not merely an ethical mandate. The nature of the ego and of religion, the very ideas of revelation, faith, belief, have been far too shallowly conceived to bear the strain they now must bear. "*Rechtpsychologie*" has arisen as a "colony" or "*enclave*" beside jurisprudence, and forensic or criminal psychology tries to improve our ideas of such psychic states and processes as are designated by such terms as "attempt," "intent," "free act," "guilt," "atonement," "punishment," "responsibility," and also postulates a better explanation of antilogies and paradoxes of willing, and even of volition itself, and determinism, and indeterminism. The problems of morbid psychology, the statics and mechanics of the folksoul are also growing more urgent.

All this shows that psychology is so closely connected with other departments that all attempts to dissect it out of these connections and place it on an independent basis, and give it a single exact experimental-physiological basis are to desoul it. Wundt's hope that every German university will soon have a psychological laboratory, and all conceptions of psychology as "the physics of the nervous system" would give us a psychology with no philosophy in it. This method can never explain conscience, remorse, wit, mood, or any complex side or question of psychic life. Soul is adaptation and cannot be isolated. The mathematical natural-history psychology will never bring all sciences into nearer and fruitful relations with each other, as all the work of the human psyche. This can only be done by methods of self-observation. (The author is evidently in close sympathy with Lotze. Apart from a few incidental expressions of Wundt, we recognize nowhere any tendency whatever to "isolate" psychology, nor to make it "independent" of any methods or results in any branch of human knowledge, even the introspective philosophy so far as it can be helpful. REV.)

Ueber Phantasie-Vorstellungen, von ANTON OELZELT-NEWIN. Gratz, 1889, pp. 123.

Notes and choice quotations from voluminous reading in general literature and in morbid psychology, conveniently grouped into an external unity which allows the whole to be divided into chapters headed: Ideas, properties, conditions, development, physical relation, and animal phantasy, the quotations well chosen and strung together by general remarks of a neutral tone that set them off to good advantage, makes a book not illy adapted to interest and instruct the general reader.

Manual of Empirical Psychology, by G. A. LINDNER, translated by Charles DeGarmo, Ph. D. Boston, 1889. pp. 274.

Although the author is still a professor at Prague and sanctioned and prefaced this translation, and although dreams, insanity, mesmerism, the will, ego, senses, etc., etc., are all given paragraphs or chapters, the book bears no trace of anything done in these or any other psychological field for the last twenty-five years. Nothing can be more helpful to teachers than knowledge of the facts and conclusions reached within this most productive period concerning memory, attention, association, habit, senses, muscles and will, psychic time, psychogenesis, the incipient neuroses so common in the school room, the momentous phenomena of adolescence, etc., but from cover to cover there is not a hint of a single one of these things. That a bright American teacher after studying pedagogy two years in Germany should call this little Herbartian primer a "great and good book," shows how far German pedagogues are behind the best in their own land and line, and how grievously American teachers who go abroad to study educational philosophy need competent direction where to go and what and how to study. That Herbartianism, the fundamental conception of which is that all psychic activity consists in working over ideas *(Bearbeitung der Begriffe)* should from its very completeness become so stagnant and barren is one of the ironies of fate. Yet despite its scientific cheapness and obsoleteness, this book will mark a distinct advance for teachers whose only philosophy of education is the current vagaries of Hegel, now so prevalent among them in this country, an advance, to be sure, made in Germany fifty years ago, but not yet very generally bettered by German teachers. The practical applicability of this standpoint and book makes its merit. It should be read and studied by American teachers for its own sake, for whom we trust it will prove a step toward very far better things for them, could the great resources of modern psychology be now made accessible to them.

Zahl und Verteilung der Markhaltigen Fasern im Froschrückenmark. JUSTUS GAULE. Abhandlungen der Mathematisch-physischen Classe der Königl. Sächsischen Gesellschaft der Wissenschaften. Vol. XV, No. IX, pp. 739-780, 10 plates. Leipzig, 1889.

Die Stellung des Forschers gegenüber dem Problem des Lebens. Rede, JUSTUS GAULE. Leipzig, Verlag von Veit & Co., 1887, pp. 24.

Der Oekus der Zellen. JUSTUS GAULE. Beiträge zur Physiologie, Carl Ludwig gewidmet. Published by F. C. W. Vogel. Leipzig, 1887, pp. 133-148.

The first of these papers, a monument to German patience, is the result of most painstaking work extending over a period of five years; and marks an important advance in our knowledge of the fibre relations in the frog's spinal cord. The condensation of the matter to a limit of forty pages, perfectly classified and arranged, together with full illustration by diagrams and plates, from which the paper may almost be read, form most commendable features of the work.

Dr. Gaule has actually counted the medullated fibres in cross sections of the frog's spinal cord at five levels. These levels are designated throughout the paper as 1, 2, 3, 4, 5; and are taken:—1, at junction of cord with medulla; 2, through root of 2d nerve; 3, near origin of 4th nerve; 4, just below that of the 6th nerve; 5, below origin of 9th nerve. As will be remarked the levels occur at the anterior end of the cord, at the middle of the brachial enlargement, at about the point of greatest constriction in the dorsal region, through the middle of the lumbar enlargement, and near the posterior end of the cord. In regard to methods employed, Erlyki's fluid, twenty-one days in the dark, at 39°, is followed by parafin embedding, making use of xylol instead of turpentine and clove oil. A perfect series is obtained, and this is stained by Weigert's haematoxylin. The counting is done by the aid of an ocular net micrometer; and since the section is too large for a single field, this is supplemented by a very exact micrometer stage. To insure accuracy in counting, the author employs the principle of bilateral symmetry. How well his work meets the requirements of this control is seen from the following figures.

	1. Section between medulla and cord.	2. Through origin of 2d nerve.	3. About 4th nerve.	4. About 6th nerve.	5. Below 9th nerve.
RIGHT.	28429	36707	21579	30141	8296
LEFT.	28245	37992	20246	30917	8017
Giving sum for different levels	56674	74699	41825	61058	16313

We are also favored with the number of fibres occurring in the different columns of the cord, as follows:—

		1.		2.		3.		4.		5.	
Posterior columns,	R.	4862	8966	6345	13120	3030	6110	3998	7854	1659	3404
	L.	4104		6775		3080		3856		1742	
Anterior columns,	R.	7499	14881	9966	21566	4578	9098	7877	16091	2067	3814
	L.	7382		11600		4520		8214		1747	
Lateral columns,	R.	14701	29887	19131	36592	13134	25345	16478	33853	4354	8596
	L.	15186		17461		12211		17375		4242	
			53734		71278		40553		57798		15811

Comparison is made between the areas of different sections and the number of fibres contained in them, and this yields the interesting result that the brachial and lumbar enlargements are due to an increase of fibres at these points more than to an increase of gray matter.

Perhaps the most remarkabl econclusion which Gaule draws from his enumeration of fibres is a scheme of the arrangement of fibres in the spinal cord; by which, from the number of fibres entering by each of the spinal roots, he can easily compute the number of fibres in a cross section of the cord at any level. The notions underlying this, as we shall see later, are the ideas so characteristic of Gaule's work, the idea of a "*Chemischer Grund*" and that of the "*Oekus der Zellen*"; *i. e.*, of fixed numerical and quantitative relations obtaining throughout the structural as well as the chemical elements of all organisms. "A certain number of cells of one kind call for a perfectly definite and constant number of cells of another kind." Eggs do not divide hap-hazard into two, three, a dozen parts. But each egg segments in a definite and constant way into two, four, eight, sixteen, etc, This relation is said to be lost in the confusion of great numbers; but in general it holds good and can be revealed in any stage of the animal life by the proper methods. Hence a given number of fibres in a nerve root calls for a definite number of fibres in the spinal cord. These cord-fibres may be divided into three classes, designated by *a*, *b*, *c*.

a.—"Long fibres," which connect the central end of root-fibres with the medulla or some other part of the brain.

b.—"Medium fibres," connecting different regions of the cord.

c.—"Short fibres," which connect parts within the same region.

The author bases the theory of his computation upon seven propositions which are in substance as follows:

Prop. 1. Each medullated fibre in the cord is so placed as to function with one fibre of a spinal root.

Prop. 2. The medullated fibres of the cord form the connections of the root-fibres with each other and with the brain.

Prop. 3. We may divide these connections, according as they are made by the above long, medium, or short fibres, *a*, *b*, *c*, into three classes.

Prop. 4. ("Characteristic and peculiar to my theory.") To the central end of each root-fibre is grouped, in the cord, a definite and perfectly constant number of medullated fibres.

Prop. 5. The central ending of the root-fibres and the origin of the cord-fibres belonging to them do not lie far from the entrance of the root into the cord. (Proved by Birge's count of the elements of the anterior roots, and the simplest supposition for those of the posterior.)

Prop. 6. The length of the medullated fibres depends upon the distance apart of the elements which they connect.

Prop. 7. (Upon which his computation immediately depends). The central end of each root-fibre makes:—*A*, *two* connections with long fibres, one on the same, the other on the opposite side: *B*, *one* connection with a medium fibre, which ascends for the lower, and descends for the upper half of the cord; *C*, *eight* connections with short fibres, two which ascend, and two which descend for each half of the cord.

Taking now Birge's count of the root-fibres as the basis of computation, the number of fibres at different levels of the cord as computed and as actually counted, correspond as follows:

	Computed.	Counted.
Section 1	56.000	56,674
" 2	74,000	74,699
" 3	45,500	41,825
" 4	60,500	61.058
" 5	18,000	16,313

Of the forty pages, Dr. Gaule devotes twelve to an elaboration of his "purpose" in this investigation. And we learn from this that he is prompted to the work by the same ideas which animate his "Rede," ("Discourse on Science and the Problem of Life"), and his "Oekus [*οἶκος*, *Haushalt*] der Zellen," (household of the cells.) Hence the reference to these papers. From these we may obtain a key to Gaule's system. I cite them for this purpose and not with a view to giving complete abstracts from them.

In the "Rede" Gaule says in effect: If we knew all the chemical reactions, and all the physical forces which are present in the phenomena of life, we might still be no nearer the solution of the problem. May not life itself lie outside of these things, in groupings or combinations of groups of chemical and physical processes? To quote a few words: "These reflections have cooled the cheerful courage and high hopes of scientists who have turned toward the problem of life. Those who grasped most clearly the greatness of the task, were the first to doubt the possibility of its solution. I do not know what gives me courage to contradict them, but I cannot silence my hope. Let me tell you how I think the difficulties in the problem may be overcome." Innumerable as are the forms of living beings, certain common limits teach us that the processes throughout are in main features the same. And Hoppe-Seyler has already reached a general characteristic of all the processes taking place in living beings.

With the same chemical basis, why then, are not all living beings alike? Why are not all molecules which contain oxygen, hydrogen, and carbon, alike? Because different *processes* result in different combinations, different compounds, *i. e.*, different structural arrangements of the atoms.

These, which we may call higher combinations, make possible higher processes, to form in turn still higher combinations, and so on. As in terms of biology different physiological processes produce different morphological structures, vice versa, more highly developed structures cause, in a sense, higher physiological actions. These chemical processes must be in nature "cyclical," catalytic, resembling the action of ferments.

As Gaule expresses it at the close of the "Rede": "Life is cyclical, thus cause and effect must change about in it. As force is the cause of form so form is also the cause of force."

In the "Oekus" we find the thought developed a step further. He uses the word "Oekus" to designate an ideal organism in which the structures, organs, mediating these cyclical changes are linked in an unbroken chain. In imagination it is possible to trace, we will say, a molecule of food through each organ from one end of the chain to the other. The first organ receives it, makes use of it for its own life and excretes it, when of no further use to itself, in the form required by the next organ; and so on through the whole chain. This he attempts to illustrate in the organization of a frog and in certain cyclical changes which he has observed to take place in the formation of the blood. "The case is further complicated," he adds, "by the fact that every cell, while a part of the œkus, is after a fashion an œkus in itself."

The next step in the development of the thought we find expressed under the head of "Purpose," in the article first reviewed. It is the necessary logical consequent of what precedes in the "Rede" and "Oekus." "I make bold to assert," he says, "that the [numerical] relations obtaining between these elements, [of nerve, muscle, gland, etc.,] characterize absolutely genera and species." The purpose of my work is to supply a small link in the chain of evidence necessary to demonstrate this fact.

It is difficult to pass judgment upon the theoretical portion of Gaule's work. At present it seems to rest more upon analogy than upon fact. On the one side, the definite constitution of the chemical molecule he projects by analogy into the organization of living matter. On the other side, from the economy of the household he draws by analogy mutual relationship between the cells or lower elements of living matter. He cannot expect all to follow him on ground of analogy. Still Dr. Gaule has faced the problem of life in a manner which calls for no prejudice. It is true his "*Würmchen*" was ridiculed as a parasite of the blood. So persecuted they the spermatozoön and the white blood corpuscle before it. Prejudice and dogmatism may say what they please about such work. It makes little difference. The problem of life is too deep for either of them to solve. And it is quite possible, if we are ever to approach its solution, that we may be compelled to adopt new ideas of organization. No doubt, however, can arise as to the value of the practical portions of his work.

C. F. HODGE, PH. D.

NOTES.

Observations on General Terms.

One hundred and thirteen school boys, between the ages of 13 and 18 were asked to write their first thoughts or mental images on seeing the words, *being*, *the infinite*, *literature*, *abstraction*, *number*, *play*, *coldness*, *horror*, *heat*, *faith* and *fun*. A word was written upon the blackboard and a few moments given the pupils to transcribe their impressions, when the word was erased and another written. A few minutes each day were given to the exercise, some days three or four words being given in succession, *number*, *play* and *coldness* happening to be given at one sitting.

Many of the images have the local coloring of the time and place. The boys had been studying Sir Walter Scott as their papers reveal, and during the week of the experiment the entire city of Boston was thrilled with horror by a suburban railroad disaster, the shadow of which is cast upon these papers, which also reflect the enthusiasm of the prize drill, the papers as a whole giving one the impression of a kaleidoscope where thoughts take the place of colored glass, the feelings regulating the symmetry of the forms.

Under *being* 44 wrote, human being, which may or may not have been an attempt to define; 18 wrote the name of the Deity under different forms; 8 wrote "something living;" 4 gave it as "our life;" 2 as human existence; 3 specifying Wallace, Adam and Blanche, myself, others giving general examples, as monkey, dog, horse, man and woman. If one could but know if the man were a warrior, the dog a Saint Bernard, the monkey a wild one in a cocoanut-tree or one caged in a zoölogical garden, or passing its scarlet cap for the organ-grinder's pennies— then the interest would be increased. Creation and something that cannot be limited were suggested, and one poetic mind gave us this: "I see a beautiful being over a baby's cradle, rocking him to sleep." A minute description of that "beautiful being" would be valuable. Six gave no expression to their thought about the word, which might have been from shyness about giving the thought to another, or a misunderstanding of the experiment and perhaps from a lack of any impression.

Under the word *infinite*, 29 directly named God, 1 love of God, none of these being of the seven who named Him under being; 21 gave no expression; 5 the algebraic quantity ∞; 5 the sky; 3 the infinite number; 2 the unknown; 1 the problem never finished, $10 \div 3$; something dark; the future; number of wonderful things; number of boys; something beyond us; space; distance; a long line of which I cannot see the end; small thing; the universe; a large tree with infinite number of leaves; a sermon in which the minister said: God is infinite love; the air; time; city; a large man; the Globe building,—to this the boy added parenthetically, "infinitely large;" miraculous; everlasting; heavenly spirits; space; day; end of being; life after death; Venus on the sun; something to happen; form of verb; grammar; book entitled "Letters from Hell." No blanks were given with this word, but there were four under literature, a suggestive fact.

To 26, *literature* suggested books, some specifying good books, story books, etc.; 7 wrote reading; 3 history; 3 Longfellow; 3 Scott; 3 Waverly; Ivanhoe, Dickens, The Inferno, Shakspere, Homer and Milton, each having had honorable mention; 2 dime novels were suggested. Among picturesque thoughts appeared: A man printing a book; with literature comes sight of immense library with books of all ages and peoples; ancient Greece, especially Athens and old Greek tablets. A painting, funny composition, piles of papers, and something classical are as definite perhaps as some of the adult notions of literature.

Under *abstraction* there were 37 blanks: 23 attempted to define or illustrate, some of these efforts being too unique for omission, as: flavoring for icecream; flavoring put up in bottles; getting a tooth pulled; apples and baskets; spoke of a wheel; kindness and a man with head resting on hands, elbows resting on marble top table; a boy leaning on his hand and looking as if he saw something away off; sitting at a window in the country looking blankly into the air; a crazy person comes to mind; I picture a man in deep thought; works of nature especially beautiful scenery. Others wrote kindness, goodness, grammar, future, a wood, a beautiful sky, part of speech, an abstract person, something small, pleasure of having plenty of money, basket of flowers, and, this list of words about which I am writing.

Under *number*, 37 tried to define or illustrate; 15 wrote that it brought to mind various numbers as 1,000,000, 1,2, 10, etc.; 11 left a blank; 9 wrote figure or figures; 2 algebra. Limitation was twice suggested, and under the preliminary "it brought to my mind" or "it puts in my mind" were written: A row of blocks; a collection of men; the times I have been in swimming; the wonders of arithmetic, and No. 30 La Grange street. Others stated without explanation: the first page of an arithmetic, the score in a game of tennis, a number of soldiers, a lot of people on the fourth of July, sand in the sea, crowds of people in various places. One boy wrote simply newspaper, and another that number led to numerals. A connection was made by one between this and the two succeeding words. On seeing number I thought of a number of boys—think of them yet as I see play, and the same group appears to be playing, but growing cold toward each other. Three wrote unreservedly: I see a figure, I see a figure on the door; I see an unreadable number that I once saw.

Under *play*, 37 defined or illustrated, 5 left blanks, 1 of whom gave the most elaborate of the mental pictures under abstraction; 7 specified children, some designating little children, and kittens playing in various ways; 13 thought of base ball; 4 of a theatrical performance, 1 of these specifying Lady of the Lake; 2 thought of Richard the Third; 4 of lawn tennis; 3 of piano playing, 1 giving this: Play brings to me the figure of a person seated at a piano engaged in playing it. One wrote without preliminary: A large stage over which are some red curtains and a very small man declaiming. The vividness of this sketch leaves the bad construction of the sentence for an after impression. Three wrote: I see boys or children running round; I see the boys play; I see somebody playing.

Twenty-six defined *coldness*, the physical and spiritual significance being about equally represented; 26 thought of winter or a day in winter; 7 simply wrote ice; 5 gave blanks, others giving such picturesque details as these: A man with a very stern face; a large field of ice; a frosty ground with here and there a stump; I think of the look of coldness on the face of a high-toned boy toward his poorly dressed comrades; surly temper; anger; shivering; Greeley's expedition to the North Pole; proud person; firmness in a man; making a call on a young lady who is not at home; dressing myself in a big overcoat; not being sympathetic toward the poor; don't notice any of your parents; I think of unhospitality; associated with kicking the feet against the dash-board of a horse-car and an ulster with a high collar; Iceland; sharp cutting wind; I see the frost and snow; I see a cold and haughty person; dark gray objects appear.

Fifty-one defined *heat;* 5 left blanks; 3 thought of a stove; 2 of a furnace; 1 of a furnace for melting glass, and 1 of a smelting furnace; 1 of a register and another of a radiator, gilded; 1 of the school-house boiler room; 2 of summer; 2 of fire; 3 of the sun; 1 of the desert of Sahara; the others of parading around the city; a red hot ball rolling on the floor; melted butter; anger; a day in East Lexington with buzzing of locusts, a fat man trying to get his breath; a large vat under which is a fire filled with saints.

Fifty-five attempted to define *faith;* 14 left blanks; 3 mentioned dogs; 2 wrote simply a cross; 1 a church; 1 a catechism; 1 a prayer-book; and others such typical subjects as Daniel in the lions' den, tableau once seen, picture of Faith, Hope and Charity; 1 thought of the Supreme Being, and another of an Irishman's exclamation. To 1 was suggested the water cooler on the common; to another the story of St. Elizabeth. One wrote this: Faith brings a figure of a child on a high fence, a person below trying to get it to come down, and then the child drops. Another gave this dramatic picture: A girl following a very ugly man through a dark tunnel. And still another: A frightened child clinging to its father for protection.

It was surprising to me that the word *fun* proved the least interesting of all, 8 even leaving a blank. I half suspect that these boys did not like to write their notions of fun, and so there were attempts to define, sometimes a game being mentioned as an illustration of fun. A smiling face, a laughing boy, and a girl laughing, were suggested; one boy writing, I see boys playing.

Fifty-two defined or illustrated *horror*, 8 of whom wrote simply murder, and 1 assassination; some left blanks, others wrote battle, death, fire, an avalanche, drowning, and battle; 2 only suggesting ghosts. It would be interesting to know whether each thought of any particular fire, death or battle. One wrote, I imagine a murder; another, simply, a picture of a man to be hung. Others as follows: a beer saloon; one being killed; the accident at Roslindale; a horrible looking word, looks as if it should be spelled hell; makes me think of seeing some one in distress; makes me think of some terrible accident; a woman and a mouse; a lady looking at an alligator; seeing a man run over here; a boy I saw stabbed, and another run over by a horse car; a fellow holding his hand in the air, his hair standing on end; an old lady holding up both hands; horror is represented by a man falling from a great height, and many people are watching him; horror brought to my mind a person dying who regarded death with horror; makes me think of the time I was chased; makes me think of the feeling I would have if a large spider were crawling over me; the feeling I imagine if I were drowning; I think of a robbery; something cringing; a train, a smash up with piercing shrieks; a woman standing with hands thrown back (from a picture I saw when a child); a dream of snakes I had five years ago; and this: I see a house on fire, a girl with long streaming white hair, dressed in white standing at a window with the fire all around her.

A picture of a window was drawn on the blackboard for the same boys and they were asked to imagine it a real window and to write what they saw in looking through it. These are the pictures seen:—A tree and some houses, I seem to see a man wearing an old felt hat. I am looking in the window of a small cottage, there is an old lady sitting in a large arm chair knitting; her young daughter is getting supper and all seems comfortable and cosy. Air, houses, trees. Darkness, Christmas tree, children playing, a procession, soldiers. Streets, people, horse-cars, and carriages. Light, people, I see a street covered with many persons, horse-cars, express teams, large buildings, etc. I see an old shoemaker pegging away at a laced boot. A lot of boys going home, a long narrow lane in the country with a pasture on one side and a pond on the other, a guide post and hills in the back ground, a green field in the country. A moon-light night, a large brick house and a tree. An old woman with a large dog that lives on the same street as I. I seem to see a beautiful house surrounded by trees and a beautiful lawn. A horse and team standing. When I look through the window I seem to see a boy fishing in a river and he seems to be catching many fish. Through an imaginary window I can see a field at the bottom of which is a lake with boats on it and beyond is a green forest. If to a room, the form of the room and arrangements. Reminiscences: Looking out of that imaginary window I seem to see my mother scolding my brother. I would see some glass. I seem to see trees, a farm house, grass and cows and horses in the pasture and a barn in the distance. I see Mt. Washington and the Presidential Range in the White Mountains. The boy who was run over by a horse-car and his arm badly crushed. I saw a man fall down. A procession of boys marching along. The scenery from a window looking toward Mt. Washington. The man selling lobsters. A palace court yard. Engine going to a fire and a crowd following it. I seem to see a black substance through the window. The sky. Makes me think of the faces at Blackwell's Island, looking earnestly at the Boston boat. A criminal behind a prison door. A dark stormy night. I see a face, it is a sad one with large eyes which have evidently been crying; it is a girl's face with a charity cap on. A train rushing along, filled with passengers. A landscape. I see a face through this window. It appears to me like a look out on to the world. A game of foot-ball. A horse-car loaded with people going down the street. A field. A woman sewing. I see the future. I see a horse and team passing. Transparent. Distant hill. A dungeon. Trees, fields, spring, horse-chestnut tree. A hill covered with snow and a few bare trees. Makes me think of seeing some one in a window. A large room with fine things in it. Soldiers. Empty room. Friend. Nothing in particular. The state of Illinois. I saw some houses through the window. I see the trees and houses as I look through the window. Stars. I can see green fields and the ocean with a light-house on a large rock in the middle of it. A railroad station. I am in a farm house on a farm and looking upon the corn field and a few trees. Some trees. A lawn enclosed by a fence with a fountain in the center. I see a house in the distance. Sky, trees, houses seem to be the only panorama of a window. I seem to see a blackboard. A room. Saw a regiment of soldiers passing. I see a large house, square and brown. A dog fight on Columbus Avenue. A comfortable room. I see an evening sky full of stars. I see the dog outside. Looking at a picture I think of what it is of, where it is, and who was engaged in it. A steamboat passing down stream. Seeing a sight through a window which never can be forgot, either of horror or pleasure. I see a young man. It reminds me of the garden, a bed of geraniums at the house I lived in when I was in Germany. Looking at a boy. A scuttle of a sinking ship. One would see as if painted on a panorama before him from childhood to old age. I see through this window the ocean with about fifty yachts sailing. A tree and some houses. I see a child running across the street, a team is coming, and the child is knocked down and killed. A lamp post. A boy fishing.

Eight boys drew a blank, and several of them drew pictures of windows on their own papers.

Such meagre data as the above show that those who disparage "mere sense knowledge" disparage children, who up to these ages show few traces of any other kind of knowledge, but think mainly in visual pictures, their mental life being chiefly made up of imagination and memory of their personal experiences. Logical definitions are never attempted. A true psychological definition of such terms could be got by greatly increasing the number of such returns and presenting the results by graphic, statistic and descriptive methods. If anywhere constant appeal from the individual to the general consciousness is constantly needed, it is in the realm of abstract and general terms. If a carefully selected set of terms in the ethical field could be selected and returns gathered thus and separately for different ages and sexes, valuable results might be expected. It is interesting to compare such results as are presented in the case of the imaginary window with those described as "crystal-vision," reviewed in this number of the JOURNAL.

Francis Galton in some studies of this nature, but on adult minds, makes a table of results from which he draws this conclusion: "Hence we may see the greater fixity of the earlier associations and might measurably determine the decrease of fixity as the date of their formation became less remote." The city teacher more than any other needs to grasp this law, and give the children an early and vivid outlook upon nature; walls and horse-cars, pavements and engines are so likely to demand the attention of children that no opportunity should be lost to give a glimpse of the sky or clouds; to turn the thoughts to a grass plat or even a grass blade and so open the windows of the soul in the direction of influences which will accelerate the growth of intellectual and spiritual life. S. E. WILTSE.

Under the title of "*Die Eigennamen in der medicinischen Nomenclatur*, Dr. Med. Richard Sy has collected some 600 proper names as applied in medicine, anatomy, and some other branches. Each entry is followed by a short definition and sometimes a line regarding the person whose name is entered. The list as a whole must be useful, but in detail is open to criticism so far, at least, as the neurological terms are concerned. For example, the Deiter's cells of the central nervous system are not mentioned, and the definition of the foramen of Monro is irrelavant.

The American Journal of Insanity, for October, 1889, contains a paper read by Dr. H. E. Allison, Superintendent of the State Asylum for Insane Criminals, in Auburn, N. Y., at the Newport meeting of the medical superintendents this year. He advocates a general system of reporting autopsies in our asylums, and gives a "form for post-mortem records." One side of this contains blanks to be filled in with the most necessary data, and the other has four outlines of the brain from Ecker, (dorsal, ventral, mesial and lateral aspects), on which any superficial lesion can be directly recorded.

The dangers of the psychiatric calling are presented in a laborious report just published by H. Lâhn in Berlin. The average age of death of 431 alienists was 57.81 years, which is very low compared with the average age in other branches of the medical profession. Of 162 alienists, the cause of whose death is known, 7 were killed by patients, 10 fatally injured by lunatics, 6 committed suicide, 11 died of slow brain diseases, 17 of apoplexy. In all, 42 per cent. are thought to have died from causes directly or indirectly arising from their vocation.

The long discussion concerning the recognition of partial or reduced responsibility for criminal acts in the penal code in Germany seems likely to issue adversely to the proposed rubric. That there are many border-line cases which deserve neither acquittal nor the full penalty, is admitted, but the practical difficulties of adjudicating such cases in the face of the general incompetency of both jurists and physicians, are thought to be decisive against this class.

In a careful study of the effect of imprisonment on insanity, Kirn (*Berlin. klin. Wochenschrift*, 1889, No. 33), shows that confinement has a very strong tendency to bring out hereditary taint; that there is commonly immunity if the first six months are endured without morbid symptoms; that collective imprisonment tends to chronic and slowly unfolding diseases, while isolation causes acute psychoses with especial prominence of sensory hallucinations.

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A SKETCH OF THE HISTORY OF REFLEX ACTION.

BY C. F. HODGE, PH. D.

I.

BEGINNINGS AND DEVELOPMENT TO THE TIME OF CHARLES BELL.

The suggestions followed out in this chapter were obtained chiefly from notes made from the original sources in several of the libraries of Europe by Dr. G. Stanley Hall about the year 1880. At that time Dr. Hall was working upon reflex action in Ludwig's laboratory in Leipzig, and his object in going through the literature was that he might write a history of the subject in connection with his own work. In 1880 there was no history of reflex action later than Johann Wilhelm Arnold's[1] which appeared in 1842; and rapid progress since that time had rendered this inadequate for the needs of physiologists and doctors for whom it was written. But, as it often happens in science, when a need is felt, that several persons take up the work independently, Eckhard had been for a number of years collecting data for a history of this very subject. His admirable book[2] was published in 1881,

[1] Johann Wilhelm Arnold. Die Lehre von der Reflex-function für Physiologen und Aerzte. Heidelberg, 1842.

[2] C. Eckhard. Geschichte der Entwickelung der Lehre von den Reflexerscheinungen. Beiträge zur Anat. und Physiol. Vol. 9. Giessen, 1881.

and seemed to meet the demand so fully that Dr. Hall laid his work aside for the time.

The two works were somewhat different in scope. With the one, interest centers about the facts of nerve physiology, with the other attention is directed to the psychological development which underlies the appreciation of facts and recognizes the value of experiment. For example, Eckhard says, "No doubt many true reflexes are included among the phenomena of the so called '*sympathies.*' To follow these out, however, has no interest for the experimental physiology of the nervous system."[1] This is in striking contrast to the way Dr. Hall has treated the subject in his introductory chapter,[2] where he brings out the underlying psychic relation between the quality of mind which produced the doctrine of sympathies of the older physiologists and that which gave rise to modern views of reflex action. It is there shown how the soul was at first thought to be able to produce sympathy between different parts of the body directly, without the mediation of any corporeal mechanism whatever. Later, when the arteries were supposed to contain the soul or "ether," these became indirectly the means of sympathy, and so on, until the arteries were proved to carry blood, and experimental evidence began to point to the nerves. Thus the reader is lead to see how the mind, from rejoicing in fanciful explanations of things, comes step by step to appreciate nature as it is, and to prefer plain reality to its own imaginings.

Endeavoring to retain this point of view we may take up the line of historical development at the time when the importance of the nervous system begins to be recognized.

With the revival of interest in anatomy under Vesalius (1514—1564), and its further progress under Dulaurens (1550—1609), by the close of the sixteenth century the nervous system had been fairly well distinguished from the other

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[1] Beiträge, op. cit., p. 33.

[2] See this JOURNAL, Vol. III, No. 1. Introductory chapter to this subject.

tissues, and to it, in a theoretical way, had been ascribed certain functions of the soul. In some cases "sympathy" was said to be due to the connection of parts by nerves. For example, Dulaurens writing in 1595 ascribes the "sympathy" between the mammæ and the uterus in part to the "intercostal nerve" and in part to the azygous vein. It is not, however, until Descartes that we have the tangible beginning of what is to-day the science of reflex action.

The general neurological conceptions of Descartes may best be given in his own words:

"Although the soul is united with the whole body, its principal functions are, nevertheless, performed in the brain; it is here that it not only understands and imagines, but also feels; and this is effected by the intermediation of the nerves, which extend like delicate threads from the brain to all parts of the body, to which they are attached; so that we can hardly touch any part of the body without setting the extremity of some nerve in motion. This motion passes through the nerves to that part of the brain which is the common sensorium, as I have sufficiently explained in my Treatise on Dioptrics; and the movements which thus travel along the nerves to that part of the brain with which the soul is closely united, awaken by reason of their diverse characters different thoughts in the mind."[1]

Thus Descartes makes the brain pre-eminently the organ of the soul. But his views on this point were far ahead of his time, and he was obliged to contend against a strong current of opinions like those of Plato, who taught that the soul thought in the brain, felt passion in the heart, and desire in the liver. In these controversies Descartes' dissections stood him in good stead, as the following will show.

"The opinion of those who think that the soul receives its passions in the heart, is of no value; for it is founded only upon the fact that the passions cause a change to be felt in that organ; and it is easy to perceive that this change is felt, as if it were in the heart, only by the intermediation of a little nerve which descends from the brain to it; just as

[1] Œuvres de Descartes, publiées par Victor Cousin, Paris, 1824. Les principes de la philosophie. § 189, Vol. III, p. 500.

pain is felt, as if it were in the foot, by the intermediation of the nerves of the foot; and the stars are seen as if they were in the heavens, by the intermediation of their light and of the optic nerves. So that it is no more necessary for the soul to exert its functions immediately in the heart, to feel its passions there, than it is necessary that it should be in the heavens to see the stars there."[1]

We see from the above that Descartes had a clear idea of the sensory action of nerves. His conception of motor nerves is no less clear, although here the general ideas of his time cause a conspicuous bias. He says: "All the movements of the limbs, moreover, depend on the muscles; and finally we know that all these movements of the muscles, as well as all the senses, depend on the nerves, which are like little threads or tubes, all come from the brain, and like it, contain a very subtle air or wind, called animal spirits."

This leads us to Descartes' notion of the reflex process, which in essentials is as good as any we have to-day, viz, that a sensory impulse is carried to the brain and there may be, unconsciously or even in spite of the will, reflected, "*réfléchie*,"[2] to motor nerves and so cause a co-ordinated contraction of the muscles.

That "reflected" movements are effected by a corporeal machine, which may act in direct opposition to the volition of the soul, Descartes proves in the following suggestive language:

"And in addition to the different feelings excited in the soul by these different motions of the brain, the animal spirits, without the intervention of the soul, may take their course toward certain muscles, rather than toward others, and thus move the limbs, which I shall prove by an example. If some one moves his hand rapidly toward our eyes, as if to strike us, although we know that he is a friend, that he does it only in jest, and that he will be very careful to do us no harm, nevertheless it is difficult to refrain from closing them. And this shows that it is not by the agency of the soul that the eyes close, since this action is contrary to that volition,

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[1] Les passions de l'ame, article XXXIII, op. cit., Vol. IV.
[2] Les passions de l'ame, article XXXVI, op. cit., Vol. IV.

which is the only, or at least the chief, function of the soul; but it is because the *mechanism of our body* is so constructed that the motion of the hand toward our eyes excites another movement in our brain, and this sends the animal spirits into those muscles which cause the eyelids to close."[1]

But Descartes goes even further, and outlines the great field of involuntary action in general, including actions which become reflex by habit and education. To quote again, he says:

"Yet I will say further that it appears to me a very remarkable circumstance that no movement can take place, either in the bodies of animals, or even in our own, if these bodies have not in themselves all the organs and instruments by means of which the very same movements could be accomplished in a machine. So that, even in us, the spirit, or the soul, does not directly move the limbs, but only determines the course of that very subtle liquid called animal spirits, which, flowing continually from the heart through the brain into the muscles, causes all the movements of our limbs, and often may effect many different motions, one as easily as the other. And the mind does not even always determine these movements, for among them there are many which do not depend upon the mind at all, such as the beating of the heart, the digestion of food, the nutrition, the respiration, of those who sleep; and, even in those who are awake, walking, singing, and other similar actions, when they are performed without the mind thinking about them. And, when one who falls from a height throws his hands forward to save his head, it is through no process of reasoning that he performs this action; it does not depend upon his mind, but takes place merely because his senses being affected by the present danger, some change arises in his brain which determines the animal spirits to pass thence into the nerves, in such a manner as is required to produce this motion, in the same way as in a machine, and without the mind being able to hinder it."[2]

It is suggestive to see how instantly the mind, set free from

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[1] Les passions de l' ame, article XIII, op. cit., Vol. IV.
[2] Op. cit., Objections et Réponses, Vol. II, p. 52.

the perplexing trrationalfty ofsan immaterial principle acting lawlessly in the body, seeks the lawful mechanical explanation of the phenomena of life. It is suggestive, too, that mechanism is so readily found by him who seeks in the right spirit. So from the thought of Descartes sprang, full formed, the principle of mechanical physiology, and with it that of reflex action.

It would hardly be fair to ask of Descartes now-a-days proofs for all his statements. Some of his proofs are as good as any we have to-day; others are as fanciful as his reason for placing the soul in connection with the pineal gland. What to us are shadows were solidest realities to the men of his time. The soul as a separate entity was as real to Descartes as his own body; and "animal spirits," as a "subtle liquid," was as familiar to all the philosophers of that time as ordinary blood is to us to-day.

It is a great descent from the clear views of Descartes to the obscure ideas of his contemporaries and even of those who follow him. But there are compensations; for we shall exchange in a measure the highways of philosophy for the by-paths of experiment.

Reflex phenomena begin to strike the attention of a number of observers independently. Swammerdam (1637—1680), notices the reflex movements of sleeping animals and men, when the skin is gently stimulated. Francesco Redi (1626—1694), in Pisa, in connection with his work on the venom of serpents, has his attention called to the movements of animals after decapitation. Boyle (1626—1669), in England, describes the same phenomena in decapitated serpents as follows: "The body of vipers may be sometimes, two or three days after the skin, heart, and all the entrails are separated from it, seen to move in a twining or wriggling manner, nay, may appear to be manifestly sensible of punctures, being put into a fresh and vivid motion, when it lay still before, upon the being pricked especially on the spine or marrow, with a pin or needle."[1] It is difficult to conceive ho Descartes could have refrained from putting his notions

[1]C. Eckhard, op. cit., p. 38.

of reflex action to the test of experiment by vivisection. Had he done so, however, he must have discovered that the spinal cord, as well as the brain, could function as a "reflection" center. But here Descartes fell short, and now it appears that animals without the brain, the drive wheel of Descartes' whole machine, retain the power of responding to stimuli by reflected contractions. This brings the question to the point, viz: does this power have its seat in the body generally or in the spinal cord? As decapitation had demonstrated that it did not reside wholly in the brain, so one crucial experiment, the removal of the spinal marrow, would have demonstrated that it *is not present* in the body in general. But instead of making this experiment, the learned doctors turned to speculation and controversy as was their wont before Bacon tried to teach them a better way of using their time. A century elapses before the simple experiment is made, and meanwhile, the fight goes on about the soul, its location in the body, its connection and relation to it, its divisibility, etc., etc.; and added to this was discussed the question, whether "*sympathy*" depended on union of nerves in the spinal cord, their union at the periphery, or on blood vessels and continuity of tissues.

To Thomas Willis (1622—1675) is generally ascribed the origination of the notion of peripheral nerve anastomoses.[1] If this is true, Willis required his good work in brain anatomy to atone for such a mistake. And still, Willis wrote his "Cerebri Anatome" in 1664. In 1628 Harvey published his work on the circulation of the blood. And just before Willis wrote (1661), Malpighi supplied the one remaining link in the evidence for Harvey's doctrine by discovering the capillaries. It was a time when everything possible in the body must circulate, and in order for the "subtle liquid" within the nerves to do this, peripheral connections must exist between efferent and afferent nerves as between arteries and veins.

[1] "Dr. Willis, who has given a more accurate description of the brain and nerves than any anatomist before him, endeavored, first, to explain the various instances of sympathy between the parts of the body, from the connection or communication of their nerves. This doctrine was afterwards further illustrated by Vieussens, and has been embraced by most of the later writers." Works of Robert Whytt, Edinburg, 1768, oot-note, p. 50[illegible]

The pressure of theory was, in short, strong enough to make some men see what did not exist. And Willis, "a lucky dissector, but a hair-splitting theorist,"[1] seems to have been the sort of man to see in this way. As Ridley, writing in 1695, quaintly put it: "I am apt to think that that learned person [Willis] too soon fell in love with his first thoughts, the ordinary reason of either one's seeing false, or not far enough."[2]

Willis was to some extent a student of Descartes, to whose influence he probably owed his bent toward the study of the nervous system. For things which Descartes treated in general terms, Willis naturally sought to discover special mechanisms. Thus, he says, if the brain secretes the "spiritus animalis," it, in turn, must obtain the nourishment which enables it to do so from the blood. This led Willis to study the blood supply of the brain, and the memory of his work in this direction is fitly perpetuated in the arterial ring which bears his name, the circle of Willis. He further correctly describes how the blood vessels of the brain distribute themselves and finally penetrate the surface in order to convey to the small nerves therein a delicate liquor which serves for the production of the spiritus animalis. The flow of the spiritus is determined by the convolutions, and each of these consists of two distinct substances, the gray and the white. Willis further considers that the actual secretion of the spiritus animalis must chiefly take place in the gray matter for the very good reason that the white resembles the matter of the nerves and spinal cord and to it should be ascribed the same function, viz.: the storage and distribution of the spiritus animalis.[3] In the matter of reflex action, Willis follows Descartes in the use of the term, "reflexa" and in general thought, likening the reflex process to that of reflected sound in echo, but differs from him in making the periphery as well as the brain the seat of the reflex process.

After Willis, Astruc of Montpelier (1684—1766), carried

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[1] Sprengel. Geschichte der Arzneykunde, 1827, Vol. IV, p. 201.
[2] Ridley. Anatomy of the Brain, London, 1695, p. 160.
[3] Willis, Cerebri Anatome, Amst., 1664, pp. 46, 49, 50.

out the suggestions of Descartes in a most rigidly mechanical way. He grouped sympathies, however, in the old style into several classes according as he supposed them to be explained by anastomoses of veins, continuity of tissue, anatomical or physiological resemblance, or by the nervous system. These latter, including respiration, deglutition, defecation, parturition, hysteria, teething-convulsions, and winking, are true reflexes. The brain he thought to be formed of tubes closely pressed together and often interrupted by columns of tendinous fibers. Against these columns the nerve tubes opened and upon them the spiritus animalis beat, the flux and reflux causing sensation and motion. As with light, angles of incidence and reflection are equal, so that a sensation produced by a concussion of animal spirits against the fibrous columns is reflected and causes motion in those nerve tubes which happen to be placed exactly in the line of reflection. The force with which the animal spirits impinge, however, may be so great as to cause motion in the nerve tubes on the other side of a column, thus producing an irradiation of reflected motion which might change the angle of reflection one hundred and eighty degrees.[1]

This work of Astruc was published in 1743. In 1751 appeared the celebrated essay of Robert Whytt (1714—1766), upon the "Vital and other Involuntary Motions of Animals." Section 1, of this essay opens as follows:

"A certain power or influence lodged in the brain, spinal marrow, and nerves, is either the immediate cause of the contraction of the muscles of animals, or, at least, necessary to it.

"The truth of this appears from the convulsive motions and palsies affecting the muscles when the *medulla cerebri*, *medulla oblongata* and *spinalis*, are pricked, or any other way irritated or compressed; as well as from observing that animals lose the power of moving their muscles, as soon as the nerve or nerves belonging to them are strongly compressed, cut through, or otherwise destroyed."[2] "The tying or cut-

[1] Cayrade. Recherches sur Mouvements Réflexes. Paris, 1864, p. 13. Cayrade makes Astruc the first to use the term reflex; but he has certainly overlooked the claims of Descartes and Willis in this matter.

[2] The Works of Robert Whytt, Edinburg, 1768, p. 3.

ting of blood vessels," he further adds, "has no such sudden effect upon the muscles," citing in proof the case of a dog which continued to use its leg, after the "crural" artery had been tied, "until the member was almost quite dead."

At the very outset, too, Whytt breaks away from the old overgrown ideas clustering about the term "animal spirits," declaring his preference for the expression, "power or influence of the nerves," and he adds: "If, in compliance with custom, I shall at any time give it the name of *animal* or *vital spirits*, I desire it may be understood to be without any view of ascertaining its particular nature or manner of acting." His division of animal movements is also good; but it is in a somewhat later work[1] that Whytt elaborates his views of reflex or sympathetic action. Here he enumerates many instances of normal and morbid sympathy, by which a stimulus applied at one part causes motion in a distant part. He especially calls attention to the fact that this may occur where no neural connection exists between the parts except through the brain and spinal cord. These, he justly urges, cannot be explained on the theory of anastomoses; and although he nowhere denies the possibility of such connections of nerves at the periphery, he brings forward a number of facts to disprove their effectiveness.[2]

"There can be no sympathy," he argues, "between the nerves derived from the same trunk by means of the membranes that surround them;" "because they have only an obtuse kind of feeling," "and no moving power," "and such connections would cause confusion in our sensations and motions." Moreover in cases of general convul-

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[1] Observations on the Nature, Cause and Cure of those Disorders which are commonly called Nervous, Hypochondriac or Hysteric. Edinburg, 1764. Works of Robert Whytt, Edinburg, 1768, p. 487.

[2] The best statement of Whytt's position in this matter is given in the following foot-note, which shows also the scientific spirit of the man.

"If it should be objected, that it is as difficult to account for a sympathy between the nerves at their origin in the brain, as in their course to the several parts, to which they happen to be connected; I answer, that the purpose of these observations is not to explain how the different parts of the body can be endowed, by means of the nerves, either with a sentient or a sympathetic power; but, to endeavor to trace the sympathy of the nerves to its true source, which I take to be the brain and spinal marrow." Whytt, op. cit., p. 512, foot-note.

sions caused by slight local irritation these connections, if admitted, must be assumed to be very extended; and still between parts close together and connected by nerves, sympathy is lacking, while it exists between distant parts. But all these arguments amount to but very little against the theory of anastomoses as compared with the fundamental and crucial experiment which Whytt brought forward. He says in describing this experiment: "When any of the muscles of the leg of a frog are pricked, most of the muscles of the legs and thighs contract, even after cutting off the head, if the spinal marrow be left entire; but when that is destroyed, although the fibres of the stimulated muscles respond with a weak tremulous motion, the neighboring muscles remain wholly at rest. There is no sympathy between the different muscles or other parts of the body as was observed while the spinal marrow was entire; from whence it seems to follow that the nerves distributed to the several parts of the body have no communication, but at their termination in the brain or spinal marrow, and that to this, perhaps, alone is owing the consent or sympathy between them."[1] The name of Dr. Hales is often coupled with this experiment, and justly so from Whytt's own account, which is as follows: "The late reverend and learned Dr. Hales informed me that having many years since tied a ligature about the neck of a frog to prevent any effusion of blood, he cut off its head, and thirty hours after observed the blood circulating freely in the web of the foot; the frog also at this time moved its body when stimulated, but that on thrusting a needle down the spinal marrow, the animal was strongly convulsed and immediately after became motionless."[2] These experiments prove that even if anastomoses existed they could not in any case mediate consent or sympathy between different parts.

Besides this, Whytt made several minor contributions to the subject. He has precedence in the discovery that, in the frog, a segment of the cord may serve to produce "consent" between the muscles to which it supplies nerves. It is Whytt, too, who seems first to have noticed that immediately

[1] Works of Robert Whytt, Edinburg, 1768, p. 520.
[2] Whytt, op. cit., p. 290.

after decapitation no sympathetic contractions could be called forth, thus anticipating the notion of inhibitory action. Finally Whytt brought the action of glands, the secretion of tears and saliva, into the category of reflex actions.

And yet with all this Whytt failed in his grasp of an important side of the subject. He repudiated the efficiency of mechanism utterly. With Whytt it is a sentient or vital principle that is behind all phenomena of life. To quote his own words: "The more probable opinion seems to be that the soul is equally present in the extremities of the nerves through the whole body as in the brain. In these it is only capable of feeling, or simple sensation; but in this it exercises its power of reflex consciousness and reason."[1] He believed in consciousness of different degrees, and that no motion can take place in the body unattended by some degree of consciousness. "The soul is diffused through a great part of the brain and spinal marrow, and might be present at one and the same time in all parts of the body where nerves are found." Yet he distinctly rejects the doctrine of Stahl that the soul directs all the bodily functions with a full degree of rational consciousness.

"We must either allow," concludes Whytt, "that both the head and body of a frog continue to be animated for some time after they are separated from each other, or else affirm that the life, feeling, and active power of animals are merely properties of that kind of matter of which they are made. The former opinion is attended with some difficulties which arise chiefly from our own ignorance of the nature of immaterial beings." "The latter view seems to be inconsistent with all the known properties of matter. If the latter, therefore, be admitted, we not only ascribe qualities to matter which it does not possess, but presume to limit, by our own narrow capacities, the power of incorporeal natures and their manner of acting upon bodies co-existing with them."[2]

These views brought Whytt into direct collision with Haller (1708—1777). For Haller had become imbued with the idea that there was a power inherent in living muscle,

[1] Whytt, op. cit., p. 288.
[2] Whytt, op. cit. p. 289.

"*irritability*," "*vis in sita*," which was independent of the "*sensibility*" of nerves; and, although he takes for granted the existence of animal spirits and even discusses at length what manner of fluid it is, he seems to have been first to discern inherent in living nerves a something inexplicable on then existing theories, and to this something Haller first applied the term, the equivalent of Whytt's "power of nerves," "*vis nervosa*." But Haller's commendable zeal for the independence of irritability from sensibility led him too far. In order to prove this, he argues at great length that the pleura, peritoneum, bones, periosteum, ligaments, cornea, and some other tissues, are entirely without nerves and therefore insensible. And since these are destitute of nerves, the theory of Whytt must be amended by allowing that certain sympathetic actions, like the secretion of the lachrymal gland upon irritation of the cornea, must be due to simple continuity of tissues. Whytt had no method then at his disposal to demonstrate the nerves of the cornea, and even he does not seem to have thought of destroying the brain to see if the sympathy persisted. He attacked the matter from the other side, however, and gives Haller an able and suggestive answer.

"Having been lately present," he says, "at the extraction of the crystalline lense in Mr. Sharp's method, I inquired particularly of the patient whether he felt any pain when the *cornea* was first pierced with the knife? He told me he thought the pain was much the same with what he used to feel when the skin of his arm was cut in bleeding. It ought, however, to be remarked, that though the skin and *cornea* have both considerable degree of sensibility; yet, when they are cut quickly with a very sharp instrument, there is less pain felt than one would imagine."[1] "The tunica cornea is so far from being insensible, as M. De Haller believes, that any one may be soon convinced of the contrary by an experiment upon his own eye; for when the cornea is touched with the finger a sensible pain is felt; and it is well known that powder of tobacco, or any acid liquor applied to the *cornea*, excites a very acute sensation. Tho' the sclerotic coat of the eye is

[1] Whytt, op. cit, p. 263.

far from being void of feeling, yet I have found it less sensible than the cornea, by touching both not only with my finger, but with a bit of soft silk or linen."[1] Since Haller's method of demonstrating sensibility was simply to stimulate the part and notice whether the animal gave signs of pain, and since he expressly includes the conjunctiva with the cornea, these arguments of Whytt are perfectly conclusive. In a similar manner Whytt deals with all the "insensible" tissues of Haller, and is justly led to conclude "If sensibility, then, be a sure mark of the existence of nerves in any part of the body, there is none without them, altho' anatomists will never be able to demonstrate them in every part."[2]

About this time begins a department of our subject which will demand attention in a subsequent chapter, viz.: the rate of the nerve impulse. Shortly before the time of which we are speaking, in 1676, Roemer calculated for the first time the velocity of light. About this time, too, Newton, Hooke and Huygens, between them had developed the idea of the hypothetical ether, which was either projected, or transmitted waves of vibration with the velocity of light. Newton himself was among the first to carry this conception over into the theories of nerve action. In the *Principia*, he advances the opinion that all sensations and movements are excited by the vibrations of a "very subtle spirit" propagated through the solid "capillamenta" of the nerves from the organs of sense to the brain and from the brain to the muscles.[3] In 1649, David Hartley developed this opinion of Newton's into the celebrated vibration theory, calling into action the ether as the subtle fluid of the nerves. This theory suggested a rate of nerve impulse equaling the velocity of light. Another writer of the time calculated the rate of a nerve impulse from the velocity of the blood in the aorta, basing his computation on the theory that the nerve fluid traveled as many times faster than the blood, as the smallest nerve fibril he could find was smaller than the aorta. This gave the

[1] Whytt, op. cit. p. 262.
[2] Whytt, op. cit. p. 268.
[3] McKenderick. A Lecture on Physiological Discovery, Brit. Med. Jour., 1883, p. 995.

unthinkable velocity of over ten million miles per second.[1] By a simple and suggestive experiment, Haller checked the tendency toward such fantastic ideas and instilled into the subject a spirit of moderation, which may very possibly have hinted to Helmholz his method of actually measuring the rate of a nerve impulse. Haller's method was, briefly, to read a number of lines from the Æneid, take the time, count the letters read, and measure the length of nerve traversed by the impulse in speaking. The notions of centrifugal and centripetal were not so clearly defined then as now, and Haller made his computation on the assumption that the nerve current passed to and from the brain at each effort. But the rate which he obtained, although accidental, was not far from correct, viz.: 150 feet per second as compared with 90 feet, the result of Helmholz' measurement on the nerves of the frog.

But Haller missed the exact point, the unconscious element of reflex action; for he maintained that the processes in the movements of an animal with and without brain were in essentials the same; whereas herein lies the chief distinction.

Closely following Whytt began the writings of Johann August Unzer, (1727–1799), his "Grundriss," appearing in 1768, and "Physiologie" in 1771. By calling attention to the fact that artificial stimulation, whenever applied to a nerve trunk, produces the same effect as normal irritation, he could point out more clearly than had been done, the path of a sensory impulse from the periphery to the brain. Here, according to Unzer, it is transformed into a "material idea," which gives rise to an image in the soul; and from the brain it may pass as a motor impulse to the appropriate nerves and thence to the muscles to give rise to what Unzer calls "*motion with consciousness*." From this, he distinguishes *unconscious* movements in which the sensory stimulus is, "bent back," "turned about," reflected" to the proper motor nerve without going up to the brain.[2] Unzer failed to appreciate the significance of Whytt's crucial experiment and taught that the reflection

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[1] Hermann's Handbuch d. Physiol., Vol. II, p. 14.
[2] Arnold, Johann Wm. op. cit., p. 29 ff.

took place in the ganglia where the spinal roots diverge to enter the cord.

With Unzer came not so much anything new as a general clearing up of the subject preparatory to modern views of the relation between the mind and nervous system. The one to work more especially in the field of reflex action at this time was a contemporary and follower of Unzer, George Prochaska (1749—1820).

Writers, fifty years ago, could not say enough in praise of Prochaska's work. Longet ascribes to him the merit of making reflexes a distinct class of movements.

Prochaska's first important work was published in 1784, and a few words from this will best serve to indicate his earlier views of nervous action.

"At length," he says, "we abandon the Cartesian method of philosophizing in this part of animal physics, and embrace the Newtonian, being persuaded that the slow, nay, the most uncertain road to truth is that by hypothesis and conjecture, but by far the more certain, more excellent, and the shorter way is that, *quæ a posteriori ad causam ducit.* Newton distinguished the inscrutable cause of the physical attractions by the name 'force of attraction;' he observed its effects, arranged them, and detected the laws of motion, and thus established a useful doctrine, honorable to human genius. In this way we ought to proceed in the study of the nervous system; the cause latent in the nervous pulp, which produces certain effects, and which hitherto has not been determined, we shall call *vis nervosa;* its observed effects, which are the functions of the nervous system, we shall arrange, and expose their laws."[1] Prochaska would use this term in a broader sense than Haller, who confined it to the power with which a nerve caused a muscle to contract. His first law is that the "vis nervosa requires for its action a stimulus, as a blow is necessary to elicit sparks from flint." His other laws do not particularly concern us. For example, stimuli which call the vis nervosa into activity may be material or mental. The vis nervosa may be more active *(mobilior)*, or more

[1] Geo. Prochaska. De functionibus systematis nervosi. Fasic. tertius Annotat. Academ. Prag., 1784. (Todd.)

sluggish, requiring stronger stimulus to produce the same effects. It is augmented or diminished by influences which tend to elevate or depress the powers of life. Prochaska's leaning toward an electrical explanation of nervous phenomena appears early in his career, before the discoveries of Galvani were made known. For example, he recognizes the influence of nerves upon the blood supply to a region, as in the case of erectile tissue, the reddening of the skin upon irritation, or blushing under emotion, and to account for these facts he advances the notion that augmentation of vis nervosa in any part attracts the fluids of the body thither as "sealing wax when rubbed with cloth becomes electrical and attracts small particles to itself."

One of the most important contributions of Prochaska is the definition of the term "*sensorium commune*," an expression used since Descartes with little significance. It is in connection with this that Prochaska elaborates his ideas of the nature of reflex action. "External impressions," he says, "made on sensitive nerves are propagated with great velocity throughout their entire length to their origin, where, when they have arrived, they are reflected according to a certain law, and pass into certain and corresponding motor nerves, by which again being very quickly propagated to muscles they excite certain and determinate movements. This place, in which, as in a center, nerves of sense and motion meet and communicate, and in which, the impressions of sensitive nerves are reflected into motor nerves is called by a term already received by most physiologists the *sensorium commune*." The law according to which the *sensorium commune* reflects sensory into motor impressions is the preservation of the individual.

To prove that reflex actions may be performed unconsciously, Prochaska instances certain movements of apoplectic patients, the convulsions of epilepsy and movements during profound sleep.

In 1786 came Galvani's brilliant discoveries in electricity and Prochaska, as might be expected, was first to work the new doctrine into an explanation of reflex action. He maintains that any irritating body brought into contact with a living organism forms a new link in the Galvanic circuit of solid and fluid parts, which constitutes the organism. This causes a quantitative and qualitative change in electric tension which is conducted by the nerves to the brain where it produces sensation. The "changed tension of the brain acts as a reflex of the irritation upon other organs and excites them to peculiar activities adapted to remove the unpleasant irritation and to retain those which are pleasant.'"[1] Thus reflexes have for their general law the preservation of the organism as before, and are "founded on electrical attraction and repulsion of advantageous or injurious irritations according as the polarities of the organ and the irritation are identical or opposite." So Prochaska went to seed in the idea that "physically considered, vis nervosa is pre-eminently a principle of life which reveals itself to us in electricity.[2] As Eckhard remarks in effect, neither Unzer nor Prochaska had unequivocal experimental grounds of their own, as Whytt had, for believing that reflexes could not take place in peripheral anastomoses.[3]

But the century did not close without witnessing the beginnings of some good experimental work in reflex action. Sir Gilbert Blane (1747—1834), on young kittens, and Legallois (1770—1814) chiefly on rabbits, redemonstrated the experiments of Whytt made on the frog, proving that portions of the cord in these animals, as well, could function as reflex centers for the corresponding parts of the body. But the work of these men marks rather a renewal of interest in this sort of investigation than the contribution of anything really new.

For Legallois, animals are constructed to move and to feel. We might, he says, suppose that the power to do this resides in all parts of the body equally, were it not for the fact that the instant a nerve is cut, all sensation and motion vanishes from the parts below the section. Hence the source of power must be sought in the source of the nerves, i. e., in the brain and spinal cord. Destroy these, and all power of motion or

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[1] Prochaska. Physiologie. Vienna, 1820, p. 85. seq.
[2] Prochaska. Vorrede, pp. 9 and 10.
[3] Eckhard, op. cit. p. 50.

sensation is irrevocably lost. But, "if instead of destroying the cord, transverse sections are made, each part of the body corresponding to each section retains its own sensation and voluntary motion; but the sections act without harmony and as though independent of each other, as if, in fact, the sections had been carried through the entire body of the animal. In a word there are as many distinct sensory centers as there are segments of the cord."[1]

The committee appointed to report on Legallois' memoir explained that he believed that the cord acted not merely as a medium of communication between different parts of the body, but that the principle of life and the power which animates the whole body proceeded from it.[2] To prove this, it was admitted, Legallois brought forward abundant and conclusive experiments. Another important point brought into prominence by the use of warm blooded animals is the direct and immediate dependence of life in the cord upon the free circulation of blood through it. Thus while Legallois contributed little that is entirely new, he certainly emphasized and enlarged that which is of most value in the work of his predecessors, and gave to investigation of nerve action a new impetus and direction.

The truth itself could hardly have awakened more profound and universal interest than the error of Galvani, already described in the introductory chapter. But with this excitement naturally enough arose a cloud of speculations which again involved the subject of nerve action in lawless confusion. Even Alexander von Humboldt, as late as 1797, was led, in spite of the good experimental evidence of Whytt, into the most laborious attempts to explain sympathy between different nerves by "conduction" and anastomoses, and proximity of origin of nerves, and by the fact that one nerve lies in the "sensible atmosphere" of another.

How this confusion is cleared up by the timely discovery of a law as important to nervous action as that of circulation to the physiology of the blood must be reserved for a subsequent chapter.

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[1] Œuvres de Legallois, Paris, 1830, Vol. I, p. 135-6.
[2] Legallois. op. cit., Vol. I, p. 265.

MINOR CONTRIBUTIONS.

OBSERVATIONS ON COLLEGE SENIORS AND ELECTIVES IN PSYCHOLOGICAL SUBJECTS.

By E. A. Kirkpatrick, Scholar in Psychology at Clark University.

A few years ago Dr. G. Stanley Hall, then professor of psychology in the Johns Hopkins University, asked eleven professors of philosophical subjects in all the larger eastern and two western colleges or universities, to request their senior students near the close of their last year to answer carefully and in writing the few simple questions below. From these answers about two hundred and twenty were selected for this report. Nearly all received were deliberate and serious and not a few were elaborated to considerable length. They do not admit of statistical presentation, but, collated as below (chiefly in the *words of the student, each clause representing a person)*, form a composite portrait of the positions held, and the educational value of these studies from the student standpoint, of significance for teachers of these subjects. They have not only educational but anthropological significance, and reflect many sides and phases of mental evolution or psychogenesis which an ordinary examination paper does not touch.

I. The first question was *why these studies were chosen.* Here only answers where these studies are elective or optional are considered (178). Excluding nearly a score of cases where the determining factor was the advice of parents, a friend, or personal liking for the professor, or respect for his reputation, or a choice between two or more evils to avoid a still more hated study, the motives fall readily into the two classes of utilitarian and more purely educational. Five chose psychology as a study useful for medicine, three chose philosophical subjects as helpful for law, twenty as a preparation for theological study, four each for history and literature, others as a help to know character, to know motives and how to deal with men, to know self and others. The less practical objects sought by thirty-nine were mental discipline or culture; thirty-six sought further light in problems in the field of natural history including evolution, seven sought a better grasp of problems in physical sciences, about three-score sought light on religious and ethical questions, or it was a chance discussion of free will that had turned the scale.

Some wanted help to judge of doubtful acts, many had theological doubts they hoped to have cleared up, or wanted to find a few certain beliefs, or to obviate trouble that had arisen about materialism, agnosticism, evolution, or necessity and freedom, in this order of frequency. Other reasons were specified as follows: to avoid the fatal narrowness of the specialist, to learn to detect and avoid fallacies, to get insight into mind, and rational processes and laws as a necessary part of a liberal education, because it was as broadening as classics, to learn of the great teachers of the world, from interest in phrenology, had heard of Berkeley and idealism and would know what it was all about, from interest awakened by a phrenological examination, to counteract the effects of Kant, as an harmless and elevating amusement, to increase general intelligence and to know that Kant did not serve under Cæsar and that Plato was not a Dutchman, to get poise between the extremes of empiricism and rationalism. Several hoped to gain a birds-eye view of the whole field of knowledge, or to see the background of the sciences, to be able to understand and talk intelligently upon the important questions of the day, to see how philosophy dealt with the questions of science, to learn what the great minds of the world had thought upon its greatest questions, or to find the last and best words of the greatest thinkers of every age upon subjects of greatest interest to man in his highest capacity. One could not tell why it was chosen, but took to it as a duck to water, one believed himself best fitted for and most likely to excel in it. One had before found it a part of his life. One expected to find it the basis of all other studies and had heard of it as the science of sciences. Another thought it the résumé of all other studies. Another reasoned, that as science dealt with matter, and philosophy with mind, it would teach him how to deal with men. One thought that as it was abstract it would require and develop more keenness of insight and power of application. One had wondered what thought was, anyway, and how great minds worked. One would learn to direct his life by it, to influence others more, it would help and insure progress, or to get settled in belief, strengthen conviction, to learn to tell false from true, to get a foundation, to clear up the question of immortality, to settle the question of inspiration of the Bible and miracles, to know God and duty, to understand the relations of mind and matter, to know the great problems of the world and of individual thinkers, to get rid of dogmatism, to gain independence of thought, power of generalization, ability to make comprehensive judgments, to arrange very unassimilated facts, to concentrate and direct my efforts, to know general principles, to get the habit of accurate thinking, to develop my mental powers as far as possible.

Among the more elaborated and detailed answers to the first question are two which give great prominence to a love of discussion and debate, and the strange magical attraction of all questions which had two even sides or even those in their nature insoluble; several whose philosophical interest began at some particular moment, perhaps in early boyhood, when the question occurred suddenly, perhaps before a mirror, "Who or what am I, what is I, or how did I come to be I and not some one else in part or in whole?" and speaking one's own name or gazing at it written, as in a spell, increased the self-estrangement and wonder. Several describe a great growing sense of the strangeness and unreality of all things, and even persons about them. What are things; are they real; what do I and they mean? One was possessed for years with the haunting suspicion that probably only things at the moment attended to were really real, and all others, perhaps, passed out of existence. Several had spun crude theories of their own they wished to test. Two describe an attack of theological skepticism with detail, which, especially in one case, is pathetic and almost magnificent; and one had had a prolonged and hardly less serious experience with the problem of free will, which these studies were to clear up.

II. The second question was, "*what have you already gained of value from these studies?*" Only six profess to have gained nothing. Of these, one hated it, another had forever lost his peace of mind and wished he had never heard of philosophy, two had had their curiosity deepened (one would study it forty years like Kant before he could answer this question), two still had little, but expected much. Another small group of students had been made more discriminative but less confident, if anything, or had concluded that common-sense, or in one case, unreflecting conscience was not a safe guide, one that all off-hand judgments were worthless, one that to actually prove anything was impossible, one that the contradictions of experience could not be reconciled, one that things were not as they seemed, or not so real after all. One had come to so hate introspection and analogies that he would escape their paralyzing effects by becoming as much of an animal as possible. One had gained so many more doubts than he ever heard of before that he was miserable and had even meditated suicide at two different times. Two had learned that their mission was to combat or expose agnosticism, skepticism, materialism or determinism.

The chief advantage gained and most often specified was religious. The most common or typical phrases are as follows :—Clearer apprehension of God and duty ; satisfied all my formerly grave intellectual difficulties about religion ; shown me the ground for my religious belief ; made me able to comprehend the divine government ; removed the sense of conflict between science and theism ; shown me the authority of the bible, God, immortality ; convinced me of free will ; revealed the truths at the basis of religion ; has brought me by considering non-christian truths to understand and see the superiority of christianity ; my ideas of God and nature are changed, enlarged, established ; has revealed solid foundations by clearing away much rubbish in religion ; has taught me to respect sincere doubts and to relieve them ; has given me a few positive convictions to live and work by ; has settled the mind and given faith better foundations.

Nearly all specified one or more of the following motives or notes :— *Growth*, e. g., gained mental development ; made a man of the boy ; matured me more than any other study ; more than all the previous three years ; the evolution of the highest truths from many systems has aroused me, compelled reflection, generated in me a new life, etc. *Discipline* :—e. g., increased my power of application ; quickened perception and apprehension ; made me able to deal with abstract ideas and questions ; to choose premises and reason logically ; to analyze all things and see the relations between parts and the whole ; to see fallacies and direct the parts in a discussion ; to concentrate and direct all my efforts ; given the habit of accurate thinking ; to exercise the mind rather than cram it with facts, etc. *Unity and relation* :—e. g., it has given unity to my mind and to all my life ; shown me my relations to others and to universal truths ; has shown me one basis for all future study ; that the relation of things is the form of reason ; that all knowing is relating ; taught the organic unity of the world. *Breadth and depth* :—It goes to the bottom and gets absolute proof of things ; gives the habit of looking at the nature of things and shows reasons and causes, principles vs. facts, meat vs. shell, makes candid and fair-minded ; shows subjects in all their bearings ; goes to the heart of things and teaches the folly of superficiality ; have been greatly broadened and deepened, etc. *Miscellaneous matters cleared up* :—Evolution, relation of mind and matter, and of brain and thought ; has shown the great problems of the world one by one ; gives insight into the turning points of great questions ; the keys to the treasure house of knowledge ; kills all prejudices against men and views ; shows me my mistakes in thought and action ; makes me tolerant of even unpopular things, and to make allowance for even children and the ignorant; feel the necessity of testing all theories; gives an idea of human progress and the unity of history; turns the mind in on itself; gives new and stronger interest in all other branches of knowledge; freedom from conventionalism and dogmatism.

To illustrate the form of these very interesting returns I quote from a few.

1. I have at last won a few convictions I can live by and preach. They have brought me much peace. I have been at sea a long time; I have now landed and got a little patch of ground to cultivate; I begin to feel the blessedness of a purely individualistic mental attitude, and this is the label of my creed.

2. I have been deeply interested in philosophy and philosophers, but have adopted no particular opinion and cast no anchor. I have been working by myself on criteria of truth and grounds of belief. I feel and believe we know some absolute truth, but I am at a loss to know from either books, professors, or my own thinking, how I shall be certain as to what is absolute truth. I expect to outgrow this state and so keep right on studying. I am looking for a modest postulate to start with. Reaction from Prof.———'s dogmatic theology first caused me to study philosophy.

3. The desire for a unitary and harmonious mental universe has been the most conscious if not deepest motive in all my philosophical study and reading. My second great interest is in history as a development of thought. The results of philosophic study for me have been largely negative,—an emancipation of the mind. I am less imposed on by theories and terms. Even ideas like substance, cause, necessity, render up their absoluteness. As a cathartic for purifying and purging the mind nothing equals philosophy. I have gained also a few fixed points or fundamental ways of looking at things, e. g., the absolute oneness of the universe and the general truth of idealism, the laws of intelligence or insight into the structure of the universe.

4. I have determined to devote myself to philosophy from love of unravelling, tucking in ragged edges, and generally transposing my ideas from a more chaotic to a more systematic and concentrated shape,—a formal interest therefore. At the outset, the *material* mystery of what the nature of the world is, whether rational or otherwise, goaded me a good deal and I hoped for a solution. At present, I do not hope for it in the way I did then, as a decision *positive*. I believe philosophy shows us that we are entitled to make practical assumptions in the matter, skepticism itself being the assumption of a definite practical attitude. This *permission* on the part of philosophy I reckon a great material gain.

III. *Whose writings in these fields have impressed you most?* The answers are in order of frequency beginning with the authors most numerously preferred:—Herbert Spencer, Kant, Emerson, George Eliot, Plato, Carlyle, Hume, Hegel, Descartes, Darwin, Huxley, Kingsley, Cicero, Wordsworth, Keats, J. S. Mill, Locke, Pope, Jevons, Schwegler, Coleridge, Paley, Max Müller, Joseph Cook, Flint, G. H. Lewes, Hawthorne, Browning, John Fiske, Hickok, Bushnel, Edwards. Many others received individual mention.

IV. *What subjects covered by the courses in this department have interested you most?* The answers, again in order of frequency, were as follows:—Evolution, deity, theological questions, free will, psychological marvels, idealism, agnosticism, animal intelligence, origin and validity of knowledge, heredity, pessimism, pantheism, immortality, brain-centres, hypnotism, education, space and time, progressive orthodoxy, transcendentalism, nebular hypothesis.

Material so diversified can be presented statistically only with some arbitrariness, but if it is hard to count, it is still harder to weigh. It is surprising that the respects in which the standpoint, opinion or method of the different professors, institutions or even the different philosophical disciplines differ are almost never apparent in these returns. On the other hand the most diverse degrees of both maturity and proficiency are strikingly manifest. Most became deeply interested and thought they found great good and enlargement which was very rarely measured by utilitarian ends. There is also a genuineness, sincerity and great earnestness about these unformed first boy-manish impressions of the great problems of the world and man, and hardly a trace of affectation. These matters are real, the interests are living, and a few papers could be selected as constituting an ideal examination far deeper than any professor's questions go. If all instructors would habitually append question II to every examination paper they would, we think, learn very much of value to them as teachers concerning the forms of youthful interest that are strongest, and the bottom quintessential wisdom that abides, and would thus be able to greatly, if slowly, increase their pedagogic powers of adaptation. If this kind of investigation were followed out in more detail much further light would be shed, we are convinced, upon the practical question of electives, and upon the psychological anthropology of the later stages of adolescent maturity.

A more comprehensive collection and a more detailed study of such returns in the light of this general and preliminary survey would, without a doubt, yield results of great scientific and practical value.

A SIMPLE AND INEXPENSIVE CHRONOSCOPE.

E. C. Sanford, Ph. D.

The application of the principle of the vernier to the exact measurement of time was suggested forty years ago by Kaiser, the veteran astronomer of Leyden.[1] From an abstract of one of his papers in an early volume of Carl's *Repertorium für physikalische Technik*, the suggestion here to be developed was received.

In principle, the instrument is as simple as possible—nothing more than two pendulums, one swinging across its arc in a second, the other in a little less or a little more than a second; for example, in ninety-nine hundredths. The more rapid one will then gain on the slower one a hundredth of a second in each swing of the latter, and when they start together will exactly coincide with it at the one-hundredth swing, the two-hundredth swing, and so on. The application of the instrument is equally simple. Required the time that elapses between the beginning and end of some phenomenon—say, the fall of a ball. When the ball starts, the full second pendulum is started; when the ball stops, the more rapid pendulum is started. The latter gains one one-hundredth of a second during each swing of the former, and finally overtakes it. It is, therefore, only necessary to know the number of swings made by the slower pendulum before this happens, to know the number of hundredths of a second intervening between the starting of the two pendulums, or between the beginning and end of the fall of the ball. More explicit examples will be given below.

In the actual construction of such an instrument two points need care; namely, the starting of the pendulums, and the recognition of the swing in which they exactly coincide. The first is rather easily managed, by having the pendulums held at one end of their arc by electromagnets and releasing them by breaking the electric circuit. The other also may be

[1] "On a new application of the principle of the nonius to the exact observation of sudden phenomena." *Tijdschrift voor de Wis- en Natuurkundige Wetenschappen.* Vol. v, 1851. Also applied by him to the measurement of astronomical personal equation: De volledige bepaling van persoonlijke fouten bij sterrekundige waarnemingen. *Verslagen en mededeelingen der akademie der wetenschappen, Amsterdam, Afdeeling natuurkunde*, xv, 1863, 173; also in abstract in the *Archives néerlandaises des Sciences*, Harlem, I, 1866, 193.

accomplished by making the two pendulums, when they coincide, complete an electric circuit themselves, in which is placed a telegraph sounder. In the cut below, Fig. I represents the pendulums as seen from in front, pendulum B held by its electromagnet, pendulum A at rest in its middle position. T is a little trough of mercury into which platinum wires s s, at the lower end of the two pendulums, dip when the pendulums are in their middle position. From these platinum points wires (not represented in the figure) run up the pendulums to the knife-edges (Fig. I, k, Fig. II, k and k') on which the pendulums rest. In Fig. II is represented the shelf by which the pendulums are supported. The knife-edges rest upon metal

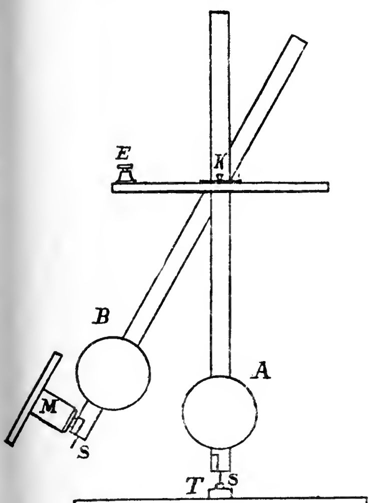

Fig. I.

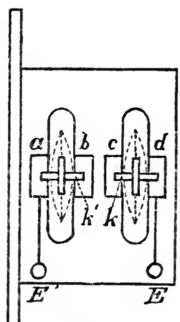

Fig. II.

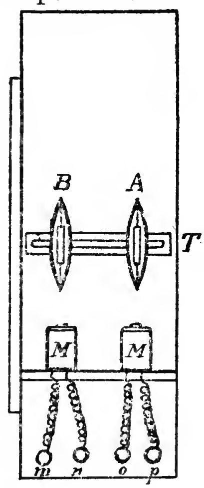

Fig. III.

plates, a b c d, fastened to the shelf; and from two of these, a and d, wires are lead to the binding posts, E E'. Now, when the wires of an electric circuit are fastened into these binding posts, the circuit will be complete when the platinum points of both pendulums are in the mercury of the trough, and at all other times will remain broken. When the pendulums are at rest the circuit will be continuously closed. When they are swinging it will be closed (and the sounder will click), as often as both cross the mercury at the same time, either going in the same or in opposite directions; that is, when they coincide or are just halfway between coincidences. Fig. III is a plan of the instrument at a level just above the pendulum bobs (A and B), showing the electromagnets, M and M, and the mercury trough, T.

The ease with which a tolerably accurate instrument of this kind can be made, and its very small expense, will appear if I describe more fully one recently made here in the carpenter's shop of the physiological department. The framework of the instrument is a pine board a foot wide and about two feet long, kept upright by horizontal pieces nailed to its sides at the bottom. About halfway up, on the face of this board, is fastened a shelf three and a half inches wide, through longitudinal slots in which the pendulums hang. The pendulums, which in this case swing across their arc in approximate half-seconds, instead of whole seconds as in the example above, are about 20 inches long. Their rods are pine slats about seven eighths of an inch wide and three sixteenths of an inch thick. The knife-edges, which are put through the slats a little above their middle, were made by filing bits of eighth of an inch iron wire into triangular shape; and to hold them in place, they are soldered to little bands of tin that encircle the pendulum rods just above them. The plates on which the knife-edges rest are small pieces of sheet brass screwed to the wooden shelf, and have shallow notches filed in them to keep the knife-edges from getting out of place in the ordinary handling of the pendulums. The pendulum bobs are made of sheet lead, several thicknesses being cut in oval form and bent around the rods and their edges caught together with solder. They weigh not far from three quarters of a pound apiece. They were made so as to slip tightly upon the rods till a coarse adjustment could be made, and then were fixed in place by driving a headless pin through each. The electromagnets, the two bobbins of such a magnet as is used in ordinary telegraph sounders, were screwed to a bit of wood and fastened at the proper angle to the back piece of the instrument and to one of the side pieces that keep the latter erect. The mercury trough was made by filing a groove about an eighth of an inch wide and an eighth of an inch deep in a small piece of hard rubber, and damming up the ends with sealing wax. This trough was further fixed with sealing wax in a shallow china dish to catch any mercury that might be spilled, and the whole was adjusted by hand, so that the platinum points rested in the middle of the mercury when the pendulums were at rest. The electromagnets and six binding posts can be bought ready-made for one dollar and sixty cents respectively; a quarter's worth of sheet lead is ample; the bits of brass, the hard rubber for the mercury trough, the platinum wires, the boards for the frame, etc., etc., together should not cost more than a dollar—a total of two dollars and eighty-five cents. While this instrument was not carelessly made, it lacks, as appears from the above description, the fine adjustments and many of the conveniences that could readily be supplied by an experienced mechanic, and, in especial, it lacks the permanency of adjustment that an instrument so made would certainly possess.

The regulation of the instrument is an important and somewhat tedious matter, but not a difficult one. In our instrument the pendulums will continue to swing long enough to be counted for several minutes. If one is at rest with its point in the mercury, the other will make and break circuit at every swing, that is every half-second, and its vibrations may be counted from the clicks of the sounder, a process which practice considerably facilitates. If the observer follows the pendulum with his eye he finds the task a little easier—at least it seems so to the writer—and he has the further advantage of a constant check on his counting in the fact that the pendulum moves one way for all odd numbers and the other way for all even numbers. To find the rate of the pendulum, the observer listens to the clicks of the sounder, following at the same time the second hand of his watch till it marks a division simultaneously with a click, counts that naught, the next click one, and so on for five minutes or more as he desires, and thus discovers how nearly his pendulum makes the required number of swings. In this way it is not difficult to get the number to a single vibration. The following are the results of several such counts, on the slower pendulum of our instrument, made at one sitting.[1]

Count by	half-seconds	for	9	minutes:	1082	against	1080	required.
"	whole seconds	"	10	"	602	"	600	"
"	half-seconds	"	9	"	1082	"	1080	"
"	whole seconds	"	10	"	601½	"	600	"
"	half-seconds	"	10	"	1203	"	1200	"
"	whole seconds	"	9½	"	572	"	570	"

It will probably be found convenient to leave the pendulum with a small error, and make a numerical correction, if necessary, in the final results.

Having fixed the rate of the full time pendulum, a more rapid way is open for the setting of the other. After a coarse adjustment by counting, the two magnets may be brought

[1] The pendulum completes a vibration in a slightly shorter period as its arc grows smaller; measurements made on the slower pendulum with the tuning-fork (though on another occasion, when a single count showed the rate of the pendulum itself a trifle slower) gave the following values in thousandths of a second as the time of a double vibration; At the start, 1000.9; after five minutes, 998.4; after nine minutes, 996.5 If we assume that this increasing loss is equivalent to a shortening of each of the six hundred double vibrations by an amount equal to the loss shown after five minutes, we get something over one and a half as the number of vibrations gained by the pendulum upon itself in ten minutes.

into one electric circuit, and the two pendulums released at the same instant by the breaking of that circuit. The swings of the slower pendulum may now be counted till the two are exactly in opposition (halfway to a coincidence), which should occur, if the rapid pendulum is nearly right, after about one hundred half-seconds; or, if one prefers, the count may be carried on to a coincidence which should occur after about 200 half-seconds. The error is thus found by counting one or two hundred instead of five hundred or a thousand. A very little change in the pendulums shows itself at once in the number upon which the opposition or coincidence occurs; a difference of one ten-thousandth of a second in each vibration, amounting to one one-hundredth of a second in one hundred vibrations, will make a difference of one in the number of the vibration in which the opposition or coincidence occurs. Indeed, the required change of adjustment is often so minute that it is convenient, as before, to leave a small error for numerical correction. The difference between tables *A* and *B*, below, are probably due to small accidental disturbances of adjustment or to spontaneous changes in the materials of the instrument; and even larger differences have sometimes been found, but so long as the rate remains constant during a series of experiments, accurate results can be obtained by correction, even from such a machine as the one above described.[1]

A.—Table showing numbers (half-seconds) on which occurred the clicks marking opposition and coincidence.

April 8.		Opposition.				Coincidence.			
		100	101			200	201		
	99	100	101		199	200	201		
		100	101			200	201		
		100	101						
		100	101			200	201	202	
	99	100	101			200(?)	201	202	
		100	101				201	202	203
		100	101				201	202	
		100	101	102(?)		200	201	202	
		100	101				201	202	

[1] As these tables show, the clicks do not indicate a single swing of the pendulum, as that to which the opposition or coincidence belongs, but two at least, and sometimes three. This, however, is not a serious disadvantage; for if three are indicated, the opposition or coincidence falls most nearly on the middle one of the three, or if two, between them. Indeed, it is sometimes possible to tell from the different intensity of the two clicks, which stands nearest to the exact opposition or coincidence.

B.—Table showing numbers (half-seconds) on which occurred the clicks marking opposition.

April 12.

First Series: Opposition.				Second Series: Opposition.		
	101	102	103	100	101	102
	101	102	103(?)		101	102
	101	102			101	102
	101	102			101	102
100	101	102			101	102
	101	102				
100	101	102				
100	101	102				
100	101	102				
100(?)	101	102	103(?)			

Another possible error, and one of a most serious kind, is introduced if one of the magnets holds its pendulum longer than the other after the breaking of the circuit, which is especially likely to happen if the cores of the magnets are allowed to become permanently magnetic. To prevent this, in using our instrument, a commutator has been put into both circuits, and the direction of the current changed at each test[1]. Fortunately, the instrument itself affords a means of detecting this error, if it amounts to more than four or five thousandths of a second. Assuming that the speed of the pendulums at the start is such that the breadth of the trough of mercury is represented by .007 sec., there will be a click from the sounder every time that one pendulum is within .007 sec. of the other, as the two cross their middle position[2] Under these circumstances, three things may happen when the pendulums start at or near the same instant. (*a*) If the rapid pendulum starts more than .0045 sec. ahead of the slow one, and gains on the slow one (as it does), one quarter of a hundredth of a second in the quarter second before it reaches the mercury, it will be clear of the mercury before the slow pendulum enters it, and there will be no click of the sounder. (*b*) If the slow pendulum starts even as little as .0005 sec. ahead of the rapid one, the latter will only be .002 sec. ahead when both cross the mercury, and there will be a click of the sounder, and again when the pendulums come to the mercury on the return swing, the more rapid one having gained half of a hundredth of a second more, it will

[1] If such an error were present, it might be balanced in the result by interchanging the pendulums, so that the error should affect one for the first half of the series of measurements, and the other for the second half.

[2] This seems a fair assumption, for if the pendulums cause a click when separated by .007 sec., a coincidence would always be marked by two clicks and might be marked by three, a condition of things which the tables already given show to happen after the pendulums have already swung fifty or one hundred seconds.

be but .007 sec. ahead, and will cause a second click. (*c*) When the rapid pendulum has less of a start than .0045 sec., or the slow one less of a start than .0005 sec., there will be a single click as they cross the mercury, and no second click till they reach opposition.

To test the accuracy of the instrument in actual measurements, it was used to measure the time of the falling of the ball in the apparatus ordinarily used for regulating the Hipp chronoscope, the apparatus having been fixed to break a second circuit instead of closing the first, as in the common arrangement. The calculated time for the fall of the ball *in vacuo* was 319.28 thousandths of a second. The average of fourteen measurements taken with a vibrator making sixty vibrations a second, gave the actual time as 331.2 thousandths of a second. Ten measurements with the pendulums (counting half-seconds) gave the following as the numbers of the swings upon which the clicks of the sounder indicating a coincidence occurred:—

April 12.	67(?)	68	69	67	68	69	
	67(?)	68	69	67	68	69	
	67	68	69	67	68	69	70(??)
	67	68	69	67	68	69	
		68	69	67	68	69	

Neglecting the doubtful numbers (for which the click was very faint, if there was any at all), the average number for the coincidence is 68.15 These, however, are half-seconds; the number of seconds (and the corresponding number of hundredths of a second) is 34.075, or, in thousandths of a second, 340.75. This first result is, however, subject to correction. In the first place, each swing is counted when the pendulum is in the middle position, while the start is made from an extremity of the arc; a quarter of the gain of a double swing, *i. e.*, .0025, is therefore to be added to the above result, making 343.25. In the next place, the rapid pendulum did not at this adjustment of the instrument reach an opposition at 100 half-seconds, but on the average at 101.3 (see table *B* above). Each one of the 68.15 half-second swings enumerated, therefore, represents, not $\frac{1}{100}$, but $\frac{1}{101.3}$ of a swing of the slow pendulum. Reducing, accordingly, to an exact adjustment gives 67.28 half-seconds and 33.64 hundredths of a second, to which, when .0025 is added, as before, a final result is reached of 338.9 thousandths of a second—7.7 thousandths of a second in excess of the result obtained with the vibrator. No correction is here applied for error of the slower pendulum, which on this occasion is believed to have been insignificant. In two other series of measurements made at another time, one of 10 and the other of 25 trials, the coincidence fell between 67 and 68 seven times, on 68 once, between 68 and

69 twenty-four times, between 70 and 71 twice, and between 72 and 73 once, the amount of the last three being not impossibly connected with irregularities in the fall apparatus itself.

A better made instrument might give better results, but the accuracy attainable with this is sufficient for the demonstration of nearly all the more important facts of simple reaction-times, and abundantly so for the longer and more complicated reactions with discrimination and choice and for association-times, where the average variation of the single tests in a series may itself amount to a tenth of a second or more. For many of these purposes, a pair of pendulums adjusted to measure twenty-fifths of a second would answer well enough, and the regulating of them and the counting at each observation would take but one fourth the time. The instrument has two advantages aside from its simplicity and cheapness. It is silent in its operation, and so may be used in taking reaction-times in the immediate presence of the subject. And it is well suited to lecture demonstrations, for a whole roomful can easily see that one pendulum starts before the other, and can count the swings to a coincidence, to all intents taking part in the observation themselves. The instrument (in the absence of any other name, why not call it a *time-vernier?*) would be greatly improved by adding a dial and second hand, so as to make the counting automatic, and probably also by swinging the pendulums between points instead of on knife-edges. Care in keeping the mercury clean and the contact good at the knife-edges is, of course, essential to a satisfactory functioning of the instrument.

PSYCHOLOGICAL LITERATURE.

1.—NERVOUS SYSTEM.

Untersuchungen über die Physiologie der Froschhirns. DR. J. STEINER. Braunschweig, 1885.

Ueber das Centralnervensystem der grünen Eidechse nebst weiteren Untersuchungen über das des Haifisches. Prof. J. STEINER. Sitzungsberichte d. Königl. preusischen Academie d. Wissenschaften zu Berlin. XXXII. 1886.

Die Functionen des Centralnervensystems und ihre Phylogenese. Zweite Abtheilung; Die Fische. Prof. J. STEINER. Braunschweig, 1888.

The work of this author on the physiology of the central nervous systems of the fish, amphibia and reptiles, has already continued for nearly ten years. Since the first paper on the physiology of the frog's brain, his general plan has widened, so that in his last publication he states his problem as the study of the development of function in the brain and cord of the lower vertebrates. In this study he is guided by the same general rules that control morphologists in tracing the phylogeny of structure. This might be called a chapter in comparative physiology, but in that case it is only fair to add that it is undertaken from the standpoint of the doctrine of evolution, which certainly adds a fresh interest to the results. This is perhaps not quite so novel as Steiner feels it to be, but that is a small matter in comparison with his observations. The technique used was excellent, and all precaution was taken to escape confusing and doubtful results which should depend on careless operations. The most suitable places for work were chosen, and to that end the principal study of fishes was made at the Naples station, where the facilities were best. The results are stated for each group of experiments, and then in a separate section the theoretical considerations are dealt with alone. This theoretical portion is certainly of interest, but when, for instance, it takes the author into speculations on the origin of the forebrain of the vertebrates, he is perhaps carried too far. Taking the papers in chronological order, the physiology of the frog's brain comes first, and this order is the best to follow, as the physiology of the central nervous system in the frog is better known than that of the other animals employed.

Rana esculenta was used, and the cerebral hemispheres were first removed. Such a specimen remains quiet, as a rule, when not in the water. If excited by mechanical stimulation, makes one or more jumps, and then comes to rest. When jumping it can see, and so avoid objects in its path. When the path is free, locomotion is in a straight line, but if there is an obstacle in the way, it, under certain conditions, either jumps over or around it. Although, when quiet, threatening motions of the hand are disregarded, yet the same specimen, once started in a series of jumps, avoids capture, often with unexpected success. The conditions that determine whether the frog shall jump over an obstacle to be avoided, are that the obstacle be not too high, for if too high the frog will not even make the attempt; and that it shall cast a dark shadow in the path, for if a plate of clear glass be put in the way, the frog jumps *against* it. Where the object is too high, the frog avoids it by jumping to one side. Something of the direction of leap in reference to an obstacle can be predicted from the motions of the frog's eyes. This same specimen balances well on a board, the plane of which is varied in the usual way. In many cases the frog slips when being thus tested, and to prevent injury the observations were made over water. When put in the water the frog swims to the edge of the aquarium, then stops swimming, and some specimens seek to get out of the water before they come completely to rest. This performance varies with different individuals, and with the same individuals at different times. It appears that when the air is warm, and the light bright, they are most likely to execute this final act. When put on its back, such a frog at once turns over to the normal position. In discussing these observations, Steiner points out that the loss of the hemispheres removes all spontaneity from the specimen. The so-called spontaneous movements on land are probably due to unobserved stimuli. Though nothing could appear more spontaneous than the swimming motions in the water, yet these are almost certainly due to the stimulus of that medium, for when the frog leaves the water the motions cease. Balancing and turning from the back to the normal position, Steiner argues to be dependent on the tension of the muscles connecting the trunk of the body with the head. We shall not enlarge on this point, on which he lays considerable stress, further than to state that he makes out a strong case. One experiment of interest in this connection is, that if the skin be removed from the back of such a frog and then he is laid on his back, he nevertheless turns over, showing that the action is due to something besides skin stimulation. In another connection Steiner brings out the fact that of the cerebral hemispheres it is the basal portion that is most important to the frog, for if the mantels of the hemispheres alone be removed, the specimen appears perfectly normal.

In the next operation the hemispheres plus the interbrain were removed. When this is done with a knife the optic nerves are also severed, and the frog is blind. This frog can jump fairly well, but does not pull himself together at the end of a leap with the same rapidity and sureness as one which has lost his hemispheres alone. He swims normally when put in the water, but does not try to climb to the edge of the tank. When laid on the back he will turn over; but when the experiment of balancing is tried, although the head is moved as the plane of the board is changed, no effort is made to get the body into a balanced position. Such specimens still croak reflexly. The interbrain is further a centre for the chromatophores in the skin. After operation all specimens become dark, and remain so persistently. To meet the objection that the loss of sight was responsible for some of these results, Steiner severed the thalamencephalon without cutting the optic nerves. Though such a frog can see, this advantage did not modify his action in any of the points just mentioned. To explain these results, Steiner assumes that the interbrain is a centre for sensations from the muscles, joints and skin, and that it is the loss of these sensations which causes the additional disturbance.

When the optic lobes, or mid-brain, as Steiner prefers to call them, are removed, a new complication appears. If the removal is not strictly symmetrical, forced movements occur. To this subject Steiner gives much attention, and such movements form an important criterion in his later speculations. In this connection, however, the cases where they do not occur will be specially considered. On mechanical stimulation, the frog without his mid-brain leaps normally. He is blind, and jumps against obstacles. When put in the water he swims, but in an uncoördinated manner. Considering the *lobi optici* as made up of a roof and base, for each lobus has a central cavity, it appears that the roof has no motor function, but is connected with vision alone, whereas the base has motor functions. After the base is removed, the "croak" reflex cannot be obtained. Besides the loss of the special function of vision located in this region, there is the more general disturbance which might be considered as due to the removal of such central elements as were supposed for the interbrain.

When the cerebellum of the frog is removed, in addition to the parts lying cephalad of it, there is no additional disturbance. When, however, the cerebellum alone is removed, a slight trembling of the limbs, on certain occasions, and a loss of exactness in some of the muscular movements, were the symptoms observed.

Finally, if the most cephalic portion of the medulla oblongata is cut off, a marked change occurs. Though on mechanical stimulation the limbs are moved, there is no locomotion. The frog does not rest in the normal position, but flat on its belly; when placed on the back, it remains there. Put into water, no swimming motions are excited. In considering the remarkable effects which follow this last operation, Steiner reaches the conclusion that this region contains a coördinating centre for all the muscular motions, or a centre for locomotion. This centre is prominently brought out in the study of other forms, and to it therefore Steiner attaches great importance.

In those cases where the brain, including the mid-brain *(lobi optici)*, had been removed, certain irregularities of reaction were observed, which led to a further study of the region. This was made by first removing the cephalic third of the mid-brain. Such a frog was but little different from one which had lost the interbrain alone. He still gave the "reflex croak." When the cephalic two-thirds were cut away, stimulation did not make him creep or jump, but the frog moved backwards. This backward motion was then a function of the caudal third of the mid-brain. By the removal of parts of the brain in an asymmetrical manner, a great variety of forced movements can be produced. A review of these, while of much interest, must be omitted here.

Having thus given in some detail the observations on the frog, those on the other animals may be stated more briefly. When the forebrain of the green lizard *(Lacerta viridis)* is removed, the animal remains motionless as if asleep, from time to time opening its eyes. When irritated it wakes up, so to speak, runs off a short distance, and again relapses into its dormant state. In this case locomotion is normal, but the lizard runs as readily towards the operator as away from him. It has no fear. It can at the same time see, for it avoids obstacles in its path. The lost functions are located, however, in some portion of the hemispheres which is not the mantel, for when that only is removed the creature runs when frightened by a movement towards it, and eats and drinks voluntarily. The removal of the interbrain plus the hemispheres introduces chiefly a change in locomotion, whereby the specimen when excited runs a few steps and then gives a jump, as the normal animal does when jumping from a wall.

Making, again, a distinction between the roof and basis of the mid-brain, removal of the roof is without effect on the locomotion. At the same time the animal can still *see*, though it appears amblyopic. Removal of the entire mid-brain does not interfere with locomotion. If the caudal portion is left in place, the tendency to motion backwards comes out far more strongly than in the frog. The removal of the cerebellum appears to be without any special effect. Finally, the removal of the anterior portion of the medulla oblongata abolishes locomotion, so that we have in this region, as in the frog, a coördinating centre of prime importance. If a specimen in this last condition have its cord severed at short intervals with scissors, it is found that when a region near the middle of the trunk is reached, the tail and posterior extremities commence what are apparently spontaneous and regular movements, which are clearly locomotory. It would appear then that there are, in this portion of the cord, centres which were comparable to the more important centres in the medulla oblongata. In the discussion of fish, this point is brought out more clearly.

Steiner opens his study of fishes by some tests on the function of the fins and tail. The tail is preëminently the organ of locomotion, whereas the fins are used to keep the animal at a given level in the water, to steer. to stop and to move backwards; with maintenance of equilibrium they have nothing to do. *Squalius cephalus* (v. Siebold) was the fish used for these experiments. In removing different parts of the brain, the improvements in technique employed were artificial respiration, to keep the fish quiet during the operation, and a useful method of closing the wound by a gellatine cap, so that healing is facilitated and water prevented from entering the cavity of the skull. The removal of the forebrain from this bony fish (*Squalius*) is followed by no loss in locomotion. Further, the movements of the specimens are not to be distinguished from the normal, and are voluntary. When food is put in the tank it is seized by such a fish with unhesitating exactness, and a worm is distinguished from a piece of string before it is taken. Fish thus operated play together. We have here the very remarkable case of the seat of voluntary activity elsewhere than in the forebrain. Steiner argues that the forebrain once possessed these functions, but becoming degenerate (as it certainly is), parted with them to the more caudal divisions. In this fish an interbrain is not available for separate study.

As in other cases, stimulation of the roof of the mid-brain causes movements of the eyes, whereas the removal of the roof renders the fish blind. In this case the removal of the entire mid-brain has a very marked effect. Regular breathing continues, but no voluntary locomotion occurs, and equilibrium is affected. When the fish is mechanically stimulated, however, it makes locomotory movements. The cerebellum, which has really an enormous development in these fish, may be removed without causing any disturbance in the locomotion or equilibrium of the specimen. The cephalic portion of the medulla in *Squalius* possesses elevations not found in the medulla of the frog, for example. When this region in *Squalius* is removed, breathing ceases, and the animal is dead. This complication is avoided, however, when an eel is used. In this fish a section here abolishes locomotion, but leaves the breathing intact. If these observations are to be harmonized with those on the frog, the locomotor centre must be considered as somewhat variable in position, for in the fish the removal of the mid-brain produces much the same result as did removal of the cephalic portion of the medulla oblongata in the frog.

Steiner next gives his attention to *Amphioxus lanceolatus*, and by way of preface describes this creature in the normal condition as swimming only so long as is needful to hide itself in the sand. and then remaining there till it is again disturbed. Of course, where locomotion is thus reduced in the normal creature, it could not be expected that much variation could be experimentally effected. If a specimen is cut in half in the middle, the two parts, when irritated, swim independently, cephalic end first, and preserve their equilibrium. A single specimen may be cut in three or four pieces, and each piece swims alone. If the parts show signs of exhaustion, simply putting them in a bath of picro-sulphuric acid, of at least one per cent., stimulates them to remarkable activity. Steiner concludes that the body of *Amphioxus* consists of a series of equivalent metameres, each of which has its own centre for locomotion, and that there is no principle centre as in the other forms thus far studied.

The shark was next examined, the dog-fish *(Scillium canicula)* being chiefly used. When the fore-brain was removed, and the specimen replaced in the tank, it swam about for a time, showing that locomotion was undisturbed, and then sank to the bottom, where it remained quiet for an indefinite period. The test was made to see if such a shark would feed. Though the test was continued for two months, the specimen still refused to take food. In some specimens the olfactory bulbs alone were separated, and in these the result was the same as that which followed the removal of the hemispheres. Removal of the olfactory bulb on one side only, did not interfere with the spontaneous taking of food. When the inter-brain as well as the hemispheres are removed, the *nervi optici* are cut in the operation, and the animal becomes blind, but there appears no other additional disturbance, save that the specimen tends to come to rest in a corner of the tank a trifle sooner than one which has lost merely the fore-brain. As usual, there is no observable disturbance after removal of the cerebellum, though it is rather bulky in these fish. The roof of the mid-brain is found to be a visual centre, for when removed the sharks became blind. With removal of the base of the mid-brain spontaneous locomotion is abolished, but the power remains, as appears on mechanical stimulation. There is an increased difficulty in maintaining equilibrium, despite vigorous efforts to do so. In the cephalic portion of the *medulla oblongata* is a locomotory centre; for when the brain, including this region, is removed, the power of locomotion is lost, even in response to mechanical stimulation. Continuing the observations of the spinal cord, some very remarkable results were obtained. The headless body of the shark will swim the entire length of the long aquarium, stopped only by the side wall; then, when turned about, will swim back to the place from whence it started. The relations in this case suggest that in the medulla there is some portion which acts to inhibit the spinal cord, for when this is removed the cord exhibits much greater activity. Steiner, however, takes the view that, since the cord is subordinated to the brain, that fact in the first place is additional proof of the location of a general centre for locomotion in the cephalic portion of the oblongata; and further that, since the cord is controlled, even in so slight a degree, by mere cephalic centres, it is condemned in the higher forms to lose its independence. In this connection, the spinal cord in the Rays was tested, *Torpedo oculata* being used, and it was found that, while the fish possessing only the spinal cord remained quiet when put in the water, it swam on stimulation, showing that the cord in this case, too, is possessed of locomobility, (Steiner's word, *Locomobilität*, meaning capability of locomotion).

Among the Ganoids the Sturgeon (*Acipenser sturio*) was found possessed of cord locomobility similar to that of the shark. Curious is the reaction of the lampreys. *Ammocœtes*, and the two forms of *Petromyzon*, were all observed. If one of these is cut in two in the middle, the head end makes regular swimming motions in the water, and the tail end remains quiet. When, however, the motionless part is put in the bath of picric acid, previously described, it swims in a most satisfactory manner. From this Steiner concludes that in the head end of the lampreys, there is a general centre for locomotion, and that similar centres exist in the cord also, but in this latter situation are so reduced in irritability that only some strong stimulus can bring them into action. This apparent loss of function in these cases where the function is, however, shown to be present, by the use of special stimuli is a suggestive observation. The spinal cord of the eel is excitable in picric acid, but in this animal the swimming motions are made with the caudal end of the body only, showing, as it appears, a localization of the mechanisms in that portion of the cord.

Taking up next the forced movements in bony fish, it is observed that removal of one cerebral hemisphere, or of one half the cerebellum, is without effect, whereas removal of half the mid-brain causes circus movements towards the sound side; and a cut through one half of the medulla, rolling movements towards the operated side. In this connection some observations on the flat fishes (*Pleuronectidæ*) were made, *Solea vulgaris* being the species employed. Steiner argued that if the circus movements in the normal fish were made in the horizontal plane, and if the flat fish represented a form in which the body of the fish had rotated ninety degrees about its long axis, that if forced circus movements were established in a flat fish by operations on the brain, then the circus movements would take place in a vertical plane. Experiments showed this to be the case in a very exact way. In the sharks the result of asymmetrical removal of parts of the brain has the same consequences as in the bony fish, with the exception that injury to the interbrain, which cannot be sectioned independently in the bony fish, produces in the sharks temporary circus movements. A lesion on one side of the spinal cord would not be expected to produce forced movements; nor does it do so. Steiner concludes, therefore, that forced movements are a function of the general motor center, and such being the case, the movements themselves can be used to determine the existence of such a motor center. The next following observations are the most novel and striking which the author has obtained, and if confirmed will be an important step in our knowledge of the nervous system. If a shark which has been so operated as to perform circus movements is beheaded, the headless trunk continues to perform the same circus movements. In the case of rolling movements, beheading puts an end to them. The trunk, however, does not acquire this capability to perform independent circus movements unless at least ten hours have elapsed between the original operation and decapitation. Apropos of these observations, Steiner has something to say of memory as a function of living matter, and some criticism of apparently similar results obtained by other authors, but nothing more definite by way of explanation.

The record of experiments ends here, but there are some general conclusions and reflections on the significance of the fishes' brain. It is here that Steiner argues that, because in the shark voluntary activity is strictly bound down to the olfactory lobes, that therefore the forebrain of the vertebrates has developed phylogenetically from an olfactory centre, a conclusion that seems somewhat hasty. In discussing the genealogy of fishes from the data thus collected, Steiner takes occasion to define the brain as a general motor centre, in connection with at least one of the special senses. The spinal cord, under the control of one coördinating centre, is by Steiner developed from some ideal form composed of a series of equivalent metameres, each possessing locomobility to the same degree. When centralization of this function occurs, it takes place at the head end of the animal, but the order in which the function is lost in the spinal cord is such that it first disappears in the most cephalic portions of the cord, while it remains longest in the most caudal portion—a conclusion which has some indirect support from other sources.

Strictly considered, investigations in the functions of the semicircular canals do not follow here, but in an appendix Steiner has some interesting observations on these organs in the shark, which may thus be summarized: In *Scyllium canicula* and *Catalus*, the cartilaginous canals were opened, and the membraneous portions removed, together with their ampullæ. Whether this was done on both sides or on one side only, the result was the same, *i. e.*, locomotion remained perfectly normal in all cases; no disturbance of equilibrium. When, on the other hand, the vestibulum is opened, and the otoliths either removed or only disturbed, locomotion becomes abnormal, the disturbance consisting usually of rolling movements towards the operated side. The results in all cases are without exception. Further, removal of the semicircular canals, and filling the vestibulum with melted paraffin, cause no disturbance of locomotion or equilibrium. Since neither removal of the semicircular canals nor complete exclusion of the vestibulum, closing it with paraffin, cause any disturbance, but only mechanical stimulation of the latter gives rise to the rotatory movements, Steiner attempts to explain the disturbance as due to direct lesion of the cephalic end of the medulla oblongata, at the point of emergence of the auditory nerves. This view is very hypothetical, and the conclusion that the condition of things in the shark holds for the higher vertebrates, also has too slender a foundation to be valuable.

This lengthy notice does not touch on many smaller observations which the author has recorded, nor does it point out what is new and what old in the observations cited. So important, however, is the fundamental idea that development of function is as real a thing as development of form, and so often is the idea disregarded in biological speculation, that it has appeared worth while to give a full statement of this work of Steiner, which so well illustrates the possibilities of this line of investigation.

Histologische Studien an der menschlichen Netzhaut. PROF. KUHNT in Jena. Jenaische Zeitschrift für Naturwissenschaft, xxiv, 1. p. 177.

The investigation of Prof. Kuhnt (of which this is a preliminary notice) had two objects,—first, to determine what ones of the histological constituents belong to the tissues of support and connection, and what to the nervous elements; and second, to trace the connections of the nervous elements from the layer of fibres through to the rods and cones. He finds, contrary to the opinion of Borysiekiewicz, that the radial fibres have one nucleus only, and that the internal limiting membrane belongs to the vitreous body. He has no theory to offer as to the function of the reticular layers, but thinks that they cannot play the part of insulators, because for this purpose they would be most needed in the fovea, where they are thinnest. [May they not act as veils, to diminish the amount of light which reaches the rods and cones, and so to facilitate the concentration of the attention upon the sensations of the fovea?] In regard to the nervous parts of the retina, he was so successful as to obtain, after many failures, three good preparations showing a plain connection between ganglia of the optic nerve (ganglionic layer) and of the retina (inner nuclear layer),—which has not been accomplished before. The connecting fibre sprang, in each case, from the body of the ganglion, and not from any of the large processes, and it had only inconsiderable varicosities. Of the fibres which come from a cell of the inner nuclear layer, it is the middle one of an umbel of fibres which joins onto a cell of the outer nuclear layer. It was determined from a large number of observations, that every ganglion of the outer nuclear layer is connected with a single cone, and with a larger or smaller number of rods, according to its more peripheral or more central position in the retina. Less frequently, it was made out that a single pigment cell encloses the cone and the group of rods which communicate with a single nuclear cell. [That an arrangement of this sort must prevail, had been affirmed before by Emil duBois-Reymond, from a consideration of the numerical relations of the fibres and of the rods and cones. A cone, with a group of rods around it, all attached to one ganglion of the outer layer, ought henceforth to be called a *cone-system.*] Under the action of a given coloring reagent, not only did the color of the processes of the ganglia vary with their thickness and with their distance from the cell, but the ganglia themselves were sometimes colored throughout, sometimes only near the nucleus, only in the nucleus, or only in the nucleolus. Whether this was owing to actual chemical differences, or to the particular condition of excitation at the moment of death of the ganglion, could not be made out. This last suggestion is a very interesting one, and invites to further investigation. In regard to one important point, we cannot help thinking that the author is very obscure. He decides against any possibility of a specific energy in the separate visual elements from the fact, as we understand him,—there are, unfortunately, no plates—that a single cell of the inner nuclear layer is connected with several cells of the ganglionic layer. In the first place, this connection would seem to be a physical impossibility, from the fact that the number of cells in the inner nuclear layer is much greater than in the ganglionic layer. In the second place, absolutely nothing is said about the multiplicity of the connection between the inner and the outer nuclear layer. In the third place, is it quite certain that several different fibres may not preserve their continuity on going through a single ganglionic cell? C. L. F.

On the morphology of the compound eyes of Arthropods. S. WATASE. Studies from the Biological Laboratory, Johns Hopkins University, Baltimore. Vol. iv, No. 6, 1889. Plates XXIX—XXXV.

The author has made both a careful and extensive study of his subject. The paper opens with "a consideration of the *ommatidium* as the morphological unit of the compound eye in arthropods, just as each little circle of rods with a cone in its centre may be considered as the morphological unit of the 'mosaic layer' (Henle) of the human retina." The *ommatidium* in *Serolis*, which is first described, presents three strata of cells. The most superficial is designated *corneagen*, the next the *vitrella*, and the deepest the *retinula*. This last alone is sensory. Each of these cells secretes chitin or a chitinous substance on what is morphologically its outer surface. The cells are, therefore, homologous with the ectodermal cells covering the surface of the body, and the *ommatidium*, with its various specializations, is morphologically a pit in the ectoderm. With *Serolis* as a type, the *ommatidia* of *Talorchestia*, *Combarus*, *Homarus* and *Calinectes*, and a number of others, are found to agree in all essentials. The compound eye of *Limulus* is next described, and the very primitive conditions found in this ancient form are in harmony with the previous observations. The pits in *Limulus* are much less complete than in the other forms described, and the dioptric apparatus less perfect. In discussing the compounding of an eye from these *ommatidia*, the anatomical point is made that the nervous prolongations of the *retinulæ* first form an intricate plexus, and then take their course to the optic ganglia. From the physiological side, it is pointed out that all vision is punctate, whether it be the vertebrate or invertebrate eye which is the organ; and therefore, in considering the vision of a given arthropod, its fineness is measured to some extent by the size of the individual *ommatidia*, whereas the range depends on the number of these units, and the manner in which they are distributed, exposure of *ommatidia* over a spherical surface giving an eye with the widest range. In an appendix, it is stated that the eye-spots in *Asteridæ* agree in their essential structure with those of the arthropods. The paper contains much more of interest, which is, however, not in place here, but which helps to make it a most valuable contribution to our knowledge of the sense-organs.

On the descending degenerations which follow the lesions of the Gyrus marginalis and the Gyrus fornicatus in Monkeys. E. P. FRANCE. With an introduction by Professor Schäfer, F. R. S. Phil. Trans., vol. 180, (1889) B. pp. 331–354. 3 plates.

The brains used in this investigation were from animals that had been employed for physiological experiments by Prof. Schäfer, in conjunction with Prof. V. Horsley and Dr. Sanger Brown, so that a complete record of the symptoms during life was available. Removal of the *gyrus marginalis* has been found to produce paralysis of the trunk muscles and most of the leg muscles on the side opposite to the lesion. France had at his disposal six cases of lesion to the *gyrus marginalis*. In two the injury was strictly confined to this gyrus, while in the remaining four there was some injury to the adjacent external surface of the hemispheres, or to the *gyrus fornicatus*. A summary of these shows the degeneration as difficult to detect in the internal capsule—all that can be said is, that it has not been observed, frontad of the knee of the internal capsule. At the level of the pons, the degeneration was scattered through the pyramidal bundles. In cases where the lesion had been extensive and the animal had lived for some time, the mass of fibres on the side of the operation was plainly less than on the other side. At the level of the *medulla oblongata*, the degeneration appears in the pyramids, and is more condensed than in the pons. The pyramid on the operated side is smaller at this level also—under the same conditions which determined a difference in size in the pons. In the spinal cord, the degeneration is mainly in the crossed pyramidal tract of the side opposite that of the lesion, and to a much less extent in the crossed pyramidal tract of the same side. In some cases it may be traced as far as the lower lumbar region. Degeneration of the direct pyramidal tract has not been observed on either side. Throughout the cord, the degeneration is most evident in the dorsal and lateral portions of the pyramidal tract, and this location appears characteristic for the lesion which it follows.

In the study of those degenerations, consequent on lesions of the *gyrus fornicatus*, six brains were examined, from which a part or the whole of this *gyrus* had been removed. During life it was found that stimulation of the *gyrus fornicatus* produced no muscular contractions, and that when it was excised, the slight paralysis which sometimes appeared was no more than could be accounted for by the almost unavoidable injury to the *gyrus marginalis* lying above it. On the other hand, its removal caused a well-marked deficiency of general and tactile sensibility over the opposite half of the body. For this lesion, the course of degeneration in the internal capsule could not be made out with any certainty. In the mid-brain, pons and medulla, the degeneration appears like that following marginal lesions, and is found only in the pyramidal bundles on the same side as the lesion. In the spinal cord, the degeneration occupies the whole sectional area of the crossed pyramidal tract, mainly on the side opposite to the lesion, but in part on the same side It may be traced caudad to the level of the fifth lumbar nerve.

In an appendix appears a study of the degenerations which follow the removal of the external motor cortex and of the whole motor cortex of one hemisphere in monkeys, as compared with those which follow lesions of the *gyrus marginalis* alone. In three cases of the removal of the external motor surface of the brain, the animal having lived for some time subsequent to the operation, the resulting degenerations were similar to one another. In the internal capsule the degeneration is well marked. It occupies the middle third of the capsule, and therefore includes the knee, but is confined to the layer of fibres adjacent to the lenticular nucleus, leaving a thin layer which is normal, towards the thalamus. At the other levels it is as follows: *Crusta*: Degeneration clearly defined; occupies middle third, the dorsal part being less completely degenerated than the ventral. *Pons:* Degeneration involves the entire pyramid, on the same side, almost all the fibers being degenerated. *Medulla:* Whole pyramid of the same side is degenerated, except a narrow portion of the dorsal and mesal tract which is less affected. *Spinal cord:* The degeneration is in the crossed pyramidal tract, the portion bordering on the direct cerebellar tract being less affected. It may be followed to the lower lumbar region. In four cases, the *entire* motor area was removed from one hemisphere. The entire motor surface comprises the region just described in the previous cases, plus the *gyrus marginalis*. The degenerations observed were quite similar to those described as following the removal of the external motor area, except that they were more complete. In the internal capsule, the degeneration includes the layer adjacent to the optic thalamus. In the crusta and pons it was more complete. In the medulla the pyramid was entirely degenerated, and in the spinal cord the entire crossed pyramidal tract was degenerated, the part bordering on the direct cerebellar tract as completely as the rest. The degeneration passes to the level of the fourth lumbar nerve. So far as these results bear on the *gyrus marginalis*, they show the plus of degeneration in this last group to be equivalent to the entire degeneration where this gyrus alone is destroyed, the two sets of observations thus harmonizing in a satisfactory manner. No definite statement is made in the appendix concerning the side of the cord in which the degeneration of the crossed pyramidal tract occurs. It is to be presumed, however, that the bulk of degeneration is on the side opposite to that of the lesion, while to some extent it occurs on the same side. No degeneration has ever been observed in the anterior columns of the cord in the monkey, and from this the author concludes that the decussation at the pyramids is complete. Since, however, the degeneration occurs in both crossed pyramidal tracts, it would seem to indicate that though no pyramidal fibers found their way to the anterior columns, yet the crossing was incomplete. Aside from the interesting point that the dorsal and lateral portion of the crossed pyramidal tract contains the bulk of the fibers from the *gyrus marginalis*; that these same have a distinct path through the internal capsule and other portions of the axis; and that there is no degeneration in the anterior columns of the spinal cord, there is the very striking result that the *gyrus fornicatus*, which is not connected with motion, but is connected with sensation, causes, on its removal, a descending degeneration, and that this degeneration follows the path of the crossed pyramidal tracts. As Schäfer points out, it is very difficult to bring this degeneration with such a direction and track into harmony with the current views of the relation of the nerve fiber to the cell, and the direction in which degeneration of sensory fibers takes place. The solution of the contradiction is left for further investigation.

(In the rabbit, at least, and probably in man, the cerebral cortex is represented in the thalamus, a portion of the thalamus degenerating in correspondence with the part of the cortex removed, e. g. primary optic centers. This gives the motor cortex at least a double connection with the lower centres, and though these fibers degenerate from above downwards, there is much reason to consider them as sensory, and the results obtained by France from the study of the *gyrus fornicatus* serves to increase the probability of such a view. REV.)

On Neurokeratin. W KÜHNE and R. H. CHITTENDEN. New York Medical Journal, Feb. 22 and Mar. 1, 1890.

In the first paper, Neurokeratin is defined as the constituent of the peripheral and central nervous systems, which is insoluble in alcohol, ether, gastric and pancreatic juice, and dilute caustic potash. The substance was first described by Kühne some thirteen years ago, and since that time has been much discussed by histologists, its existence being doubted by some, while certain parts of the nerve fiber were by others identified with it, one argument against it being that it was an artefact developed by the action of the alcohol and ether. That objection seems now to be answered by the fact that it can be equally well obtained, whether the specimen be first treated with alcohol and ether and then digested, or the order be reversed. Five analyses were made. No. 1, for example, gives:

C.,	56.11
H.,	7.33
N.,	14.32
S.,	1.88
Ash,	1.21

Neurokeratin, therefore, does not contain phosphorus; and sulphur is the most variable constituent, the percentage in one analysis reaching 2.24. Compared with keratin from the hair of a rabbit, it also shows a decided difference in composition, principally in sulphur, which in the keratin, reaches 4.02. An interesting point is, that the examination of the central nervous system of the lobster showed the analogous insoluble substance to consist of chitin. A study of the quantitative distribution of neurokeratin shows the white matter of the brain to be richest in it, and to have some nine times as much as either the gray matter or the peripheral nerves. The second contribution treats of the histological detection of neurokeratin, pointing out some of the differences between the frog, fish and mammals (rabbits), and concluding that the double sheath joined by cross bands which is found after the treatment of the nerve fibers, represents the neurokeratin framework of the sheath of Schwann, the axis cylinder sheath and the medullary substance.

(The paper is very valuable from the full descriptions of all methods used—something which was much needed. The statements as to the structures which may represent the neurokeratin in the cortex, and the white matter of the central nervous system are, however, suggestive rather than conclusive. REV.)

Ueber eine neue Färbungsmethode des centralen Nervensystems und deren Ergebnisse bezüglich des Zusammenhangen von Ganglienzellen und Nervenfasern. PAUL FLECHSIG. Archiv f. Physiologie, Heft 5 und 6, 1889. 1 Tafel.

The plate accompanying this short communication is very instructive. The difficulty with the cells, as brought out by Golgi's method, has been heretofore that no connection between them and the medullated fibers was demonstrated. In this case, specimens treated by Golgi's bichloride of mercury method were further treated with an extract of Japanese redwood, ("*Japanischer Rothholz*"—further information as to what plant is meant by this commercial term is not given). For the details of the method, which is complicated, the reader is referred to the original. By the treatment the nerve fibers are all colored red, the cells and their prolongations being black, and where the prolongation of a nerve cell goes over into a nerve fiber, it can in these specimens often be followed. The tissues investigated were bits of human cortex from about the central and the calcarine fissures. The general conclusions arrived at were: 1. That the protoplasmic prolongations were not found in connection with nerve fibers. 2. The axis cylinder in most cases branches; it often forms a T, similar to that of the cells of the spinal root ganglia. These branches of the first order may divide again, forming as many as eight subdivisions. Such cells are only from the calcarine region. There is, therefore, a marked distinction between the methods of branching in the two regions examined. 3. The fine network formed by the subdivision of the axis cylinder of cells of the second category (Golgi, Nansen) is not brought out by this method. 4. The fibers forming the superficial and middle horizontal plexuses in the cortex arise from neighboring cells by branches that leave the axis cylinder at right angles.

Ueber ein neues Opticuscentrum beim Huhne. DR. PERLIA. Archiv für Ophthalmologie, Bd. xxxv, Abth. i, 1889. 1 Plate.

Upon studying in the chick the degeneration which follows the removal of one eye, Perlia finds, besides the usual degeneration of the contralateral tractus, a bundle of fibers which separates from the tractus at the ventro-lateral angle of the interbrain, and passes first dorsad then caudad along the mesal margin of the optic lobes, finally terminating in a large nucleus which lies laterad of the trochlearis nucleus, and is at least twice the size. The ganglion appears to connect with the *lobus opticus*, with the motor nuclei, and with the ventral portions of the axis. This bundle and its nucleus degenerate when the optic tract degenerates. Pending further work on its function, Perlia designates this as the median optic bundle, and makes the plausible suggestion that it will be found connected with the pupillary movements, which are so well developed in the bird.

Die Formentwickelung des menschlichen Vorderhirn von Ende des ersten bis zum Beginn des dritten Monats. WILHELM HIS. Abhandl. d. Mathemat.-phys. Cl. d. Königl. Sächs. Gesellschaft d. Wissenschaften. Bd. xv. Leipzig, 1889. 1 Plate.

This, the most recent paper by His on the development of the nervous system, is well supplied with cuts, and has, moreover, one plate of very unusual excellence in every way. The text is mainly a description of the contained figures, so that it cannot be given in abstract, save in a very incomplete manner. The immediate object of the paper is to give the topography of the first appearances (*primäre Anlagen*) of the different portions of the encephalon; only in the case of the olfactory lobe does the author enter into histological details. He opens with a discussion of the axial flexures of the mid and forebrain. Under the head of primitive longitudinal divisions of the mid and forebrain, His maintains that the division of the lateral half of the neural tube into a dorsal wing-plate (*Flügelplatte*) and a ventral basal-plate (*Grundplatte*) is recognizable not only in the region of the myelon, where he has already described it, but that it is continued cephalad to the extremity of the primitive forebrain. The line of demarcation between these two plates follows the flexures, as illustrated by the brain of *Ammocoetes* and that of a salmon embryo. This line terminates at a point just cephalad of the chiasma; and the optic tract, running as it does for some distance at the junction of the two plates, behaves like the ascending root of the other sensory cranial nerves.

The optic vesicle represents substance taken from the wall of the neural tube, and it is of great importance to determine from which of the above mentioned plates it may be derived. His decides that the main portion, and at least all that which forms the retina, comes from the basal plate. He is doubtful concerning the pigment layer alone, which may, in part, arise from the wing-plate. Morphologically, then, the retina is homologous with the anterior cornua of the spinal cord, and the region of the motor nuclei in the hind and mid-brain. This striking result puts the retina by itself, and separates it from all the other sensory organs thus far described. In speaking of the formation and protrusion of the optic vesicles, His holds to the mechanical explanation for the former, and goes into the anatomy of the region in the embryo in much detail. In the first stages the optic stalk enters the optic cup eccentrically, the point of union lying ventrad of the centre of the cup. With the change in the position of the eye, as development proceeds, the bulbs move cephalad and mesad, the change of position taking place in such a manner that the junction of stalk and cup becomes mesal. The optic nerve fibers follow the line of the optic stalk. It thus comes about that the eccentric insertion of the optic nerve in the retina of the developed eye is a consequence of the similar relation of the stalk to the cup in the embryo.

When the hemispheres commence to develop, it is not until the end of the fourth week that they are at all divided into right and left, and the first indication of division is, curiously enough, a longitudinal ridge in the parietal region. A careful description of the development of the forebrain region, including the plexuses, *corpus striatum*, and the divisions of the interbrain, finally brings the author to a description of the olfactory region. The condition in the embryo is prefaced by a study of the region in the adult. Starting here from the bulb, and passing caudad, the olfactory tract splits into a median and lateral root. These first enclose the *trigonum*. Caudad of this, and separated from it by the *fissura prima*, is a roughly quadrilateral field, a portion of the anterior perforated space, which is bounded laterally by the lateral root of the tract, and mesally by the *gyrus subcallosus* (peduncle of the callosum). This region is the quadrilateral space of Broca. There is another small region lying in the mesal surface, and bounded by the *fissura prima* caudad and the *fissura serotina* frontad, and this His names "Broca's region." In discussing the olfactory lobe in the embryo, His divides it into a cephalic and caudal portion. The cephalic lobe in man gives rise to the bulbus, tractus, trigonum and Broca's field—to the caudal lobe belongs the *gyrus subcallosus* and the quadrilateral space. Where the bulbus comes to overlie the nose region, there is developed over a region of thickened nasal epithelium a true olfactory ganglion, consisting of bipolar nerve-cells, such as are found in the posterior root ganglia of the spinal cord. This ganglion appears first in embryos about 11 mm. in length. In the adult, the ganglion contributes the fiber and glomerular layers, the other portions of the bulbus being an outgrowth from the brain. This discovery, which brings the olfactory nerve in man into line with the typical sensory nerves, is a most welcome one, but the retina still remains, according to His, as much of a problem as ever. For the many other points of value, the reader is referred to the original.

Recherches sur les terminaisons des nerfs dans les disques terminaux chez la grenouille (Rana esculenta, Rana temporaria). J. FAJERSZTAJN. Arch. de zool. exp. et gen., 2d série, T. VII, 1889, p. 705—750, pls. XXXIII et XXXIV.

The author discusses at great length the conflicting results and opinions of Waller, Leydig, Billroth, Fixsen, Hoyer, Key, Hartmann, Engelmann, Merkel, Krause, and Holl. The memoirs of Beale and Maddox, on the arrangement of the nerves in the papillæ of the frog's tongue, were inaccessible to him. For fixing agents, in the present investigation, the best results were obtained with bichloride of mercury (5 to 100), Flemming's solution, and Carnoy's solution. The hardened tissues were imbedded in paraffin and in celloidin, preference being given to the latter. The cells of the disc were teased in a mixture of bichromate of potassium 4 to 100 + 1 to 100 of hydrate of chloral. A weak solution of eosin and iodine-green stained the cell nuclei green and the plasma of the cells red. For coloring the nerve terminations methylene blue, injected into the living animal according to Ehrlich's method, was mainly employed. Near the summit of the fungiform papillæ, and just beneath the end-discs is a "basal membrane," the *Nervenschale* of Key, *Nervenkissen* of Engelmann. Fajersztajn describes four kinds of cells in the end-discs, viz.: cylinder, winged, forked, and staff-shaped. The cylinder cells (*Cylinderzellen*, Merkel, Schwalbe, Holl) correspond to Key's modified epithelial cells, Engelmann's *Kelchzellen*, and Leydig's *Geschmackszellen*. Their central processes are very irregular and most difficult to follow. They reach the basal membrane, where they appear to intersect with the processes of the other cells. The winged cells (*Flügelzellen*, Merkel) have only been found in batrachians. Leydig mistook them for cylinder cells, while Merkel looked upon them as merely representing a stage in the development of those cells. Their central processes pass between the cells of the disc and pierce the basal membrane. The forked cells (*Gabelzellen*, Engelmann), considered by Merkel artificial products, were found but rarely. They possess very long, varicose central processes, there being always two to four of these processes to a cell. The processes perforate the basal membrane, where they ramify freely and form a plexus with the central processes of the winged and staff cells. Two forms of staff cells are described. The first form corresponds to Key's *Geschmackszellen*, Engelmann's *Cylinderzellen*, and Merkel's *Stützzellen*. The second form is marked by a very short central process. These cells are doubtless Merkel's *Stäbchenzellen*, although no cilia were detected on their free extremity. Merkel looked upon these cells as constituting the sensory elements of the disc. Fajersztajn, however, does not so regard them. He agrees with Engelmann in considering the forked cells as the true sensory cells; but as to whether they are specifically gustative or specifically tactile he does not venture an opinion. Beneath the basal membrane is a plexus formed of non-medullated nerve-fibrils, which the author terms the "*plexus subbasalis*." From this plexus fine varicose fibrils enter the basal membrane, where they ramify in all directions. Some of these fibrils traverse the membrane and penetrate the epithelium, forming beneath the bed of nuclei of the staff cells an exceedingly compact network. From this subepithelial network very delicate varicose fibrils pass between the cells of the disc and reach its free surface, where they terminate in bud-like enlargements. Where and how the fibrils terminate which do not reach the free surface of the disc Fajersztajn is unable to say. He believed in the contiguity, but not in the direct continuity, of nerve-fibrils and the central processes of the sensory cells. Contiguity, he suggests, may be effected either by the terminal buds applying themselves to the bodies of the sensory cells, or by the central processes of those cells adhering closely to the nerve-fibrils of the subepithelial plexus. F. T.

Within a short time the writer of the present note published the results of some studies touching the development of the gustatory organs of man, and at the same time offered a few suggestions as to the nature and probable mode of origin of these terminal structures. (*Journ. Anat. Phys.*, xxiii, 1889, pp. 559–582; xxiv, 1889, pp. 130, 131.) The earliest tongue investigated was from an embryo of about the tenth week. In this specimen the gustatory papillæ were wholly undeveloped, nor was it possible to determine with any degree of certainty their future position. In the next tongue examined, that of an embryo of the fourteenth week, the dorsal surface was more or less marked by papillary elevations of the mucous membrane. The elevations varied greatly in size and shape, and the spaces between them were filled for the most part with epithelium. The epithelial covering of the elevations had an average thickness of about 0.024 mm., and was composed of three somewhat indistinct layer. The superficial layer consisted of slightly flattened cells, which, at its deeper part, became blended with those of the middle layers. The middle layer was much thicker than the preceding, and was composed of nucleated spheroidal or polyhedral cells. Below this was a deep layer consisting usually of a single row of columnar cells. The mucosa was very rich in nuclei, and, at short intervals, was penetrated to a considerable depth by the proliferations of the epithelium. These proliferations of the epithelium are of interest, as indicating the future position of the glands and their ducts.

The striped muscle-fibres of the tongue were clearly shown, but their striæ were exceedingly faint. Several papillæ of the circumvallate type, in the early stages of development, were present. The trenches, however, were undifferentiated, although their future position was clearly indicated. Fungiform papillæ, in various stages of growth, were scattered over the dorsum, and at the sides of the back of the tongue the lateral gustatory organs were sufficiently advanced to be perceptible. A few taste-bulbs were detected in the circumvallate papillæ of this embryo, but, unfortunately, little could be learned of their structural details. The best marked bulb was spheroidal in shape, and resembled, in some degree, those of the soft palate and epiglottis. It was placed vertically in the long axis of the papilla, with its lower two thirds resting in a cavity of the mucosa. On the tongue of a fœtus, at the fourth month of intra-uterine life, were five papillæ of the circumvallate type. One of the smaller of these papillæ bore on its exposed surface a taste-bulb in an early stage of development. This bulb measured 0.0165 mm. in length, and 0.012 mm. in breadth, and was largely subepithelial in position. The tongue of a fœtus at the middle of the fifth month showed circumvallate papillæ in process of transition from the fungiform type. The greater number of the circumvallate papillæ, and also many of the fungiform papillæ bore embryonic bulbs on their upper surface. The more advanced among them were mainly epithelial in position, while the less mature were largely imbedded in the stroma of the mucosa. Medullated nerves were fairly shown in these papillæ. Directly beneath the basal cells of the epithelium was a fine, delicate, reticulated network, from which non-medullated nerve-fibrils passed upwards, penetrating the bulbs and neighboring epithelium. On the tongue of a six months' fœtus the trenches of the papillæ were for the most part differentiated, and a few immature bulbs were detected on their lateral area. In the lateral organs of taste the furrows were quite free from epithelium, save at their lower part, and bulbs were scattered over the upper surface and sides of the folds. In a fœtus at the seventh month, the bulbs had increased greatly on the lateral area of the gustatory papillæ, and there was no apparent decrease in the number of those on the free surface. In a child about a month old the bulbs were quite uniformly disposed at the sides of the papillæ, those of the lower tiers being less regular in arrangement and smaller, and lying partly in the mucosa. In a child four months old, isolated bulbs still occurred on the free upper surface of the papillæ of both gustatory areas. In the circumvallate papillæ of the adult, the bulbs did not appear to have decreased in number, but they had disappeared almost completely from the upper surface. In the adult papillæ foliatæ they were far less numerous than in early life, but were still normally present on the upper area of the folds.

What purpose the temporary taste-bulbs (for such they appear to be) of the free upper surface of the circumvallate papillæ subserve in the embryo, is difficult to comprehend. With the appearance of the bulbs of the lateral area, they gradually disappear, and, from all indications, perish. By the time the bulbs of the free surface of the papillæ have attained their full development, bulbs in early stages of formation make their appearance on the wall, the lowermost bulbs being the most elementary. Were it otherwise, it might be conceivable, as Hermann suggests, that by an unfolding of the papillæ laterally, the bulbs of the free area are shifted to the sides. In the present state of our knowledge, there seems to be no better way than to believe, with Hoffmann, that "the bulbs of the free surface perish through the proliferation of the ordinary epithelium." It is not improbable that, after the bulbs have once disappeared from the upper surface, certain altered conditions of the epithelium prevent, save in rare instances, their recurrence there.

Before concluding this brief summary, the earlier investigations of Hönigschmied, Hoffmann and Lustig should be mentioned. Hönigschmied, in a communication on the microscopic anatomy of the taste-organs (*Zeit. f. wiss. Zool.*, xxiii, 1873), merely remarks that he failed to detect in the circumvallate papillæ of the new-born child any regular arrangement of the bulbs. Hoffmann (*Virchow's Archiv*, lxii, 1875) investigated the human embryo and new-born child for the purpose of studying the distribution of the taste-organs in man. In a fungiform papilla of a four and one half months' fœtus, and also in the papillæ of one at the sixth month, he found taste-bulbs, but he failed to detect them in earlier embryos. He concludes that they are more frequent in embryos and in newly-born than in older individuals; that in embryos and new-born children they occur more frequently and in greater number on the free surface of the papillæ than in the adult, and that in old persons they are but rarely met with in this region. Lustig (*Sitzb. d. k. Akad. d. Wiss. Wien*, lxxxix, iii, 1884) failed to detect bulbs in the papillæ of a fœtus at the end of the fifth month, but in one at the seventh he found them on the free upper surface of both circumvallate and foliate papillæ. While taste-bulbs were wanting in the tongue of a ten weeks' embryo, it is not improbable that they may yet be found in the incipient stages of growth in one of the twelfth week of intra-uterine life.

F. TUCKERMAN.

II.—EXPERIMENTAL.

Ueber die Theorie des simultanen Contrastes von Helmholtz. E. HERING. Four papers in Pflüger's Archiv, Vols. 40, 41, 43.

I. *Die farbigen Schatten.* Helmholtz considers that the experiments with colored shadows show conclusively the influence of the judgment in producing simultaneous contrast. Hering, by more careful experiments, makes it plain that this is not the case. He makes the usual arrangement for colored shadows, the sources of light being day-light and a gas-flame, and the tube being arranged so that it can be instantaneously split open. The tube is so directed that the observer looks half upon the gas-lighted paper and half upon the blue shadow, complete fixation being made easy by a dot in the middle of the line of separation. To facilitate reference we shall call the shadow half of this field *s*, and the gas-lighted half we shall call *g*. After everything is in position, the gas is lighted, and *s* instantly becomes blue and *g* yellow, the yellow being an objective color and the blue subjective. Whether that subjective blue is physiological (in the retina) or psychological (in the judgment) is the question at issue.

The next step in the experiment is to move the shadow-throwing prism so that the tube looks wholly upon its shadow. Under these circumstances, according to Helmholtz, the whole field of the tube is blue, and this shows that the effect is due to the judgment; what one has just judged to be blue one still judges to be blue, and other reason for seeing this blue there is none. But as matter of fact, if the fixation has been careful, *it is not true* that the whole field of the tube is now blue; on the contrary, *g* is blue, but *s* is a distinct grayish-yellow. The blueness of *g* is now easily accounted for,—it is simply the complementary fatigue-color to the former yellow gas-light. Hence there is no occasion to say anything about the persistence of the judgment-error. But what is the cause of the yellowness of *s*? If the former blueness of *s* was physiological—a spreading over of the yellow-excitation, as Hering believes—then it, too, is due to fatigue. But it is still possible at this stage, as it seems to the reviewer, that the color of *s*, both in the first and in the second phase of the experiment should be due to judgment contrast.

There is a third phase to the experiment, however; the gas is extinguished and the tube is suddenly opened. Helmholtz says that everything now appears of a natural white. But in fact, if one looks carefully, one can still see a circular spot, the field of the tube, the colors of both *s* and *g* being very much the same as in the second phase. This after-image persists longer, the longer the first phase and the shorter the second phase have lasted. There is no difficulty in getting it, even without the self-opening tube. It was overlooked by Mr. Delabarre, who has repeated these experiments, and who says, "If . . one lay aside the tube and glance at the field the color at once disappears." (This *Journal*, Vol. II, p. 641).

This after-image lasts a much shorter time, of course, than that in the second phase. Its occurrence seems to the reviewer to render it certain that a mistaken judgment is at least not the principal cause of the whole phenomenon. It is incredible that a mistake should extend itself over a small semi-circular spot and no farther.

II. *Der Contrastversuch von H. Meyer und die Versuche am Farbenkreisel.* Hering first calls attention to the fact that he, too, lays great stress upon the effects of experience and of practice, as is shown in his *Gedächtniss als eine Function der organischen Materie*, and that if he does not agree with Helmholtz in explaining simultaneous contrast as an effect of the judgment it is simply because the facts seem to point, in this case to a different explanation. In order to show that simultaneous contrast is due to the judgment, Helmholtz endeavors, in all cases where the sensation is a strong one, to so vary the circumstances as to make it weak, or evanescent; for instance in Meyer's contrast-experiment he shows that if the grey ring is held in front of the colored paper so as to be plainly distinct from it in space, its color vanishes. But Hering points out that *actual* slight-differences in color are easily made to vanish by slightly varying the circumstances. A feeble after-image which one can easily see on a smooth surface will quite fade out on a rough one. A slight difference of color of two papers is overlooked if one is smooth and one rough, or even if they have a different grain, and they are so held that the grain is perceptible. A black mark around one will also destroy the difference. On a color-top, all unevennesses of surface disappear and a color is seen in its ideal state. But a bit of paper of exactly the same color as the top, when held in front of it, will look different. Even if the paper behind is not rotating, one cannot be sure that the one in front is of the same color, so long as there is a difference of brightness, or a distinct edge, and all the more if one cannot accommodate for both at once. If the lighting is as near as possible alike, and if the accommodation is for neither (so that the edge becomes indistinct) the observer may think the colors alike, but he may also actually fail to see that there are two different papers, however much he knows that there are two. Fixate a bit of paper in front of a ground of the same, but shove in between them a black card-board for a few seconds; then remove suddenly both the card-board and the bit of paper. A spot appears on the ground, which is of different color from that, and which is also perceived to be a different color from the just-removed bit. In other words, a separate bit, *seen to be such*, forms a hindrance to perceiving a slight amount of difference. But this is a case of an *after-image* being far less perceptible on the scrap of paper itself than on the large sheet; and Helmholtz himself would not say this proves the psychological nature of *after-images.* No more should a similar fact be taken, then, to prove the psychological nature of simultaneous contrast. This experiment has been varied by the reviewer by having two dots on the scrap of paper, and fixing first one, and after the black card-board is removed, the other. In this way the after-image of the scrap falls in part on the scrap itself and in part on the paper underneath, and the two colors can be compared at leisure. In this case, *no difference can be detected* in the two colors, other than what is due to some unavoidable difference of brightness. But Hering might reply that in this case, the after-image, even where it falls on the scrap, is taken to be a distinct object, and not a simple color of the scrap of paper.

These considerations remove the force from most of Helmholtz' arguments in favor of judgment as a cause of simultaneous contrast. Hering denies that the brightness of the contrast-color does not increase with the saturation of the inducing field, but his experiments in another paper (Pflüger's Archiv, XLII, p. 119. See this *Journal* I, 706) are more conclusive on this head. This point is important, because the opposite fact is considered by Wundt to be the chief objection to the whole theory of Hering (Phil. Studien, IV, p. 312.)

III. *Der Spiegel-contrastversuch.*

In the experiment of Ragona Scina, a vertical and a horizontal sheet of white paper have one edge together and a colored glass plate forms an angle of 45° with each. Instead of small black squares on the sheets of paper, Hering uses concentric black rings. One ought to see a mirrored vertical ring green (using green glass), a horizontal one white, and the space between them a mixed whitish green, but the white one is by contrast red. If the brightness of the whole is properly regulated (it is enclosed in a chest), the success of the experiment is surprising, the red is quite as saturated as the green. Helmholtz' explanation is that since we suppose the greenness of the plate to be uninterrupted, a spot which really looks to us white we fancy to have a red spot underneath it, because it would take a red spot under a green glass to *look* white. This explanation assumes an extraordinary power on the part of the observer in picking out complementary colors; it is completely vitiated by the fact that the red color is as distinct as ever when, by a proper framework, the green plate is made perfectly invisible, and to a fresh observer who is quite unaware that there is any plate there. Moreover, by moving the sheets of paper (and so making the rings not quite concentric) the green rings may be made to seem in front of the red, or the red in front of the green, at pleasure. The red and green rings seem to swim in a whity-green space like birds in a blue sky. According to Helmholtz, a bit of white paper held evidently in front of the green cloud does not look red; but according to Hering, if it is fine-grained, and if the color and brightness are exactly the same, it looks quite as red as the other, even though it be made to swing in front of the glass plate and be looked at binocularly, and this whether the glass-plate is visible or not. In this, as in every case of simultaneous contrast, the color is very fleeting if successive contrast is carefully shut off by means of fixation. It quickly passes over into what Hering calls the "simultaneous induced" color, which is the same as that of the inducing field. [This name is very bad, because it does not distinguish the thing from the simultaneously induced opposite color. There is a great need of a new terminology for contrast, to take the place of the both cumbrous and inexact one which is now in use. Helmholtz frequently uses *contrast* alone, when it is impossible to find out by the context whether he means simultaneous contrast or successive contrast. The following may be proposed. In the first place, there is no reason why we should not say *co-color* instead of *complementary color*, as we have long said *cosine* instead of *sine of the complementary angle*. We might then have for the four things to be named:

1. Induced co-color (brief, and, if there is fixation quickly passing over into) 2. Induced self-color.	if Hering is right.
1. Judgment co-color. 2. Spread self-color (Physiol. Optik, p. 400.)	if Helmholtz is right.
3. Positive after-images. 4. Negative after-images	in both cases.

(1) and (2) are occurrences in the immediate vicinity of the original impression, (3) and (4) are occurrences in the same place. REV.]

IV. *Die subjective "Trennung des Lichtes in zwei complementäre Portionen.*"

Helmholtz is of the opinion that our unconscious experience causes us, under certain circumstances, led by unconscious false judgment, to separate an actual white sensation into two components, and to deceive ourselves into thinking that we see one of these components only. This hypothesis is used by Helmholtz to explain many cases of color-contrast. Hering has already given reasons for not adopting it, and more follow in this article. It presupposes, for one thing, an acquired unconscious knowledge of what colors are complementary which is totally wanting in our conscious store of knowledge,—a rather violent supposition, and one which could only be accepted if colored veils and mists and glasses had been much more common in the experience of our remote ancestors than there is any reason to suppose that they have been. Helmholtz considers that it is easily possible, when an object is seen through a colored screen, to decide what part of the mixed color perceived is due to the screen and what to the object. Hering shows that when proper precautions are taken this is an absolute impossibility. An observer, provided with a tube, looks through a thin colorless glass plate and sees a transmitted image of a piece of colored paper behind the glass with a reflected image of a smaller, differently colored piece of paper from in front thrown upon the middle of that. If the front and back papers are equally distant from the glass plate, the two objects seem like one; if either is moved, one is seen to be plainly in front of the other, since they are looked at binocularly. But in either case, *the color of the combined images is the pure color of the mixture*, there is not the slightest tendency to separate it up, subjectively, into the two colors of which it is really composed, provided that all the proper precautions have been taken in preparing the experiment, although it is impossible not to perceive that one object is seen through another.

Hering promises, at the end of this communication, another, in which he will speak of general considerations having a bearing upon Helmholtz' theory of simultaneous contrast. C. L. F.

Sur la vision des couleurs de contraste. D. AXENFELD. Archives italiennes de Biologie. Vol. XI, part 1, Jan. 1889. Extract from the Bullettino della R. Accademia medica di Roma, An. XIV, 1887-88, fasc. 7.

Axenfeld gives an improvement on Ragona Scina's method of producing color-contrast. In front of a source of light he puts a screen with holes in it, and allows these holes to mirror themselves in a plate of colored glass. The images from the front and the back surface of the glass show complementary colors. For binocular color contrast, he produces double images of a black square on white paper, one eye looking through colored glass and the other not. He is of the opinion that the contrast-appearances due to light penetrating through the sclerotic coat are not produced by fatigue, since they appear instantaneously. He attributes great weight to the fact that one of the colored surfaces seems, in all these cases, to be transparent, and hence he concludes that the psychological part of the explanation cannot be entirely dispensed with. In general, he accepts Hering's color theory.

Ueber die von v. Kries wider die Theorie der Gegenfarben erhobenen Einwände. E. HERING. Pflüger's Archiv, XLII, u. XLIII.

I. Following out the mathematical discussion of the conditions of color-mixtures which he gave in his *Newton's Gesetz der Farben-Mischung*, Hering replies in detail to v. Kries' objection that when more than three fundamental colors are assumed color-mixtures which look alike at one degree of fatigue do not necessarily look alike at a different degree of fatigue. The objection of v. Kries is based upon the assumption that the three distinguishable qualities of a given color-mixture (tone, intensity and saturation) give rise to three equations expressing respectively the identity of the same function of three processes when the processes are modified by different fatigue co-efficients. Three equations involving *three* unknown quantities (the fundamental processes) suffice to determine those unknown quantities but not if they involve more than three.

To this Hering very properly replies (overlooking the arbitrariness of the original assumption) that it is not necessary that the colors should *necessarily* look alike, but that it is sufficient that one of the many possible solutions of the equations should *permit* them to look alike, provided that that is not a solution that is otherwise improbable. Hering goes through a complete discussion of the question in the case of the reduction of the plane of color-mixtures to a straight line,—that is, in the case of the partially color-blind. The discussion involves modern mathematical methods, which, as Hering has shown in the case of the horopter, are eminently applicable here also.

II. Hering lays great stress upon the fact that the nervous visual organ is an organic whole, and that when a stimulus falls upon a part of the retina, all the other parts, and especially those which are near, respond as well. This is the key-note of Hering's explanation of the phenomena of induced self-color. These phenomena are, according to Hering, of the utmost importance from a theoretical point of view; the value of v. Kries' contributions to the subject may be inferred from the fact that he says (*Analyse d. Gesichtsempfindungen*, p. 133), that they have not nor *can* not contribute anything towards a theory of vision.

Hering repeats with various modifications, his fundamental experiments for exhibiting the *Licht-hof*, or bright border by which the dark after-image of a bit of white paper on black is surrounded. On Helmholtz' theory, this brightness is merely the ordinary self-light of the retina, heightened by judgment contrast with the dark after-image. Hering gives many ingenious experiments to prove that this is not the case, and in particular he provides that the "border" should be produced in one eye only while the other eye, having been shut (and hence rested), looks upon an actual grey surface with which to compare it. Anyone who has performed this experiment can no longer doubt that the "border" corresponds to a real sensation, of quite comparable intensity with that of a good grey light falling upon an untired retina; there is no reason to suppose that it is not due to a physiological process, of whatever nature it may be, superinduced by the adjoining stimulation. In the same way the after-image of a black strip on a red ground may look a brighter red than an actual red with which an unfatigued eye compares it. Von Kries says that this can be explained as a propagation of the *stimulation* instead of the excitability. Hering in reply points out that (in the form of experiment in which a narrow black strip with a sheet of white on either side of it looks afterwards bright) the strip grows dark as the sheets are brought up and bright again as they are again removed, but that if the sheets diffuse a stimulation they ought to do it the more the nearer they are to the black strip. This reply is perfectly adequate, but to the reviewer it is impossible to see why it does not hold against Hering's theory as well.

What difference is there between an increased excitability and an increased excitation, of such a nature that one can be diffused when the sheet is not there and the other only when the sheet is there?

Von Kries says that this border is only seen on a dark back-ground, but that if it were caused by an increased excitability that ought to betray itself on a bright back-ground as well, whereas a real process might easily be so slight as not to be noticed in the presence of a greater one. Hering shows that, with a proper arrangement, it can be seen on a bright back-ground; but he does not explain why it ought not always to be easily noticeable on a bright back-ground. Hering points out that he has not proposed any theory as to what the physiological process is which is the basis of the increased excitability, but that he is only engaged at present in getting a correct mode of expression for the facts. A third position which v. Kries takes up is that everything can be explained as well by assuming that an excitation in one spot lowers, instead of heightens, the surrounding excitability, but Hering shows that this is quite incompatible with several variations of the experiment to which v. Kries has not applied it. [It must be remembered that *excitation*, according to Hering's complete theory, must correspond now to a state of super-nutrition and now to a state of mal-nutrition in the nervous structures; the co-color sensations, red-green and blue-yellow, are, according to him, processes of assimilation and dissimilation respectively. Hence Hering must say, in full, that a tearing down of nervous structures in one spot causes a *tendency* to tearing down in surrounding spots. But what can a tendency to tearing down consist in, if it does not consist in a greater built-up-ness of some chemical structure? A chemical substance which is the same as to quality and amount cannot be now more and now less loosely put together. Hering's theory would therefore seem to be *at bottom* the same thing as this suggestion which is casually thrown out by v. Kries. In fact, the reasonableness of Hering's theory of vision, as far as it involves assimilation and dissimilation is a very different matter from its reasonableness exclusive of those ideas. The whole subject is in a condition in which it will repay any amount of hard thinking and careful experimenting.]

III. The third division of Hering's paper deals with after-images. Von Kries overlooks the fact that according to Hering's theory, fatigue for one color can exist without producing any change in the sensibility to white; while according to Helmholtz, fatigue for one color involves a total change in the reactions to white light. Take a yellow which is produced, on Helmholtz' theory, by equal excitations of the fibres sensible to green and to red. Let white light presently fall upon the same spot of the retina, and the green and red fibres being equally fatigued, it ought to stir up the violet fibres only; but in fact the complementary color to yellow is blue, or, at most, an indigo-blue. [Helmholtz, it would seem, would need to add to his theory the assumption that the green fibres are exceedingly vigorous, and not easily capable of fatigue; but, in fact, it is as easy to get the complementary color to green as to anything else.] Hering proceeds to describe a very striking experiment; a piece of spectral red is looked at first, fixedly in a bright light, and then the light is diminished, (or the observer takes the red paper into a shaded place.) Instantly, although his eyes are open and he is looking at red paper in a not faint light, it looks to him of a bright blue-green. A modification of this experiment is to place three bits of paper (red, green and violet) on black, to look at a point midway between them for a moment, and then to turn down the light. Each bit of paper appears in its complementary color, and as all the colors are present, a mistaken judgment cannot be called upon for an explanation of the phenomenon. Simple fatigue cannot explain it, for if the fatigue of the red fibres is so great that a real red looks blue-green, why does it not betray itself before the shadowing? If the shadow be removed, the red looks as bright as before.

We are forced to assume that exposure to red light causes a strong disposition to the production of a blue-green sensation, not simply an indisposition to the production of a red sensation. At this point Hering commits a curious error in logic. He thinks that the objection set forth above to the possibility of two complementary colors both containing any considerable amount of green is *more* forcible on the supposition that an image and its after-image correspond to positive and negative forms of one process (viz. growth and decay) than that they correspond to different *degrees* of a positive or a negative process merely. He forgets that the difference between two quantities, both positive or both negative, may easily be as great as that between a positive quantity and a negative quantity. His reviewer, Schön, in *Hermann u. Schwalbe's Jahresberichte über die Fortschritte der Anat. u. Physiol.* gravely sets forth this position of Hering's without comment. The objection is a perfectly valid objection to a three-color theory as opposed to a four-color theory, but it has nothing whatever to say to a theory of assimilation plus dissimilation as opposed to a theory which attributes complementary sensations to the breaking down of two different kinds of chemical substance.

On the whole, this paper of Hering's which contains a large number of ingenious experiments, for the most part carefully weighed, does much to strengthen the belief that the black-white sensation is distinct from the color-sensation, and not composed of its combinations, but very little to strengthen the belief that the sensations of black and white (and of the opposite colors) are the psychological aspect of anabolic and metabolic processes respectively.

The principal weakness at present which exhibits itself on Hering's side of the question is that in his late papers he confines himself to answering objections, and does not sufficiently indicate, at each step, in what way his own theory applies to the case in question. He has promised a full discussion of the subject *de novo*, but that discussion seems to be long in coming. C. L. F.

Ueber den Farbensinn bei indirectem Sehen. DR. CARL HESS. v. Graefe's Archiv für Ophthalmologie, Bd. XXXV, H. 4, 1889.

This very important paper is a thorough re-examination of the color sensibility of the peripheral portions of the retina. The general results are as follows: (1). Three kinds of homogeneous light can be found, and only three, which change in saturation, but not in color tone, as they are moved toward the periphery of the retina, the eye of course being wholly free from the effects of other color sensations previous or simultaneous. These are a yellow (wave length, 576–574 $\mu\mu$), a green (wave length 497–494 $\mu\mu$), and a blue (wave length 472–470 $\mu\mu$.) The same is also true of a fixed compound color mixed from homogeneous red and homogeneous violet or blue, except where the absorption of the *macula lutea* interferes. (The effect of the *macula* must be regarded in almost all these experiments so far as they are made with mixed colors.) These four unchanged colors are the primary colors (*Urfarben*) of Hering, determined in a purely objective manner. (2) Mixed lights agreeing with these in color-tone, and only such, behave as these do. (3). These four colors, homogeneous or mixed, form two complementary pairs *i. e.*, the mixture of the red and the green and of the yellow and the blue gives white. (4) Reds and greens that differ from the primary red and green become more and more yellow or more and more blue as they advance toward the periphery, finally losing all red and green character and appearing a more or less saturated yellow or blue. The points at which this happens as also that at which the primary colors fade out, depends on the saturation, the size of the retinal area affected, the brightness of the color, the brightness and color of the back-ground, and the radius of the retina along which the colors are advanced. (5) The best method for fixing the point at which the color fails to be seen is to make the back-ground exactly as bright as the colored spot becomes when it has lost its color, in which case it fades into the back-ground and becomes wholly indistinguishable. (6) The colorless brightness or "white valence" of two colors may be assumed to be equal when on losing their color they become indistinguishable from the same back-ground; and the "color valence" of primary red and green may be considered equal when, being mixed in equal quantity the y produce white. Fields of primary red and primary green examined u nder exactly parallel conditions, (*i. e.* when they have equal "white valence" and equal "color valence;" when they are of the same area, are observed with the same portion of the eye and against the same back-ground,) become colorless at the same distance from the center of the field. The same is true for primary yellow and blue. (7) From this it follows that the red sensibility and green sensibility decline exactly together as the periphery is approached; likewise the blue and yellow sensibilities, but much less rapidly. (8) No fixed point can be assigned where these colors will invariably disappear, though such a point can be found for any given set of conditions. (9) White light appears white at all points of the retina. All colors matched on the red-green sensitive part of the eye (except the *macula lutea*) match on all other parts, but colors that match on red-green blind areas, while they match for all other red-green blind areas, do not necessarily match for those that are red-green sensitive. It is hardly necessary to say that most of these observations, which in part support and in part supersede previous observations, are very much more easily explicable on the color theory of Hering than on that of Young and Helmholtz.

The experiments of Hess were conducted with great care; when spectral light was used the eye was kept in the dark for from 15 minutes to half an hour before observation; and care was taken to avoid fatiguing the retinal spot worked upon. The device (one of Hering's) for obtaining a definite area of a definite color in a field of exactly the right shade is especially simple and effective. Through a small round hole in a horizontal screen of gray paper the observer looks down upon the horizontal disc of a rotary color mixer. If the hole is clean cut, the portion of the disc seen below appears in indirect vision simply like a colored spot on the surface of the screen. By changing the inclination of the screen with reference to the light its brightness can be considerably varied, and with a set of interchangeable screens any desired degree can easily be secured. With the same apparatus the "white valence" of colors at the point of disappearance can be measured by the width of the black and white sectors required to make a gray with the disc of the color mixter that shall be indistinguishable from the gray of the screen when the eyes are in the same position as that at which the color disappeared. E. C. S.

Ueber die Hypothesen zur Erklärung der peripheren Farbenblindheit. Prof. EWALD HERING. v. Graefe's Archiv für Ophthalmologie, Bd. XXXV, H. 4, 1889.

In this article, which in a sense furnishes a theoretical and polemical part to the article of Hess above, Hering subjects the explanations of peripheral color blindness advanced at various times by Helmholtz and Fick to a vigorous examination. The first view, conjecturally advanced by Helmholtz, was that the sensibility for red in the peripheral zone was less than for green and blue, approximating a red blindness. This however was contradicted by observations, among others, mentioned by Helmholtz himself, namely, that red and green appear yellow when moved toward the periphery (according to the Young-Helmholtz theory a union of red and green sensations are necessary for yellow), and that blue became a grayish white, for which on that theory all the sensations must be present. The colors that are still seen should also look more saturated as the others fail, but directly the reverse is the case. To avoid this difficulty the hypothesis of Leber and Fick was proposed. Fick assumed, instead of an absence or loss of function in any of the three kinds of nerve fibers, that all three were functional, but that the degree in which each kind was excitable by the various homogeneous lights of the spectrum changed continuously from the center toward the periphery, so that in the so-called red-blind zone the red and green fibers had a like degree of excitability toward all lights, and in the extreme peripheral zone all three kinds had the same degree. Such a hypothesis adapted to fit a photochemical explanation of vision is given by Helmholtz in the new edition of of his Physiological Optics.

Against this hypothesis, which Hering regards as itself destructive of the Young-Helmholtz theory, he urges the theoretical objections that it is illegitimate to assume three color sensations where two or only one would be sufficient to satisfy the law of color-mixing, and at the *same time* to deduce from that law the dictum for the center of the retina that there can only be three primary sensations, which certain of the representatives of the theory, (though not Leber and Fick) have done. Furthermore since the color-sense changes on the retina continuously, an infinite number of different ratios of excitability must be supposed. Theoretical objections aside, however, the theory breaks down in explaining facts such as those brought out by Hess, whose results Hering here resumés. Moreover, in order to explain a part of these results on the Young-Helmholtz theory the assumption is forced that *all* colors remain unchanged in color tone as they move toward the periphery, which is flatly contradicted by others of them. Whence it follows "that the Young-Helmholtz theory in general offers no possibility of explaining the above cited and for the most part already long known facts, and that it is by them alone to all intents refuted." Another explanation of Helmholtz, advanced at the same time with the last, was this, namely that when one of the primary sensations is wanting, we learn by experience which sensation of those remaining corresponds to the most frequent and intense sensation received from luminous bodies, i. e., white. From this as a basis we "interpret the rest of the perceptible colors as colors of a line which is laid in the color triangle through the place of white, parallel to the line joining the two fundamental colors yet retained. This would go, if red were lacking, from yellow through white to blue" (Phys. Opt. 2nd. ed. p. 374). Though yellow and blue are the colors seen on the "dichromatic" parts of the eye, this statement as it stands contains a palpable error; for it is when green and not red is lacking that the line would go "from yellow through white to blue." Helmholtz explains that we do not recognize the colors seen at the periphery in accordance with the actual sensations received there for the same reason that men for thousands of years failed to discover that all colors were not seen with the periphery. To this Hering replies that men, to be sure, did not recognize the peculiarities of the color vision of the periphery because they never had need to attend to them. When attention is once given, the color is recognized as it is seen; a violet color is seen blue, and not the clearest knowledge that it is violet can help it in the least. The facts that Hering finds thus in such disaccord with the theories of Helmholtz and Fick, are so easily explicable, he thinks, on his own theory that he waives detailed explication.

E. C. S.

Ueber Beziehungen zwischen Farben und Tönen. Prof. PIETRO ALBERTONI. Originalmittheilung, Centralbl. f. Physiol. No. 15, 26 Oct. 1889.

Drawing parallels between color and tone has been a tempting occupation to many people. Hauth for example assumes three primary colors, blue, yellow and red, and over against them three primary tones *c* (*do*), *e* (*mi*), *g* (*sol*). Prof. Albertoni has, he believes, found clinical evidence for something of the kind in the case of three color-blind persons. Two were red-blind and failed to distinguish *g* (*sol*); and one was green-blind and failed to distinguish *d* (*re*). The persons tested were of musical ear, and their failure to perceive these tones consisted in inability to distinguish them from neighboring tones on the piano and to sing them accurately when they were given. Some persons not red-blind were also found who could not produce *g* (*sol*), but whether from failure of perception or of voice mechanism does not certainly appear. For the first cases Albertoni proposes the name "auditory daltonism." [The natural comment on these observations is: Interesting, but in need of confirmation. It is not impossible that tone-deafness may be found more frequently in the color-blind; but what is to be said of its correspondence with the three-color Young-Helmholtz theory which seems now on the point of collapse? REV.] E. C. S.

Studien über die elementaren Farbenempfindungen. Erster Abschnitt. FRITHIOF HOLMGREN. Skandinavisches Archiv für Physiologie, Bd. I, H. 1–3, 1889.

Finding himself definitely prevented from completing his studies, in large measure because of the eye-strain entailed by them, Prof. Holmgren is compelled to give his researches to the public, if at all, in their present incomplete condition. He is further urged to publication by the criticisms, both theoretical and experimental, which the preliminary accounts of his work have drawn from Hering (*Pflüger's Archiv*, Bd. xl, 1,) and Isaachsen (*Ibid.*, Bd. xliii, 289). His line of experiment was this, namely, to bring upon the retina a point of light fine enough to stimulate the visual elements singly, and thus call out the three fundamental sensations which should result according to the Young-Helmholtz theory. This first paper is devoted to the statement of the problem, to the preliminary experiments, and the choice and management of the apparatus. The experiment, if it can be generally verified, is one of such great importance for the theory of color vision, that the continuation of Holmgren's account of it will be looked for with interest. Incidentally, the author observed a very interesting instance of the effect of muscular sensations upon vision. In looking at his very faint and fine points of light with eyes somewhat elevated (the same thing, he says, may be seen on looking with the eyes in that position at a gas flame turned down to the faintest blue), the image seems to move constantly upward or in the direction of the muscular exertion—that is, the sensation of continued tension expresses itself in the illusion of continued motion. E. C. S.

Ueber Nachbilder im Binocularen Sehen und die binocularen Farbenerscheinungen überhaupt. H. EBBINGHAUS. Pflüger's Archiv XLVI, pp. 498-508.

Ebbinghaus describes a simple phenomenon in the subject of after-images that seems to have been hitherto overlooked. The left eye, say, looks at a bit of bright paper an a dark ground, while the other eye, being open, is prevented from seeing it by a piece of card-board. On suddenly shutting the left eye, a *positive* after-image is seen by the right eye on the piece of card-board. It is certain, Ebbinghaus thinks that this after-image is due to the right eye, because the circumstances are not such as to cause a *positive* after-image in the left eye, that being caused only by a relatively bright light or in a well-rested eye. In the given circumstances, it cannot be detected with the right eye closed. Moreover, this after-image can be got, though with more difficulty, even if the left eye is kept open, provided the bit of bright paper is cut off by a piece of card-board; but these are conditions under which, according to all that we know about after-images, only negative ones can arise in the affected eye. Ebbinghaus does not suppose that in this phenomenon an actual effect is produced in the right retina, but rather that it is due to central processes; and in supposing this he does not consider that the well-founded belief that ordinary after-images are peripheral is at all affected.

The hypothesis that an excitation of one eye produces an effect in (at least the central attachments of) the other eye, Ebbinghaus considers is borne out by other facts. In binocular color-mixing, *two* colors are produced which succeed each other by rivalry; even when the colors mixed are nearly alike and the composed color looks like one, it will be found, on trying to match it with pigments, that it is really two. Ebbinghaus' hypothesis here is that the two eyes see two distinct images, A and B, and at the same time two faint, sympathetic images, *b* and *a*; and that rivalry takes place between the fused pairs, *A*, *b* and *B*, *a*, the color of the mixture thus leaning now towards one and now towards the other of the component colors. [This is the same thing as saying that a real *binocular fusion*, in the original meaning of the phrase, does not take place at all.] A similar explanation is applied by Ebbinghaus to binocular contrast.

The new phenomenon described is difficult to get and Ebbinghaus recommends trying it, for the first time, after a sleepless night.

C. L. F.

Optische Urtheilstäuschungen. Dr. F. C. MÜLLER-LYER. DuBois-Reymond's Archiv. Supplement Band, 1889.

The interesting illusions described and explained in this article are difficult to understand without the accompanying illustrations. If we draw an acute angle and an obtuse angle with equal sides, the sides of the latter will seem very much longer than the sides of the former, and this effect will be the more marked the greater the difference in the two angles. Again, draw a pair of such angles and connect their apices by a straight line, and the straight line connecting the obtuse angles will seem longer than the one connecting the acute angles, that is, provided the sides of the angles are directed towards the connecting line; if they are directed away from this line, then the line connecting the acute angles seems the longer, and the contrast becomes strongest in comparing two lines connecting pairs of acute angles, alike in the size of the angle and the length of the sides, but the one directed towards, and the other away from the connecting line. The same illusion appears in various forms: the sides of a triangle seem smaller than the sides of a square, though really the same; and the sides of the square will seem shorter than the equally long sides of a pentagon or hexagon, and so on. The general principle of explanation is, that the more contracted the suggested environment of the space-dimension in question, the smaller will it seem. This explains at once why the sides of acute angles seem shorter than those of obtuse ones, why lines with contracting angles or curves seem shorter than lines with expanding outlines at their extremities; why a space between two narrow oblongs seems larger than the same space between two squares, or a distance on a line marked off between two short lines seems longer than the same distance marked off between two longer lines, and so on. It is also to be noted that these illusions differ from the ordinary effects of contrast in that while in contrast the stronger effect weakens the effect it accompanies, here the reverse holds true. With these are connected two other types of illusions, the one referring to the change of form of the contour of an interrupted figure, as when a portion of the circumference of a circle is omitted; the other to the contrast induced by placing the smaller side of one of two equal figures next to the larger side of the other figure, and thus causing the first to seem smaller, etc. These illusions are all clearly marked, have a wide field of application, and promise to repay further study. J. J.

Das Netzhautbild des Insectenauges. Prof. SIGMUND EXNER. Repertorium der Physik, Bd. XXV, H. 9 und 10, 1889; also Sitz.-Ber. der Wiener Akad. (3 Abth.) Bd. 98 (1889).

In this paper, which in some sense corrects and completes an earlier one on a similar subject, Prof. Exner seems to have definitely settled the question as to whether insects with compound eyes see by means of a single erect image, (Johannes Müller's view), or by means of a multitude of little inverted images, (as held by several later observers), and to have settled it in favor of the earlier view, at least with modifications. By taking the eye of the male firefly (*Lampyris splendidula*), (the same might be done with the American *Elater noctilucus*), replacing the softer parts with diluted glycerine, and mounting it under the microscope (power of 60-100) in such a manner that the convex surface was free to the air as in life and the focal plane of the microscope lay in the place once occupied by the retina, he was able to observe the image directly, and by focussing up and down to study its nature and formation. The dioptric unit of the compound eye in this insect consists of a crystal cone (*Krystallkegel*), the lower end of which is rounded into a lens-like point, and of the attached corneal facet, also lens-shaped. This crystal cone, assisted somewhat by the lens-forms at its ends, but depending in large measure on its own peculiar refractive powers, behaves like a minute astronomical telescope and projects an erect image of the portion of space to which it is directed on the retinal elements lying below it. The neighboring cones also project similar images, each differing slightly because of the different directions of the cones. The points of these images that represent the same objective points in space coincide, and thus form a "summation image," which was that observed by Exner. In the eye of *Lampyris* as many as thirty cones contribute to the "summation image" of a small light object. The peculiar refractive powers of the cones rests in the increase of the refractive index in successive strata from the convex surface toward the axis. To account for the presence of large quantities of pigment in the space between the crystal cones and the retina in some insects and its absence in others (*e. g.* these fireflys) the author offers this hypothesis, which in a later paper (*Sitz.-Ber. der Wiener Akad.* Bd. 98, (3 Abth.,) v. 21 März, 1889.) he has substantiated by observation, namely that when the eye is exposed to light the pigment spreads backward from the region of the cones into the otherwise free space. The effect of this would be to cut off as it advanced more and more of the single images going to form the "summation image," proportionately reducing its intensity; it would thus serve the same function as the iris in the eye of higher forms. The author by no means believes that the eye of *Lampyris* is typical of all composite eyes, though the understanding of it is an advance; indeed he devotes a section to the consideration of other forms in which the structure is different. For these details, however, and for very much information not easily abstracted, or not of immediate interest here, *e. g.*, the other optical images to be observed in addition to that mentioned above, the physico-mathematical consideration of the crystal cones, the measurement of the eye, the developmental relations of the simple vertebrate eye and the compound eye, etc., etc., the reader is referred to the full treatment and the cuts of the original. E. C. S.

Psychophysische Untersuchungen. Dr. F. C. MÜLLER-LYER. DuBois-Reymond's Archiv. Supplement Band. 1889. pp. 91–141.

This very extensive research is so intimately connected with the many explanatory tables and illustrations, that a resumé of its contents must be confined to a statement of the most general points; special students of psychophysics must go to the article itself for the detailed numerical results and their justification. The article begins by maintaining that it is wrong to speak of *the* psychophysic law, for there may be any number of such laws; the problem is to determine all the conditions that affect sensibility to differences of stimuli, and the intensity is but one of such conditions. There will be here considered the relation of the intensity and the extension of optical stimuli to the sensibility. The author had shown that Weber's law does not hold for sensations of brightness (method of detecting the difference between two differently illuminated discs), but as the stimuli increase, the sensibility increases, though at a constantly decreasing rate. This was tested separately for each eye, with a light disc upon a darker ground or vice versa, for a great range of intensities, etc. This may also be expressed by regarding the effect of the application of the stimulus to be the lowering of the irritability, but not as rapidly as the stimulus increases. It is concluded that for visual sensations, as the stimulus doubles its value, the irritability decreases by one-third its value. Some of these points were specially tested for peripheral regions of the eye, and it was found that such portions are in general more sensitive to the vision of small dots than the fovea, and also that Weber's law seems to hold better for the peripheral than for the foveal portions. Had the sensibility been independent of the intensity of the stimulus, the determination of the relation of sensibility to the extension of the stimulus would be easy; but as it is, we are dealing with two variables at a time, and have the complex problem of determining how the sensibility changes for each intensity when the extension remains constant, and how it changes for each extension when the intensity remains constant. This the author does for visual sensations, expressing the result by a surface in the three dimensions of space. For changes in extension, the general result is that as the surface upon which the judgment of difference of illumination is founded is increased, the sensibility increases, at first relatively rapidly, and then more and more slowly. These relations are subjected to a minute experimentation, the result of which is a series of tables expressing the influence of the changes in any one of the factors of the stimulus upon the rest. The main point is the treatment of the sensibility, not as dependent upon a single variable, but upon several. The article certainly merits detailed study, but the question arises whether these exact and many-sided calculations are warranted by the accuracy of the method, and whether we should not demand a corroboration of these results by other methods before drawing the sweeping generalizations here propounded. J. J.

Neue Grundlegung der Psychophysik. HUGO MÜNSTERBERG. Beiträge zur experimentellen Psychologie. Heft, 3. Freiburg, 1890. pp. 122.

It is impossible to notice this original and painstaking contribution to Psycophysics without renewing the protest against the undue length to which all the studies of this series have been drawn. It is not sufficient that the spirit of science should enter into the methods of the new Psychology; it must also enter into its exposition, and we feel assured that the author is very considerably diminishing the influence of his work by his undue prolixity. The three instalments of Dr. Münsterberg's work could easily have been printed in a pamphlet the size of the smallest of them, without omitting anything essential or important. If this disastrous policy is to be continued, let us at least be supplied with an index of principal points, so that those who want merely the kernel of the work may know where to find it.

The cardinal thought of this research is, that we cannot measure sensation-intensities in the ordinary sense, because only that which can be reduced to units can be measured. A weaker sensation is not contained in a stronger as an inch is contained in a foot or an ounce in a pound; but each intensity of the stimulus gives rise to a sensation qualitatively different from any other sensation. All quantitative differences of sensation are thus resolved into qualitative differences—of a special kind, however, namely, such as depend upon differences of muscular tension. It is held that our organism reacts to every stimulus by reflex muscular innervations which give rise to feelings of tension (*Spannungsempfindungen*), and it is the perception of differences of degree of these feelings that lies at the basis of intensity distinctions. All physical measurements ultimately depend upon space, time and mass, and each of these is connected with muscular sensations; so that it is the production of like muscular sensations that in the last analysis makes measurements possible. This is equally true of measurements of sensation, and it is owing to the fact that in these muscular feelings the more intense really includes the less intense, that the measurement of sensations of intensity is possible. (A long digression discusses whether sensations of sound-intervals can also be reduced to this category.) If this theory is true, then, Dr. Münsterberg infers, sensation-differences will be perceived as equal when they give rise to the same difference of sensations of muscular tension, and inasmuch as these occur in all senses we should be able to compare sensation-differences amongst disparate senses. This apparently difficult, if not impossible problem, we are assured, is easy when we once set about it, and we are presented with the result of such a series of trials. One black disc was kept constant with 20° of white, while another was changed by 10° changes from 20° to 180°; again the left arm made a constant excursion of 20 cm., while the right arm made an excursion that would seem as different from the excursion of the left arm as the second disc seemed lighter than the first. In the same way, differences of pressure and differences of sound-intensity were compared, or rather translated into differences of arm-motion, and though the separate experiments were conducted in an utterly irregular order, the result is a very orderly rise of the excursion of the right arm with the differences in the lightness of the two discs, or the weight of the two weights, or the loudness of the two sounds. The same three classes of sensations were also translated into differences of visual extension, and with an equally satisfactory and regular result. The results are not considered sufficiently numerous or accurate to warrant attaching importance to the numerical tables (especially as they are founded upon but one subject, Dr. Münsterberg); but they are tested in several ways, and found to give consistent results among themselves. The relative increment of stimulus for the different senses, however, does not seem the same, but the percentage of stimulus-increment necessary to produce equal differences of sensation in the three senses of pressure, hearing and sight, are in the ratio of 2.0, 1.0 and 1.24. This practical result is held to give the theory an unusually high degree of probability, and it is furthermore shown that the theory is capable of harmonizing the contradictory results of different observers in a variety of ways. For example, whether the method of mean gradations will give an arithmetical or a geometrical mean, will depend upon whether we attempt to place a sensation in between two others which will seem in absolute value equally distant from each of the other two, or whether we attempt to make the differences of sensation, *i. e.*, the differences of the muscular tensions, alike. In the latter case Weber's law will hold. The law, too, will hold, for the same reason, when the direction of the difference of sensation is perceived, but is not so likely to hold when the bare difference, without a perception of the direction of this difference, is tested.

Interesting and original as this theory is, it cannot be accepted without much experimentation by rigid methods and with due reference to other modes of explanation of the results. It is certainly difficult to conceive that the difference between two pressures or two sounds can be equal in any sense to the differences between the lengths of two lines. What seems to have taken place is this: the weakest and the strongest sensation in each sense were known, as also the number of different sensations in between; the smallest sensation was naturally associated with the shortest length, and the movements of the eyes or the arms having their natural limits, these limits stood for the most intense sensations. The results would then simply show that it is possible to keep in mind these ten sensations or differences of sensation in the disparate spheres of sensation, and make the several intervals or magnitudes correspond roughly each to each. That this power is interesting and worthy of study cannot be doubted, but that it can only be explained by the theory of muscular-tension feelings, or proves this theory, is by no means clear. J. J.

Sur la perception des radiations lumineuses par la peau chez les Protées aveugles des grottes de la Carniole, RAPHAEL DUBOIS. Comptes rendus. T. CX, p. 358, 17 Fév., 1890.

The ocular vision of these creatures is so imperfect that they will run against objects set in their way. They nevertheless perceive the difference between light and darkness, (in part by means of a kind of dermal vision most distinctly marked at certain points about the head and tail), and are profoundly disturbed by the former. In the dark they will remain for a long time in one place, but on being stimulated with a beam of light soon make efforts to escape. This characteristic has been used by Dubois to determine what might be called their reaction-times. In 43 experiments the average time was 11 seconds; in 30, in which the eyes were covered with an opaque mixture, there was reaction in about 24 seconds, except in three cases where there was none at all. With colored lights (produced with colored glass) for which the intensity of the illumination decreased in the order, yellow, blue, red, green, violet, and with the eyes open the following times were found: violet 26 seconds, blue 23, red 16, green 13, yellow 10.5. Where the eyes were covered the results with colored lights were conflicting, probably from too frequent repetitions of the tests. The order of preference of the animals was: black, red, yellow, green, violet, blue, white. The same author has studied the visual ability of the molusk *Pholas dactylus*, see *Comptes rendus.* CIX, pp. 233 and 320.

Experimentelle Studien über den Zeitsinn. MICHAEL EJNER. Inaug. Diss. Dorpat. 1889.

The intervals studied by Ejner were very much larger than those used by most previous experimenters, 0.5, 1, 2, 3, and 4 minutes. The method was that of average error and both forms of it were used: single reproductions, for which the standard is given each time, and multiple or serial reproductions where the standard is only given at the beginning of the series. The time was measured with a stop-watch of some kind, capable of indicating fifths of a second. During the experiments the subject endeavored to keep himself as much as possible in repose. Ejner himself served as a subject for a large part of the experiments, but a certain number were made on others, including three morbid cases: a neurasthenic, and one each in a maniacal and in depressed condition. His results may be summarized as follows: By the method of single reproductions the estimated time was always too short (least so for the interval of two minutes, both relatively and absolutely); by that of serial reproductions it was too long (most so for the interval of two minutes, absolutely but not relatively), except for the longest interval. The average error by the first method is smaller than by the second in about the proportion of 2 to 3. The average error bears an approximately constant relation to the reproduced interval (not the standard); to this extent the requirements of Weber's Law are fulfilled. The average error is reduced by practice; the estimated time is made shorter by fatigue and longer by practice. The estimation of time depends chiefly on the feelings of inner effort such as accompany the straining of attention on the interval and the like, a result not so far from that of Münsterberg (cf. this JOURNAL, Vol. III, p. 130). In the psychopathic cases the time estimates were less accurate. In a few experiments, made by the method of serial reproduction on a normal subject with intervals of 0.5 and 4 minutes, a metronome was allowed to tick at the rate of 200 per minute, or the subject performed a somewhat elaborate process in mental arithmetic. These showed a greater regularity of estimate than before, and the estimated time was shorter, especially for the shorter interval. The author fails to make mention of the work of Stevens (*Mind*, Oct., 1886), who likewise approached the problem by the method of multiple reproduction, though using shorter intervals.

III.—MORBID PSYCHOLOGY.

RECENT DISCUSSIONS ON PSYCHIATRIC CLASSIFICATION AND NOMENCLATURE.

BY WILLIAM NOYES, M. D.

Katatonia. MM. T. SÉGLAS and PH. CHASLIN. Brain, July, 1889. (From Archives de Neurologie.)

Séglas and Chaslin have contributed a valuable critical paper on the history of Katatonia, and have summed up our knowledge of this vexed subject fairly and justly. Kahlbaum's monograph, *Die Katatonie* appeared in 1874, and since then there has been much division of opinion, as to whether he had really described a new disease or only a group of symptoms. Kahlbaum tried to define a form of disease in which certain physical, and particularly muscular symptoms accompany (as in general paresis, and as frequently) certain psychical phenomena, and play a leading part in the whole morbid closely process. This new form of mental derangement may be allied to melancholia attonita, which is ordinarily considered a distinct disease. On careful examination of the latter disease, we can very often, according to Kahlbaum, discover at the onset, epileptiform seizures or other manifestations of spasmodic attacks. These conditions become permanent, attain their greatest development in the *flexibilitas cerea* stage of the mental condition, and merge into the final stage of dementia. These symptoms are by their importance placed in a line with the paralytic phenomena of general paralysis. By their side, and in addition to the usual symptoms of melancholia attonita, we find other physical, and more especially psychical phenomena, notably a particular form of exaltation, which may be termed "*pathetic estasy*," as well as a tendency to speak as if discoursing or to recite, which gives a characteristic physiognomy to the disease. All these symptoms constitute what is called Katatonia, and up to a certain point this form of disease should be considered as a counterpart to certain forms of general paralysis with or without grandiose delusions. Analogous to general paralysis as regards the succession of different psychical phenomena in connection with the muscular symptoms, they seem to differ from it, on the contrary, by the quality of the muscular and psychical manifestations, and consequently a marked difference is to be found in the prognosis. Those who have recorded themselves in favor of the entity of the disease are Hecker, Kiernan, Hammond, Spitzka, Neuendorf, Neisser, and Schüle; while Arndt, Westphal, Tigges, Von Rinecker, and Krafft-Ebing entirely oppose the conception. The first group claim that it is an essential morbid form; the second that the cases classed under that name are only variations of types already known and described. Amongst the characters given as pathognomonic, of chief importance, are placed katatonic phenomena of the most varied nature: the pathetic attitude, stereotyped gestures, verbigeration, marked obstinacy (often systematic), and finally the cyclic course of the disease. Are these katatonic phenomena, as well as others mentioned before, really characteristic of a special form of mental disease? After considering this question with care, and studying the phenomena in degenerative conditions, our authors conclude that katatonic phenomena, taken singly, have nothing to characterize them, for they are found in a multitude of mental affections. Apart from accidental motor disorders, such as spasms or contractions, which one may meet outside mental diseases properly speaking, there are motor disorders which belong specially to insanity, and which can be present in the most varied forms of mental disease, divided by Morselli into states of increased reflex excitability of the muscles (tetany), increased muscular tonicity, (catalepsy,) and states of abnormal distribution of central motor impulses, (such as stiffness at the beginning of a movement). Consequently we may say with Arndt that the insanity of tonicity (*Spannungs-Irresein*) is not a disease, but may develop itself upon the most diverse grounds, and under the most varied conditions; and further considering them only in the cases called Katatonia, their mode of development, course and relations with the other symptoms, have nothing to specify them, and they present no regular characteristics. Other katatonic symptoms, verbigeration, dumbness, stereotyped gestures, pathetic attitudes and systematized resistance, are equally proved not to be specially characteristic of Katatonia; and neither does the course of the disease, called cyclic, offer anything characteristic, for the variable conditions through which the disease passes have nothing regular in their mode of appearing or in their relative positions. The stages in the cycle of Katatonia show nothing but what is known to occur in many other diseases. Kahlbaum himself recognizes "that mental diseases in general, including Katatonia, begin with melancholia, pass into mania, next into *Verwirrtheit*, and finally end in dementia," and in another place he says, "Melancholia attonita, which has been considered until now as a special form of disease, *develops itself primarily in very rare cases;* it pursues in general rather a course of simple melancholia, or a condition of melancholia following mania in such a manner that the melancholia attonita is the third stage of the complete process which terminates in recovery or dementia."

To sum up: Isolated, not one of the symtoms reviewed can by itself characterize a special psychopathic form of disease. Is it otherwise with them when considered *in toto?* In short, in order that a union of symptoms not characteristic in themselves may constitute an essential pathological entity, it is necessary that they possess among themselves close relations with regard to their nature, origin, mode of succession and causation, in such a manner that notwithstanding their inevitable variations, one can always grasp their relations, recognize their connections, and refer them to a defined primitive type, and to a common superior cause. We do see a co-existence in the description of Katatonia, but not an association or a combination of symptoms.

The etiological causes which Kahlbaum gives are perfectly commonplace ones, and such as we may find at the source of all possible forms of mental disease. There are, however, two causes, not mentioned by Kahlbaum, which in the opinion of Séglas and Chaslin might induce a special predisposition and serve to characterize the foundation on which the disease develops itself; these are degeneration in general and the hysterical state. Séglas and Chaslin, from a study of the cases, feel justified in asserting that these factors have been overlooked by the advocates of Katatonia. Finally, they complete their study by saying that Kahlbaum's attempt does not seem to them so far sufficiently justified; and they repeat with regard to Katatonia what has been said of catalepsy, namely, that in the description of this affection, some authors have coupled together facts which, from different points of view, are dissimilar; and that they have rather recorded the history of a symptom, (or better, of a "syndrome,") than of a veritable disease.

If we consider further that from the physical point of view the prominent symptom is the presence of disturbance of the neuro-motor functions, while the principal psychical feature is a more or less acute condition of melancholia, (the other symptoms, progress, etc., presenting nothing special,) the opinion must be formed that for the present Katatonia must be classed under the general group of stupors—simple or symptomatic—of which it may only be a variety more closely connected with a degenerative and more particularly hysteric ground. This conclusion, the authors add, is not an explanation, but it is to their mind the only opinion which can be formulated in the present state of science.

Ueber Heboïdophrenie. DR. KAHLBAUM. Allgem. Zeitsch. f. Psychiat. Bd. XLVI, H. 4, 1889.

Kahlbaum's conception of *Hebephrenia* has been before the psychiatric world since 1870, (Virchow's Archiv, Bd. 52) and after 20 years he now puts forward a claim for a separate position in classification for a second form of the insanity of pubescence, under the name of Heboïdophrenia. Before discussing this second form, it may not be improper to review the position assigned to Hebephrenia by Kahlbaum's fellow alienists.

Krafft-Ebing, (Lehrbuch, 3d Edition, 1888, p. 162) in discussing the Causes of Insanity, gives the influence of the time of life, and concludes his review of the influence of puberty by citing the group of symptoms called hebephrenia by Kahlbaum, and sums up as follows: "The right to put forward hebephrenia as a separate form of disease, seems to me to be questionable," and he quotes Schüle as finding only two cases of pure hebephrenia among 600 patients, while he himself in 3000 found only 8, and in all of these there was hereditary predisposition, original imbecility, and signs of degeneration; two were microcephalic. The only case he cites has the heading "Maniacal insanity in puberty with hebephrenic symptoms."

Schüle (Handbuch, 1886, p. 508) places hebephrenia under Idiocy, of which he makes six types, the last being the type Hebephrenic Imbecility—"the true hebephrenia, the pubetic insanity, as it has been designated by Kahlbaum and Hecker, may find its place here, although it does not always develop on a basis of idiocy, yet in the great majority of cases leads to a persistent imbecility."

Kraepelin, (Psychiatrie, 1889, p. 52,) under general etiology, simply states that one of the frequent clinical pictures of psychical disturbances occurring in youth is described as hebephrenia, "characterized by the change in the superficial emotional conditions; odd, fantastic delusions, eccentric behavior; and the quick passage to dementia."

Arndt, (Lehrbuch der Psychiatrie, 1883, p. 273), referring to Kahlbaum's classification, in which hebephrenia is included, says that while these distinctions may appear to have their foundations, yet they also have their difficulties and have practically no significance.

While all admit, therefore, that Kahlbaum has described a real condition, they would refuse it the dignity of a special place in the classification of mental diseases, claiming that it may more properly find its place in some of the present existing groups. Despite this attitude, however, Kahlbaum proposes to divide the insanity of pubescence still farther, and to make two distinct diseases where he has heretofore claimed only one. Owing to its close relationship to Hebephrenia, he proposes to call the new disease Heboïdophrenia, (on the analogy of *typhus—typhoid*).

Under Heboïdophrenia, or simply heboïd, Kahlbaum understands a psychical disease making its appearance in youth, and of such symptomatic peculiarities that it is covered by none of the forms of mental disease described up to this time.

The following are its peculiarities:—

1. In anomalies of the general behavior; in deviations and anomalies of that complex of mental qualities which make up the psychical individualities of man in his social relations, and which taken together are called his character, personality or temperament.

2. These characteristic peculiarities consist in deviations and anomalies of the instinctive life, and are comprehended in a deficiency or variation from custom and morality, and in extreme cases manifest themselves as criminal tendencies or as criminal acts. Other symptoms, such as a weakening of the intelligence, or on the other hand a high development of this, an extremely genial nature, a diminution or increase of the emotional life, may likewise be present in individual cases, but are not characteristic and may be entirely wanting.

The above symptomatic peculiarities Kahlbaum has already pointed out in the disease entitled by him Hebephrenia, and he has been led to the study of the new disease through a study of Hebephrenia. He would distinguish, therefore, two forms of the insanity of pubescence. In one the attacks are much stormier and lead through different stages eventually, and indeed generally in a short time, after a relatively short course to a decline of mental power; this is hebephrenia proper. The other group has a course that is much less stormy; the patients may indeed show a change of disposition, but they remain in essentially the same condition of mental capacity that is characteristic of their individual endowment, and in general do not pass into confusion or imbecility. To the superficial or casual observer they show much less the stamp of mental disease than of poor education. Differences are also to be noted in other directions. The first cases of hebephrenia are symptomatically comprehensive and severe, the last are narrowly circumscribed, and while the first are to be noted as generally incurable the last may generally be looked on as curable. Since, however, both forms belong closely together, the last form is to a certain extent only a sub-division of the clinical picture of the first. Kahlbaum gives the clinical history of two cases, one at considerable length, but a careful examination fails to show why they might not equally well be included under hebephrenia. Kahlbaum holds it as an important point to note that these patients do not fall into mental decay, and if this had been the case they would have belonged to hebephrenia. But it appears to be an over-refinement to attempt to form a new disease out of cases which present a clinical picture similar to a form already described, but not sinking quite so low in disease, and rallying after a comparatively short time. Spitzka, who admits hebephrenia into his classification, and calls the prognosis on the whole exceedingly unfavorable, takes a more rational view, when he says, (*Insanity*, 1887, p. 177): "Imperfectly developed cases, such in which the disturbance is limited to a slightly strained emotional condition, with a tendency to writing silly and extravagant poetry, and which appear to be merely instances of a pathological intensification or undue prolongation of the ordinary pubescent state, present better prospects." While welcoming therefore every minute clinical study of mental disease, which cannot but help to increase knowledge, those who are struggling with the already over-burdened sub-divisions of classification must regret, as tending to still greater confusion, all attempts at further sub-division, if the cases can be placed under already existing forms, as may easily be done with Kahlbaum's cases of Heboïdophrenia.

Klinische Beiträge zur Melancholie. Prof. E. MENDEL. Allgem. Zeitsch. f. Psychiatrie. Bd. XLVI, H. 4, 1889.

Mendel divides melancholia into three classes. 1. The patients are troubled solely or most strikingly by fear and anxiety regarding the present or future conditions of their own bodies; here the perceptive feelings are almost exclusively concerned; generally there are hallucinations of the muscular feelings, and especially of the organic feelings. This form is almost unanimously called *melancholia hypochondriaca.* 2. The intellectual feelings are especially the ones concerned in the morbid process. The patients say that they have not a single bodily ill; that they should be before a judge and not a physician; that they have sinned against God and their fellow-men. Morbid sesations are present, but play a subordinate part. Here belongs the religious melancholia of the authors. Mendel would call this form *melancholia intellectualis.* 3. Finally, there is a series in which both the perceptive and intellectual feelings are changed by disease, termed by Mendel, *melancholia generalis.* These patients may think that their bodies are destroyed, and all within them destroyed, and that they thereby stand under judgment of God. *Melancholia generalis* usually develops out of primary *melancholia hypochondriaca*, more rarely out of *melancholia intellectualis.*

Melancholia attonita cum stupore is a sub-division of *melancholia generalis* on the conception that *melancholia attonita* is seen to develop itself directly out of intellectual melancholia. Diseased disturbances of the intellectual feelings may be recognized in this condition in many cases through single spoken words or single acts. Here Mendel would promise convalescence with almost certainty. In this form, on the side of the perceptive feelings are important disturbances which are bound up with hallucinations of the muscle feelings, and are the source of the condition of abnormal contractions of the muscles. Experiments in the production of the cataleptic condition in hypnosis point without doubt to the fact that cataleptic stiffness, like the waxy flexibility, is a reflex process from certain muscular feelings.

Analysis of 206 cases of melancholia observed by Mendel gives these results: Hypochondriacal melancholia, 36; intellectual melancholia 116; *melancholia generalis*, 54.

There were 84 men and 122 women as follows:—

MEN.		WOMEN.	
15—20 years	2	10—20 years	10
20—30 "	22	20—30 "	40
30—40 "	16	30—40 "	38
40—50 "	18	40—50 "	16
50—60 "	22	50—60 "	17
60—70 "	4	62 "	1
	84		122

Of the men 8 per cent., and of the woman 2½ per cent. were under 20 years. The disease is especially common between 20 and 30 years of age. In later years it is most frequent in men. Sixty per cent. were hereditarily predisposed, but with no difference as to form. The hypochondriacal form is most favorable for prognosis.

Regarding relapses, there is little given in literature. Krafft-Ebing states that of 100 recoveries, 25 per cent. return to an asylum. Hertz in 67 recoveries from psychoses found 31 relapses (41 per cent.). Mendel found 24 relapses in his 84 men and 46 relapses in 122 women, and is inclined to think that far more than half of those attacked with melancholia have relapses. Relapses are most frequent in the hypochondriacal form, less so in *melancholia generalis*, and proportionately least frequent in the intellectual form. Relapses generally did not occur before three years; rarely after one or two years; and as a rule there was a longer period, 6, 8, 10, 12 years; exceptionally 26 and 34 years. Repeated relapses were observed 4, 5 and 6 times; in the last cases, 5, 10, 20, 26, and 30 years after the first attack, showing that recoveries may occur after repeated attacks. Relapses usually followed the clinical picture of the first attack, the identical delusions even reappearing. One woman recovered, and after 12 years had general paresis.

Opium, especially morphine subcutaneously, was of most benefit in the intellectual form; it was of no use in the hypochondriacal form, and in many cases even produced an aggravation and increase of the melancholic symptoms.

Die Ueberschätzungsideen der Paranoia. Dr. L. SNELL. Allgem. Zeitsch. f. Psych., Bd. XLVI, H. IV, 1889.

Since 1865, psychiatry has been indebted to Snell for his study on the third great group of psychical diseases, in which he advances the conception of *primäre Verrücktheit*, characterized by ideas of persecution founded on hallucinations and diseased sensations, by which, in contradiction to melancholia the self feeling is an exaggerated one. A further essential symptom of this form of disease is the appearance of delusions with the character of over-importance and ideas of grandeur, which may appear from the beginning, but generally only make themselves important later on, and in addition to the delusions of persecution produce a second series of delusional formations. From the vantage-ground of the one who was first to insist on the *primary* nature of these mental disturbances, it is eminently proper that Snell should review the history of the evolution of his conception into the *Paranoia* of to-day, which he accepts, while at the same time he enters a protest against what seems likely to become a growing evil, the tendency to apply the term to acute and curable cases. Misunderstandings have been brought about, he says, by confusing conditions of acute disease with the delusional formations in Paranoia, while he had only in mind the chronic form, and he claims with justice that all attempts to extend very much the notion of Paranoia have resulted in unclearness, so much the more since the definition of this form of disease in itself already presents so much difficulty. The French alienists have always conceded the primary origin of Paranoia, or at least the possibility of this, while on the other hand they have conceived the ideas of grandeur and the ideas of persecution as two different forms of disease. The later treatment of the subject by the Psychiatric Society of Paris shows, however, that the interdependence of these two symptom groups will be more and more recognized in France. The essential feature of Paranoia, according to Snell's researches, is the formation of delusions based on hallucinations, with the characteristics of injury and persecution. This symptom also remains in existence when the delusional formation with the character of over-importance is bound up with it.

The pure delusion of over-importance, without the delusion of persecution, comes forth in many conditions of mental weakness, e. g., sometimes in general paresis, but never in Paranoia. The proportion of ideas of over-importance in Paranoia is a very varied one, and Snell reviews a series of cases of this disease, which indicate the different forms of this proportion, with the following results:—(1) the ideas of over-importance may fail entirely; (2) they may appear from the beginning of the disease at the same time with the ideas of persecution; (3) they may appear the same as in (2), and then retreat for a time, it may be months or years, generally making themselves prominent later in a higher degree; (4) they may appear, as in the ordinary relation, after a longer or shorter time, months or years, added to the ideas of persecution, and continue bound up with these.

This constitutes Snell's idea of the relation of ideas of over-importance to ideas of persecution in Paranoia. It is manifestly one parent disease-stem, from which both spring.

The germ of the over-importance lies in the way and manner in which these patients conceive their imaginary persecutions; while the melancholy patient receives the persecutions which, according to his opinion are imposed on him, humbly and comfortlessly, and holds his own unworthiness and baseness to be the fault of all the misfortunes that he fears, the paranoiac feels throughout that he is the blameless sacrifice to a wicked malice. A paranoiac may commit a murder, and after it appear cold and unmoved at his act, feeling no repentance and no pity. It is the morbidly raised feeling of self, the exaggerated subjectivity which permits him so to feel and behave. The consciousness of disease, present in melancholia, is wholly lacking in paranoia, and every feeling of duty and love is subordinate to the merciless, hard egotism, without limits or bounds. That under such conditions a glorification of the personality of the patient builds itself up, that the delusion lays hold of him, that he is a man of unbounded influence, a prince, an emperor, or a prophet, is in some degree explicable. The whole direction of the disease points to these results of self-importance, if hallucinations indicate the special formation of ideas of grandeur. As Snell has shown in the cases given and elsewhere, Paranoia does not always tread the typical path. It may almost come to a stand still. The delusions and hallucinations lose in these cases their formative power and force on the disposition of the patient. They almost die out. Even if no recovery follows,—recovery in Paranoia, as is well known, is extremely rare,—yet a period of quiet comes on, which for the patient himself and those surrounding him is of the most beneficent effect.

In conclusion, Snell pleads that it is almost necessary to take refuge in this Greek word *Paranoia*, since alienists cannot agree on an appellation for this form of disease, the designations *Wahnsinn* and *Verrücktheit* standing almost diametrically opposed. For the quiet, measured course of Paranoia, in which the formal side of the intellectual activity appears so little changed that the uninformed person notices nothing wrong, *Verrücktheit* appears in a degree insufficient, while the word *Wahnsinn* for those conditions in which the delusion takes a wholly dominant place may be used not without a certain degree of propriety.

Ueber die psychiatrische Nomenclatur "Verrücktheit" und "Wahnsinn."—DR. RODA. Allgem. Zeitsch. f. Psych. Bd. XLVI, H. 4, 1889.

At the yearly session of the Union of German Alienists, June, 1889, Dr. Roda brought up the ever-fruitful subject of the classification of the chronic primary insanities. It would be an incalculable gain if a relative agreement might be brought about as to what "*Wahnsinn*" and "*Verrücktheit*" should individually mean, but there has been no agreement in the past, and does not seem likely to be in the future. Roda reviews the well-known history of the two terms and what they have signified to

Griesinger, Snell, Westphal, Hertz, Nasse, Schäfer, Kraepelin, Meynert, Mendel, Fritsch, Schüle and Krafft-Ebing.

In how confused a state the subject is, Roda shows by citing a case which would be classed by Mendel as *mania hallucinatoria*, by Westphal as acute *primäre Verrcüktheit*, by Krafft-Ebing as hallucinatory Wahnsinn, by Wille as confusion simply, and by Mayser as asthenic delirium, and so on through all the other authors. One can well imagine, says Roda, the state of mind of the beginner in the study of mental diseases in whose hands are placed the best and most commonly used text books.

Roda urges that the expressions "*Verrcüktheit*" and "*Wahnsinn*" be put in the background, and that for them the Greek word *Paranoia* be substituted, and would favor enlarging the boundaries of this word. The problem of chief importance in Psychiatry is how much or how little shall be included in the term *Paranoia*, of which Mendel proposes the following divisions:

1. Acute Paranoia, in which the hypochondriacal, hysterical and original paranoia would be reckoned.
2. Chronic primary Paranoia.
3. Acute hallucinatory Paranoia, in which for example the psychoses from inanition, of Krafft-Ebing, would be reckoned.
4. Cronic hallucinatory paranoia, and finally,
5. Secondary paranoia, the terminal or transformation stage from other psychical diseases.

As the less of two evils, it may perhaps be found necessary to give up paranoia as a special equivalent for *primäre* or *originäre Verrücktheit* and make these but a subdivision of paranoia on some such plan as Mendel suggests, but this can only be settled by future discussion.

IV.—CRIMINOLOGICAL.

By Arthur MacDonald, Ph. D.

In a report prepared by Lombroso for the International Penological Congress is the question whether it will be advisable to organize instruction in penal science. That is, by what means could there be added the positive study of the facts and questions of application, without interfering with the performance of duties, and without prejudice to the administration.

In our own country and Europe, both past and present, science and the university have not only done almost nothing, but have manifested little interest in criminological subjects. They have taken the position of the public that crime is a necessary and incurable evil, and so there is little use in troubling about it. Yet penitentiary and carcerial sciences are the most complicated, and most susceptible to instruction of all other sciences. To construct the most healthy, most economical and best adapted prison cell or workshop is a desideratum. The same is true as to the construction of women's prisons, houses of arrest for accused persons, innocent or guilty, and places for witnesses.

At present our jurists study law books much more than they do criminals; and yet perhaps one half of the time of our courts is confined to criminals. Criminals are considered by many jurists, prison employees and the public, as normal men, who are unlucky and unfortunate. The individual study of the criminal and crime is a necessity, if we are to be protected from ex-convicts, the most costly and the most dangerous class we have. But the criminal cannot be studied without being seen and examined. For the love of science and humanity, we permit the examination of the sick, of pregnant women by young men, manipulation in surgical clinics of fractured members; the visiting, examination and individual study of the insane, although these are sometimes injurious to the insane. But the criminal may not receive visits, may not submit to an anthropometrical examination. Why should criminals be so privileged a class? An accused innocent person may have his name and life, with photograph, published in the newspapers; and yet objections are raised to the study of habitual criminals for scientific purposes.

Benedikt, a specialist in craniology at the University of Vienna, says, that to correct the criminal and protect society, the criminal must be studied scientifically. For this purpose, the universities, higher courts of justice and prisons should have places for instruction and investigation. The importance of scientific criminological study may be illustrated in one of its phases by the work at Elmira. If the system there succeeds in showing how a young man, who is weak, can be best educated physically, mentally and industrially for success in practical life, *a fortiori* will this system be applicable to most young men outside of prison. The pedagogical value of such work is clear. According to Lombroso's idea, criminological instruction should comprehend: (*a*) A theoretical part on law, ordinances and carcerial regulations, kinds of cells, etc.; (*b*) A study of criminal statistics, penal theories, conditional liberation, patronage, etc.; (*c*) Studies in criminal anthropology and psychiatry; (*d*) A wholly practical part, consisting of examination of the places of detention, cells, etc.

In order to understand what the scientific study of a criminal means, we give in detail, a very important table, drawn up by Benelli, Tamburini and Lombroso.

Generalities: Name, age, country, profession, civil state.

1. *Anthropometrical examination*: Development of skeleton, stature, development of muscular system, weight. Color: of skin, hair, iris, uniformly colored, double coloration, peripheral and central, non-uniformly colored, color predominant, color not predominant, beard. Piliferous system. Tatooing. Craniometry: face, height, bizygomatic diameter, facial type, facial index; nose: profile, dimensions, direction, anomalies; teeth: form, dimensions, anomalies; eyes; neck; thorax; lungs; heart; genital organs; disfigurements.

2. *Examination of sensibility:* Touch: electric current, left hand, right hand, tongue; aesthesiometer of Weber: right hand, left hand, tongue. Pain: "algomètre" of Lombroso: left and right hands, tongue. Sensibility: muscular, topographic, thermic, meteorological, magnetic, metallic, hypnotic, hypnotic credulity, visual, acoustic, olfactive, gustative, chromatic, sensual (generative); first sensual relations, aberrations. Anomalies.

3. *Examination of motility*: Voluntary movements: gait, speech, language, writing; reflexes; muscular force; dynamometry; manual skill; anomalies.

4. *Examination of vegetative functions*: Circulation, respiration, thermogeny; digestion; secretions: saliva, urine, sweat.

5. *Psychical examination:* Perception (illusions); ideation (hallucinations); reasoning; will (impulsion); memory; intelligence: works, writings; slang; conscience; sentiments: affective, moral, religious; passions; instincts; sleep; moral sense; habitual expression of physiognomy; psychometry; anomalies.

6. *Anamnestic examination:* Family, parents; state of family; daughters, sons; age of parents; history, diseases, crimes of parents. Precedents: education, instruction, intellectual development, political, diseases, traumatic accidents, crimes, habitual character, occupation preferred. Latest information: last crimes, cause of crime, repentance, admissions, nervous diseases and mental anomalies (inter-current); inquiries.

L'Homme de Génie, par CESARE LOMBROSO, précédé d'une préface de M. Ch. Richet. Paris, 1889. pp. 499.

This work is one of the most interesting, that has appeared on this subject for some time. It is placed under the head of criminology, because indirectly it throws light upon the idea of crime. The insane and the men of genius are outside of common humanity; one is below, the other above common mortals. But at the same time, the great and powerful genius of inventors, discoverers, sowers and creators of ideas is not in accord with irreproachable intellectual health. Certain psychological characteristics are common both to the insane and men of genius.

While no formal line can be drawn between men of genius and men of talent, yet the genius of Dante, Pascal, Shakespeare, Newton, Victor Hugo, Goethe, Leonardo de Vinci, Raphael and Napoleon is beyond question. These men differed from their surroundings, they put forth ideas impossible to men around them; originality is their indispensible characteristic. In this sense the man of genius is abnormal. The genius can find those associations of ideas, which do not appear to others, and in this he is strange and abnormal, an exception. The same is true of the insane; in them the associations of original ideas abound; they are often ridiculous,but always unforeseen and sometimes ingenious; the insane are different from their contemporaries; they are abnormal, exceptions. Nature does not love exceptions, she endeavors to cause them to disappear, she is above all solicitous for the uniformity of the race, she is democratic and leveling. In studying closely the characters of superior men, we rarely miss finding in their mental organism and intellectual processes something defective, morbid, pathological. Great men have fixed ideas, prejudices, moral perversities, constitutional vices, gaps in reasoning, sometimes hallucinations and delirious ideas. Pride, sensibility, moral irritability, fear are some of the affections of soul in them, which sometimes assume an unhealthy exaggeration. Women should never be advised to marry them, because these psychical characteristics reappear with force in their descendents.

In every work of genius we find something spontaneous that baffles the common ideas, either by audacity, or vigor or unforeseenness; long patience can produce something moderate and honorable; but genius produces the immoderate, the extraordinary, the strange. It is exactly this character of strangeness which is found in the thought of the insane. Especially in poets do we find a promptitude, an oddness, a preposterousness of associations of ideas. The insane proceed by puns, by alliterations. In the great inventors as in the poets, the idea is almost always involuntary, sometimes uncouth and surprising. The insane give birth to gorgeous inventions. Rationa men confound great inventions with those of the insane. In fact, great inventors have been ridiculed by the public. Napoleon considered Fulton as insane. The Academy of Sciences at Paris doubted the reality of the telephone; great inventions like the lucubrations of the insane are above our ordinary conceptions. True, the genius has the rapid and strange conception of the insane man; but he has something more that makes his conception fertile, instead of sterile and absurd; he has clearness and expansion.

Most men live in a half-dreamy state, are incapable of seizing the relations of objects around them, are on the surface of things, and faithfully follow their dream. The insane have this intellectual infirmity still more; they live a full dreamy life. Insanity is the outpouring of a dream into real live. Men of genius, having an ardent imagination, separating them from the crowd, have at the same time a great critical sense, which is exercised immediately, and with creative ideation. The mingling of the critical and inventive spirit gives them their power. In the last analysis the genius differs from the insane man, in having not only a single association of ideas, but almost an infinite series of ideas; and, still more important, the vastness of his intelligence permits him to correct the wildness of his imagination. The genius then, is original and abnormal, but has a critical mind. The insane man is original, but lacks the critical spirit. The ordinary man has some critical spirit, but lacks originality.

For example, Don Quixote has large and fertile ideas. He is a great renovator, an ardent soul, enamoured of good and justice. In everything he has astonishing notions, superior to the common opinions of his contemporaries. He conceives quickly, invents associations of strange ideas. He has the invention of discoverers and men of genius. A little more practical spirit, and he would reform humanity. But, alas, he is insane, and truly so, since the faintest trace of critical spirit is wanting in him. He renders no account of real things, he is in the clouds; he takes his imaginations for verities, sees everything through his dream, walks like a somnambulist in common life. He cannot arrive at anything; he is destined to finish in an insane asylum, notwithstanding his efforts, his courage and his power of audacious conceptions. The works of Edgar Poe are full of the fantastic element, invention, original creation, association of extraordinary ideas, which dominate absolutely over the critical side. Poe was somewhat dipsomaniac and even alchoholic. His works are remarkable, nevertheless they resemble the wanderings of a maniac. But how shall there be a defence against the sentiment of horror in associating those who represent the highest manifestations of the human mind with idiots and criminals?

In some late teratological researches of Gegenbauer, it is shown that atavistic regression does not always indicate a real degradation, but is often compensated for by a development in other directions. Apes and quadrupeds possess a larger number of muscles than we; but by losing their advantages we have gained intellectual superiority. Giants pay for their stature by sterility and a relative feebleness of intelligence; so genius expiates its intellectual power through degeneracy and psychosis, and it is for this reason that the signs of degeneracy are more often found in genius than in insanity. But it may be objected that it is not necessary to refute the hypothesis of insanity in genius, because force is not feebleness, health is not disease; and the cases are merely exceptional. The answer is that the physician knows very often, that force in fever, in delirium, in epilepsy is an index of disease. As to the second objection, the facts are sufficiently numerous.

Aristotle says that under the influence of a congestion of the head, there are persons who become poets, prophets and sibyls. Plato affirms, that delirium is not an evil but a great benefaction, when it eminates from the divinity. Democritus makes insanity an essential condition of poetry. Diderot says, "Oh how close the insane and the genius touch; they are imprisoned and enchained; or, statues are raised to them." There is philological evidence in the Hebrew words, *wavi mesugan* and the Sanscrit *nigrata* that the ideas of insanity and prophecy were mingled.

Some of the geniuses who were insane are Southey, Poe, Comte, Swift, Newton and Rousseau; those who led a vagabond life are Heine, Byron, Leopardi, Goldsmith, Musset, Petrarch, Cervantes; those given to alchoholism are, Alexander, Poe, Addison, Goldsmith, Burns, Coleridge, Handel; those morally insane are Sallust, Democritus, Plato, George Sand, Byron, Carlyle; those who were epileptic are Montesquieu, Buffon, Chateaubriand, Napoleon, Peter the Great, Julius Cæsar, Molière, Charles V, Schiller; those with double personalities are Shakespeare, Dryden, Bruno, Renan, Pascal; those with melancholia are Goethe, Leopardi, Molière, Mozart, Chopin, J. S. Mill; those who attempted suicide are Zeno, Aristotle, Lucretius, Rousseau; those who had a mania of greatness are Hegel, (who said: "I can say with Christ not only, that I teach the truth, but I am myself the truth,") and Comte who thought he was the High Priest of humanity. In the words of Aristotle: "*Nullum magnum ingenium sine quadam mixtura dementiæ.*"

The most complete type of insanity in genius is Schopenhauer. He says himself that his intelligence came from his mother, an authoress full of vivacity, but without heart; while his character was transmitted from his father, a banker, misanthropic and bizarre even to *lypémanie.* He was hard of hearing from youth. In spite of changing scenes and voyaging, he lived without gaiety. He often gave vent to his discontentment. The Alps gave him a deep sadness. Owing to his temperament he could not live with his mother. He passed rapidly from profound sadness to excessive joy. He described men as "bread-soup soaked in water with a little arsenic;" and man's egotism as like to that, "which unites a dog to his master." He confessed, that when he composed his great work, he carried himself strangely, and was taken for insane. He had a very distinct apparition, accompanied with a psychical affection, he passed weeks in a state of profound sadness without seeing anyone. From infancy he had the mania of greatness, melancholia and the idea of persecution. He was afraid of a razor; a cup not his own could communicate a contagious disease. He was occupied always with himself "creator of a new system." He said, that men of genius are often like the insane, given to continual agitation. Hearing his landlady talking in an anteroom, he went and shook her so severely as to break her arm.

If it be objected to our author's view, that it is cruel to compare all that we consider highest in the world with insanity or criminality, it may be answered, that we might as well deny beauty to the lily, because it grows in a marsh; as well say, that botanical analysis destroys the fragrance of a plant, or object to classing man among the bipeds, because vultures and other birds are so named. The genesis and evolution of an object does not change the present nature of the object. If man came from the lower animals, it is no dishonor. What man is, is what elevates him, not where he came from. Any analysis of genius, that may show the closest relation to insanity or crime, cannot change genius itself. It might be said, that it is rather to the credit of genius, to come so near insanity, and yet not be it. The question is not a matter of sentiment, but of facts.

We might classify men into geniuses, insane, criminal and normal. We may say, that the genius is more like the insane than any other class of men, and the most divergent from the normal man; that the insane is more unlike the normal man than the criminal is. Considering all the characteristics of the criminal he is the nearest allied to the normal man, but in one characteristic he is the most distant from the normal man; that is, in a feebleness or want of moral sense. As the genius can be a monster of intellectual development, so the criminal can be a monster in immorality. The criminal is the only one, who can be a member of all these classes. Lacernaire, a celebrated criminal, was a genius. Geniuses, who were criminals, are Bacon, Seneca, Rousseau and Donizetti.

Hypnotism and Crime, DR. J. M. CHARCOT. The Forum, April, 1890.

There is comparatively little written on criminal hypnotism. The ideas as set forth by the originator and leader of the Paris school are of all the more interest. Persons susceptible of hypnotization are nervous and capable of becoming hysterical, if not actually so at the beginning of the experiments. Hypnotism and hysteria are near akin. Hypnotism is a genuine neurosis, not a physiological state. There are three states: lethargy, catalepsy and somnambulism; in the first two, particularly in lethargy, there is absolute unconsciousness, the subject is motionless, his will in abeyance, there is no suggestibility. In the third state, the subject hears, sees, receives and carries out suggestions given him by the one who hypnotized him. An important fact is, that on awaking he recollects, outside of the suggestion given him, nothing that has happened during the sleep; but he will recollect it in a second period of hypnotic somnambulism, unless a contradictory suggestion be given. This loss and this recovery of recollection under fixed conditions is important in medico-legal hypnotism.

Rape and attempts at rape are the most frequent crimes upon hypnotized persons. Gilles de la Tourette is able to cite five cases of this class, developed in action at law; not a small number, considering the difficulties of detection. The problem to be solved is this: "Given the suggestibility of a somnambule, can one use him to do a criminal act to which he would never have consented outside of the hypnotic sleep?" Suppose a subject put to sleep, and in the somnambulic state he is told: "You know A; he is a contemptible fellow and is ever trying to injure you. He must be put out of the way. Here is a dagger, to-morrow you will go to his house and stab him. You are not to remember that I ordered you to kill him, even if you be hypnotized again." This can be done in the laboratory.

But some subjects refuse to obey; the training of subjects is not easy, it takes time; and suitable subjects are not numerous. Suppose the subject is already to act, but the victim does not pass, what happens? In most cases a fit of hysteria; or an attack of acute delirium, or of babbling mania. Thus, it is as important that the conditions be realized, as that the suggestion be accepted. Now, no one has been able to discover one single crime of this kind actually committed in real life. A criminal desires first of all to escape punishment; he will not make sure of his revenge and conceal himself from prosecution by putting a weapon in the hand of a lunatic somnambule. Suppose a somnambule signs a check; on awaking he will hardly part with his property without protest. He will ask himself how he came to sign such a paper; an investigation might be embarrasing to the holder of the check. Although the courts will seldom be called upon to consider crimes committed by somnambules or upon somnambules, yet there is danger in another direction, that is, in the injurious effects of ill-advised hypnotizations by persons who are not physicians. We can track a "showman magnetizer" by the persons he succeeded with, who become nervous and irritable; some fall into deep sleep out of which it is difficult to bring them; they are unfitted for duties of daily life. Others, and they are the majority, have convulsions resembling the crises of confirmed hysteria. Hypnotism should be confined to the medical profession. The expert in court has to inquire if the subject has an affection capable of coming from ill-advised hypnotism. He ought not to go beyond the formula: "The individual can (or cannot) be put into the hypnotic state."

Les Suggestions Criminelles, Leçons professées à la Faculté de Nancy, par M. le Professor BERNHEIM. Revue de l'Hypnotisme, 1er Mars, 1890.

This article, written by the leader of the Nancy school, brings out clearly the main point of difference between the two schools. Free will and responsibility are problems that present themselves to us. We are all suggestible in a certain measure; our reason leaves us sometimes; evil thoughts creep into our imagination out of our control; the thought tends to become an act. To what degree can we resist this tendency? Can it not impose upon us the law of ideo-motor or ideo-dynamic automatism, which transforms the idea into action? Can crimes be committed by suggestion? The Nancy school replies affirmatively. Liébeault, Liégeois, Beaunis and Bernheim say that certain somnambulists can under the influence of suggestion, either during sleep, or after wakening, execute with docility what they have been ordered. Numerous experiments should carry conviction.

The Paris school, with Charcot its eminent head, Brouardel and Gilles de la Tourette, reply in the negative. It is said that the crimes we cause to be committed are those of the laboratory; that if we give to a man a paper knife to kill his neighbor with, he knows that the knife is harmless; his confidence in us renders him obedient to the suggestion. This is true in certain cases; the somnambulist knows it is a representation, and plays the comedy which we desire him to play. It is sometimes so in natural dreams; we know that we dream; we dream passively; we endure the most terrifying things, without feeling any emotion; the heart-beat and respiration are not accelerated; we are indifferent to the drama in which we are actors; the individual is as if he had to do with another of his selves; the conscious being is awake by the side of the new being, the sub-conscious. The feeling of our identity is stronger than that of the hallucination, which strikes our sensation without reaching the moral foundation of our being. The same is true of certain hypnotized persons. I say to the subject, the dog will bite you, but he puts his hand upon the dog without the least dread. Other subjects resist suggestions; they retain a certain initiative. I command him to steal a watch, but he refuses; his moral character is a primordial anterior suggestion that neutralizes these other suggestions. But there are others, who have no power of resistance; the sub-conscious in them annihilates their conscious being; these will commit crime. So in natural sleep, we have dreams, in which we are not ourselves; we fall from a precipice, we are terrified, respiration is anxious, the face pale, we groan in our sleep. There are a sufficient number of cases, where crime has been committed during natural somnambulism. Can this not be true in provoked somnambulism?

The author gives the case of a young artist to whom he had suggested to steal his watch, when he should awake; which he did without hesitating; and when discovered, was confused, trembling, imploring them not to arrest him; this latter was a real emotion; the subject was honest by nature. Among somnambulists who act post-hypnotically, there are some who do it as impulsive epileptics. Sometimes the epileptic knows that he kills, but does not know why. The insane sometimes say: "I have a foolish idea to set fire to the house, or kill my child." Why, to what purpose? Do you not love your child? "Yes, I love him, I know it is wrong, I have no reason to kill him." In hypnotism a similar psychical state is realizable; it is a blind instinctive impulsion, without reason; it is an impulsive insanity. There are others who do not act abruptly. The operator said to one during his sleep, "When you awake you will steal my purse on the table." On awaking he did. He was asked, "Why have you stolen?" He answers, "It is to take what you owe me, I lent you some money and you have not returned it, it is a restitution, not a theft." In this case I did not produce a perversion of the moral sense. Imagination turned the difficulty; it suggested to the subject a retroactive illusory memory through which the theft became allowable. To the subject was said: "Here is a pistol and when you awake you will shoot this man." On awaking he does it. I ask him why. He replies, that the man insulted him, had pointed a pistol at him; so he defended himself. Hallucination like imagination furnishes a rational pretext. This hallucination can be created, if auto-suggestion does not interfere. One can say to the patient: "Here is a man who has seduced your wife; when you awake you will avenge your honor and kill him." It would be still easier to suggest crime to those who love it, because there is no moral conscience to reject the suggestion. It is difficult to say, whether a person with a developed moral sense, could be directly so enfeebled or perverted as to commit a crime. But it is certain, that an honest man can, when carried along by an impulsive giddiness, delirious idea or hallucination. The nihilists, anarchists, socialists, revolutionists can become criminals by suggestion. The excited crowd, hearing the word, "spy," "traitor," become ferocious and bloody and rush upon some innocent person. It is a collective suggestion, a blind passion that carries the masses. The brute nature is unchained.

It has been objected, that there is not on record a case of crime committed under the influence of hypnotic suggestion. This is possible; hypnotizers are not generally criminals. But if a hypnotizer was a criminal, he would not tell it to the person he hypnotized, much less to anyone else. The truth is, suggestion plays a rôle in many crimes. There is hypnosis without sleep; suggestion can occur during the waking state; some persons are normally very suggestible; a word can produce in them analgesia, catalepsy, hallucinations, acts; the suggestion is made without their knowledge, and sometimes the suggester is unknown to them.

These ideas find their application: A young lady of good principles, honest and of sweet disposition marries. The first years are happy. A young man gains control of her. Her husband involved in difficulties for subsistence neglects her. Later her husband meditates vengeance against this young man, who, having seduced his wife, established a rival business, which prospered, while his own was in peril. To satisfy his vengeance he gained again the heart of his wife; and persuades her that his rival is the cause of their trouble; and hints that he ought to be killed. Docile and yielding to threats, she arranges a meeting with her lover under the pretext of renewing old friendships. She goes there; she enters the "Madeleine" to pray; then coldly, without emotion, she conducts her lover to her husband, who assassinates him. No regret, no remorse troubles her conscience. Nothing in her antecedents had indicated such monstrous moral perversity. Before the jury, the matron of her "pension" testified to her sweetness of disposition. Another testified she was like soft dough; she went to vice as well as to virtue. Her brain was open to all suggestions.

L'Alcoholismo, sue conseguenze morali e sue cause. Dr. NAPOLEONE COLAJANNI. Catania, 1887, pp. 203.

Alcoholism is most ancient; it has infected barbarous and civilized peoples; it was not a politico-social question. In modern times there is the greatest uncertainty concerning this question. The most fallacious statistical method to resort to is that of averages. For the quantity of wine produced in a country is given without deducting the part exported; and the comparison should be between the production of one year and the crime and suicide of the year following, in which ten twelths is consumed, and not of the same year.

The official statistics of France and Italy indicate that alcoholism, as a direct motive of crime, is very, very limited. Comparing the first year of observation with the last, there is everywhere a perfect parallelism between the increase of alcoholism and that of crime and suicide; but the increase of crime is for the most part apparent, while that of suicide is real, continuous and without numerous oscillations, which characterize the increase of alcoholism and crime. On this account alcoholism increases in the inferior classes; suicide in the cultured classes. A slight increase in consumption of alcohol often corresponds to a large increase in crime, and *vice versa.* The maximum or minimum of alcoholism does not correspond once with the maximum or minimum of crime and suicide. Alcoholic intoxication makes the sentiments of man neither worse nor better; but it lets them loose, it accents them, it reveals them in their naked truth. Well established cases of insane or criminal descendents through alcoholism do not authorize one to generalize this fact. There is wanting between alcoholism, crime and suicide constancy, regularity, and universality of relation, of coincidence and of succession; therefore the relation of cause and effect cannot be established between them, according to the laws of statistics.

Among the more authoritative writers, the opinion prevails, that alcoholic beverages, which are concentrated or of bad quality, injure the physical and moral health; but that the consumption of wine, (the most innocent of alcoholic beverages), day by day and year by year, cannot be shown to be a true and efficient cause of crime. The conditions that favor the increase of alcoholism are physical, economical and psycho-social. Climate is the most important cause of all; is constant and independent of human action.

All physiologists recognize that alcohol increases the circulation, excites the intellectual faculties, and aids and stimulates the action of the digestive organs, and that it produces these beneficial effects in the shortest time, and with the least cost. An inquiry into the conditions that favor or determine alcoholism admits but of one conclusion: that in its morbid conditions, it is a product of the social organization. When this organization is opportune and conformable to equity, it is more beneficial than the influence of climate. The principal remedy for drunkenness is of an economical and social order. We must interest the laborer in organizing his work better; we must favor for each family the possession, first of moveables, and then of a habitation; we must multiply indefinitely artistic distractions and encourage intellectual recreations.

On the whole, this author represents the opinion of Europe as to alcoholism. It seems to us, however, that the question may be somewhat different in America. For one of the most apparent and real differences is the fastness of growth, which has become rooted in the American nature. Thus as a nation we walk, run, travel, eat and drink faster than the Europeans. This drinking fast and often, without eating, and often when not thirsty, together with the unfortunate habit of treating, are conditions in our social organism, which make so much more drunkenness visible. It is also true that a majority of our drunkards are not Americans.

Experiments as to the action of Alcohol on the Brain. J. J. RIDGE. Physician to the London Temperance Hospital. Quarterly Journal of Inebriety, Jan., 1890.

A narcotic cannot become general in use without injuring the race. Any one of the narcotics habitually used so alters the nervous system as to cause uneasy sensations when abstained from. Alcohol is no exception to this rule. Insurance societies are proving what the influence of alcohol on the race is. As to the individual, it has been shown in a former paper that the sense of sight, common sensations and the muscular sense are blunted by alcohol in doses from two to four drachms. Dr. Hughlings Jackson agrees that those powers of mind developed last are the least stable and the first to be paralyzed by alcohol. Dr. Kraepelin in a series of experiments has shown that alcohol prolongs the simple reaction time, and the time for discrimination and decision. While then, the influence of alcohol upon the psychical processes makes them slower, the individual believes them to be much quicker. This illusion shows most rationally the necessity for abstinence. Alcohol, then, injures the capacity for self-control or temperance, which cannot be as great or complete with alcohol as without it.

El Craneo y la Locura. DR. W. RODRINGUEZ. Buenos-Ayres, 1888.

The purpose of the book is to study the relations between the form of the cranium and mental diseases. The results are from the study of 532 cases. These might be questioned, since an apparatus called the conformitor (used by hatters), was employed in obtaining the anterior-posterior and bilateral diameters with the aid of Broca's compass. The form of the cranium is an important element in the diagnosis of insanity. The majority of cases show a striking asymmetry; there is a marked predominance in the lateral posterior regions. In the maniacs the anterior-posterior diameter is greater than the average. In cases of dementia, there is a twisting movement of the head with an exaggerated development of the parietal eminences. There is always a predominance of the frontal lobes in the general paralytics. In idiots and cretins the lines which form the contour of the head are very irregular; there is also an exaggerated development of the occipital protuberance. The author is consulting physician and director of the Argentine Medical Society for nervous diseases. It is interesting to hear what an authority from South America says.

La Contagion du Meurtre, étude anthropologique criminelle. Le Dr. PAUL AUBRY. Paris, 1888. pp. 184.

The phenomenon of morbid psychology, which the author considers, is a combination of suggestion, imitation, heredity and contagion. Contagion may arise from family influence, as in the case of the child raised in crime, who sees his parents profit from it; or it may come from contact with prisoners. If the child goes to the house of correction, the case is no better, as contagion has a hold on him. A good man rarely comes from a criminal family, but a bad man frequently comes from a good family. Reformation from prison life is a myth. Lacenaire, a most celebrated criminal, himself says: when a young man enters prison and hears of the grand exploits of the others, he regrets that he had not been a greater criminal himself. Contagion comes from public executions; those who quit the prison assemble at public executions to see the blood, which for them has special attraction. Out of 177 persons condemned to death only three had not been present at other executions. The indirect contagion of the press is an established fact. In 1885, in Geneva, Switzerland, a woman killed her four children, then tried to commit suicide; in her autobiography were these words, "As a woman did it, which was in the newspaper." Tropman, a celebrated criminal, confessed that the cause of his demoralization, was the reading of novels by which he developed a strong passion for heroes of the prison. If such reading influences a sound mind, its effect on the weak minded and insane is still worse. The reading of the details of crime first produces repulsion, then indifference; soon crime is looked upon with complacency, and after this, overt acts may follow with less difficulty.

There is the contagion to vitriolize or to use the revolver. A woman wishes simply to disfigure some enemy; she has read in the paper how another woman accomplished this and was acquitted with the congratulations of the jury and with public applause, how everyone talked about her, how her picture was in the paper; she finds vitriolizing convenient, and imitates her model. Those who use the pistol are not so contemptible as the vitriolizers, though the results may be more fatal. Poisoning was once the royal and aristocratic mode of disposing of persons, but owing to the advancement of chemical science, it is now comparatively infrequent, and if resorted to, it is generally by the ignorant. In infanticide the mother was accustomed to place her hand over the mouth and nose of the infant, but the newspapers showed the danger of this method; so at present the child is strangled under a pillow or blanket, which leaves no traces. Mutilation and incineration often follow each other. It is natural to assassins to cut a body into pieces, as it is easier to dispose of it.

Epidemic and endemic murder are frequent in great social disorders, as in the French Revolution and the Paris Commune; the sight of blood in a crowd is contagious, excitement follows, then concentration on one idea, which demands victims. War is a neurosis, in which people rise in a mass, it is a contagion that affects all minds, and acute in nature; it is a homicidal insanity. Violation followed by murder is a local epidemic. A band of young men after more or less drinking, meet on an isolated route a woman, it matters not whether old or young; they maltreat and violate her; their wantonness being appeased, it changes into homicidal furor, they urge one another on; they not only kill their victim brutally, but make her suffer.

The author after giving numerous illustrations makes the following general conclusions: The idea of murder is essentially contagious; in order to be manifested, two factors are necessary, (1) heredity or degeneracy, (2) education, by which is understood the action of examples, the description of crime, etc. The prophylaxy of murder rests: 1, in the moralization of customs; 2, in the regulation of the accounts of crimes given by the press; 3, in a more logical severity in the courts; 4, in a more moral and individual hygiene.

Du Dépeçage Criminel. A. LACASSAGNE. Archives de l'Anthropologie Criminelle. Tome troisième, 1888.

The author is one of the most distinguished medical legalists in France. "Dépeçage" (*διὰ-τέμνω*, I cut through), is the act of cutting a body into more or less equal portions. Criminal "dépeçage" is the act of cutting the human body into an indefinite number of fragments for the purpose of disposing of the victim and of rendering his identification more difficult. Sometimes the head, the arms, the limbs and trunk are separated; or they may be reduced to pieces. This method of the assassins has become the style; it is by imitation, made contagious in feeble and hesitating individuals through detailed descriptions by the press. They seek the methods that will make the greatest difficulties for justice. In inquests, care must be taken not to suggest to the guilty machiavelian plans; since their minds are very simple, and too impulsive to carry out combinations. The magistrate or physician should try to think as they do, and always by making the most simple hypothesis.

The advancement made in constituting identity has caused the criminals to take more precautions. Thus an assassin says that if he killed anyone, he would strike him on the head, then he would skin him as a calf, cut off his ears and nose, and take out his eyes so that he could not be recognized, and cut his body into pieces and scatter it here and there.

This form of bestiality is the most genuine mark of the destructive instinct. This is not in obedience to the laws of atavism. But it is because these criminals are as they are, that we call them an arrested type; since the most ancient times, their instincts have remained the same; and since they have few ideas, they are necessarily destined to imitation.

Historical anthropology distinguishes religious "dépeçage" or sacrifice from judicial "dépeçage" or torture. To appease divine anger, children were offered; after victory, the prisoners were sacrificed and eaten. There is a sort of pathological cannibalism as in famines and popular tumults, manifested through a perversion of taste and excitation of destructive instinct. In judicial cannibalism, after sentence, two or three days are given the people to assemble; the party offended has his first choice, and cuts it from the living victim; then follow the others according to their social ranks, and cut according to their preference. In the middle ages crimes against royal persons were punished by quartering the guilty; sometimes the wrists or feet were cut off before execution. In all times criminals or despots have had the cruel fancy of mutilating their victims.

The author presents an instructive table giving the observations of forty cases. The practice most common is where the assassin after the homicide, greatly excited and out of himself, begins at once to section the head, to make sure of death, and to do away with the part most liable to cause recognition; then follow the inferior and superior members. Sometimes fatigued by the struggle and the emotion, the assassin waits till the next day, sleeping soundly during the night.

Dépeçage can be practiced in case of accidental death, by dismemberment for conveniently carrying the body. Some aids in examination are: the teeth, surface of body, length and color of hair, scars, tattooing; wounds by both fire-arms and knife, indicating more than one operation; or some parts well sectioned and others badly; direction of the cuts, showing left or right-handed person; way of tying knots, packing or sewing, indicating a sailor or a woman; way of disarticulation, indicating a cook; bloody hands, direction of the drops of blood, instruments stained, or clothes torn or stained; general disorder in location; rate of putrifaction, especially rapid in those succumbing from great fatigue; if cut soon after death, there is hemorrhage, so putrifaction is slow; but it is rapid if "dépeçage" is long delayed; the flow, coagulation, and infiltration of blood, and separation of the wound leave no doubt. If there are traces of inflammation, or change of color of the ecchymoses, these indicate that the wounds were made during life.

Although the publication of such details provokes imitation, or forces the murderer to improve his methods; yet observations are reunited, compared and commented upon; this is a compensation, and can be utilized by the state.

Le Crime en pays Créoles. Dr. A. CORRE. Paris, 1889. pp. 314.

This book is a sketch in criminal ethnography. It is a natural history of crime; but of distinct races under metropolitan assimilation. The author gives a general insight into the evolution of delinquency and crime among the Creoles inhabiting Martinique, Guadeloupe and Gugane in the Atlantic ocean, and Réunion in the Indian ocean. These contain in all 450,000 inhabitants, of whom one tenth is white. There are the black Creole as distinguished from the black Africans; the white Creoles and the white Europeans, and a mongrel race coming from the union of these.

Criminality here is influenced rather by the social conditions than by racial factors. In the time of slavery the negro, a passive and almost negative being, committed less crime than the white man. At the time of emancipation the blacks gave themselves to abominable acts; the white population was so reduced as to have scarcely any influence on crime. The colored population increased in power as the field of its appetites enlarged. Criminality increased proportionally to the population, however. If social development is a cause of crime, it is also a corrector and reducer of dangerous impulses through the collective education on which it reposes. Emancipation certainly ameliorated the negro. But assimilation makes the number of crimes formidable, for in a rapid evolution the weak and impotent, remaining behind, furnish the largest number of criminals. The negro and white man have distinct physical organizations, and as a result distinct social aptitudes. The most advanced social organization is not comprehended by the negro; extreme liberty without the control of the white man brings him back almost to the ancestral savagery. The negro kills with little or no premeditation; is sure to obey the sexual appetite; is seldom guilty of infanticide or any atrocious suppression of descendents. The negro is very tolerant, has few needs which oblige him to struggle; is contented, if he can be lazy.

The Hindoos are isolated from the Creoles, but not in castes; their offences show a certain degenerative refinement in motive or execution; they will not submit to tyranny of masters; debauch, adultery and jealous rivalries involve them in their worst offences; they learn skill and foresight, and are almost professionals in crime. Creolian and Hindoo criminalities conserve their own ethnic and sociological characteristics. The author concludes this study in criminal ethnography by giving a detailed enumeration of measurements and observations to be made in the anthropological study (properly speaking) of colonial criminality.

De la Criminalité en France et en Italie; étude médico-légale. DR. ALBERT BOURNET. Paris, 1884. pp. 153.

The author is a pupil of Lacassagne. The book is important as treating of the statistical criminology of France and Italy. The following are some of the general conclusions:—

1. In France criminality has more than tripled; this increase is due especially to the modifications of legislation; crimes against the person have varied little, but rather increased than diminished. Corsica, where crimes are still very frequent, is a veritable disturbing element. Crimes against property are diminishing.

2. In Italy crimes of blood are three times more numerous than in France, and murder is six times as frequent.

3. Assassination is on the increase in France, while in Italy it is diminishing; yet it remains twice as frequent as in France.

4. There is a notable diminution in poisonings in both countries, the number being the same in the two countries.

5. Violations and crimes against chastity are infinitely less frequent in Italy. In France these crimes are increasing at a frightful rate, especially among children.

5. In France infanticide is twice as frequent as in Italy; while parricide is twice as frequent in Italy as in France. Abortion is about the same in both countries.

7. In France and Italy the law of antagonism between suicides and crimes of blood is manifest; in France suicide has been constantly increasing, especially in the army, where it has doubled within the last ten years.

Ueber die Körperlichen und geistigen Eigenthümlichkeiten der Verbrecher. DR. V. HÖLDER. Archiv für Anthropologie, Januar, 1889.

The writer gives a short survey of facts taken from his varied and extensive experience as guardian of the insane and administrator of penal justice and prisons. His craniological remarks and his distinctions between insanity and criminality are especially valuable.

Though many characteristics are common to the insane and criminal, one is not justified in doing away with freedom of will; for criminals are not sick, like the insane. It is impossible from cranial asymmetries to conclude as to psychical characteristics. Physical signs of degeneration indicate nothing further than the presence of a tendency to psychical degeneration. It is scarcely a pardonable error to consider every man with these characteristics as a predestined criminal, as some of the Italian school would do (Garofalo).

The great influence of occupation, education, poverty, rough-handling and misery is self-evident. In such cases, where the tendency has a certain intensity, deformations and even physiognomical peculiarities form an important factor in patho-psychical degeneration. The most important of these symptoms are found in the head and genital organs. Most of the characteristics come from the premature growing together of the sutures. The dropsy of the pia mater can enlarge the cranium in all directions, so long as the sutures in childhood are capable of considerable extension; in the later growth of the edges the coronal suture remains an annular transverse depression from rachitis; a further misformation from the same cause is a flattening or deep depression around the occipital fossa. The inferior degrees of asymmetry of the two lateral cranial sides occur without the premature growing together of the sutures. This is mostly hereditary. The tying up of the head, as practiced in the south of France has no influence on psychical development. If several sutures grow together in fœtal life or soon after birth, as in idiots, the form of the cranium is little changed; except it remains microcephalic. If the premature closing of several sutures occurs at the same time; if the height increases at the expense of the width, the head becomes pointed; if the breadth is at the cost of the height, we have a pathological flat head. Premature closing of the frontal suture makes it smaller, low and flat, and causes the orbital arches to project out. The closing of the sagittal suture makes the cranium very long, small and high; both these forms are more frequent in dolichocephaly than in brachycephaly. By the closing of half of the coronal suture, a crooked growth of the cranial roof takes place which in its highest degree produces a kidney-shaped form (plagiocephaly.) The closing of one side of the occipital suture makes the corresponding side flatter than the other.

These misformations are accompanied by those of the face. There is the bird face of the microcephalic heads, and the flattened upper part of the face of the pointed heads; further a high degree of asymmetry of both sides of the face; the bent and flattened nose; so the asymmetry of the orbits; here belong the cases where the under jaw projects beyond the upper; also vice-versa; also the bending of both rows of teeth; the gums are often too flat, too wide and too small; squinting of the eyes, division of the iris; and sometimes skin duplicature in the corners of the eyes reminds one of the mongolian duplicature. The signs of degeneration in the ears are their smallness, great length or want of developed muscles; and very small laps, that grow on.

The deformations of the genital parts have a special diagnostic value, because a part of them in both sexes leads to sexual disorders of every nature, which are causes of mental troubles. The most frequent deformations are: atrophy of the testicles, phimosis, stunted or deformed penis; fissure forms of the urethra, growing together of the penis with the scrotum, hypertrophy of the clitoris, closing of the back part of the vagina. Stunted growth, club foot and corresponding deformations in arms and hands are seen in the skeleton.

The lowest degree of all these deformations are directly connected with individual oscillations within the sphere of normality. Dr. Seiffer from the examination of a large number of criminals found 47 per cent. with at least one of these signs of degeneration; 10 per cent. had cranial and facial anomalies. These deformations are rarely greater in criminals than in normal men, except in criminal idiots or cretins. Physiognomy stands in close relation with facial and cranial signs of degeneration. Habits however have great influence; the passage to prison physiognomy is gradual. In prison garb a face makes quite a different impression. Some criminals change their looks very much. Out of 1022 portraits it was impossible in many cases to pronounce one a criminal from his physiognomy; one will see the features of the insane.

There are two classes of criminals: 1st, criminals by occasion; 2nd, recidivists. The basis of all criminality is irradicable tendency to lying. Men furnish almost six times as many criminals as women; it is easier for men to overstep the bounds of morality and custom. Most women criminals loose every trace of womanhood in demeanor. Criminals by occasion are those who become so through levity, passion, imprudence, unfavorable surroundings and above all through abuse of alcohol. According to Baer 50 per cent. of all crime comes from alcohol; three-fourths are crimes against the person, and only one-fourth against property; while the reverse is true with the recidivists. Minor criminals are to a large extent capable of improvement. To accomplish this, the perversity and exceptionableness of their actions must be recognized. The infanticides are the best of all criminals. The recidivists should be divided into two classes: one class includes those, who for the most part have no mental or bodily signs of degeneration, caused by bad bringing up, society, poverty, sexual disorders; and those who make crime a trade, or as a vengeance for injustice suffered. The improving of these is rare. The second class of recidivists comprises those with inborn criminal inclinations. In prison they are inclined to coarseness, boldness, resistance and willful spoiling of their clothes; they may be regarded as in the first stage of insanity. But legally the recidivists are sharply distinguished from the insane. Delusions disorder the judgments of the insane, but not so in the case of the recidivist. Thieves, swindlers and incendiaries, if not insane, are cowards; robbers and murderers are little affected by fear. Between mental health and insanity there are many cases of hereditary anomalies: nervousness, irritability through the least cause, peculiar unconquerable inclinations, eccentricities, propensity to dissolute ideas with no purpose, a mingling of contradictory peculiarities, of one sided mental powers—this all, united with a weakness of deliberation; here belongs also the inborn criminal instinct. According to Richter, most crimes, especially murder, audacious burglary, common theft, embezzlement, resistance of state power, come by epileptics, or in those with a tendency to epilepsy. Those addicted to alchohol are light offenders. Those with hereditary mental weakness are given to crimes of unchastity.

The class of recidivists is a mixed one: (1) Those who have a positive tendency to insanity or epilepsy; (2) Those whose family antecedents plainly lead them to crime; (3) Those whose morality and sense of honor are destroyed through training and environment.

Criminal phenomena and manifestations of insanity are a distorted or diseased expression of mental activities, which by themselves are present in everyone; but in some they develop in one or the other direction. No one is sure that his mental soundness cannot be endangered through outer or inner troubles; or that he can escape inclinations, which might lead to crime. The increase of crime keeps step with that of population, or rather, with its increase in density, as in large cities. The increase of both insanity and criminality is due to over-population.

Indeterminate Sentence and Conditional Liberation. Z. R. BROCKWAY. Proceedings of National Prison Association of United States, for 1887.

One of the best and most successful methods in criminal prophylaxy is at Elmira, N. Y., under the charge of Mr. Z. R. Brockway, a leader and innovator in prison discipline. We give the following to illustrate some points in the method. The true idea of the indeterminate sentence includes all classes of prisoners in custody without any maximum or minimum term. Thus applied, it includes conditional release and the marking system, which are inseparable. The indeterminate sentence substitutes in the mind of the prisoner, and in the public mind (more important) the idea of correction instead of punishment. But penal treatment is not abolished. Prison discipline is rather intensified. Punishment does not make a man a safe citizen; pain is soon forgotten. When one sees that his conduct is an expression of soul-defect, making him unsafe to his fellow-men, he gets a rational confidence and is likely to get on better than if restrained by fear.

The indeterminate sentence contributes to the idea of certainty as opposed to severity; certainty and celerity of trial, conviction and cure are beneficial both in case of the criminal and the public. Another advantage is in placing the responsibility of determining the date of the prisoner's release upon the warden, who should know his prisoners best. It changes the attitude of keeper to convict; the prisoner desires to convince the warden that he is fit to go out; he tries many crooked ways, but eventually realizes his time is wasted; at this point reformation begins; the prisoner's next step is an honest effort to get out in the way the warden marks out for him. The prisoner is released at the best time, since, having earned his promotion, he is hopeful and encouraged. After his release he is surrounded with the strength of legal liability, beneficial to habitual criminals, and indispensable to criminals by occasion. In a reformatory system, the indeterminate sentence gives the strongest and almost the only true motive that influences one to conduct, cultivate and prepare himself properly for free life. Some of the methods at Elmira Reformatory will illustrate this. The prisoners, on entering, are brought one by one to the warden, who says: "How long have you been in the Tombs, my boy, and who came to see you there?" "Mother." "How did you feel to see your mother come out of a respectable home to see her son a felon?" Generally here, if a man has emotion, he shows it. The men are gathered in a group; the warden says: "Well, how long are you going to stay?" Some snicker and laugh. "You can stay five years; you ten," etc. They do not mind it; one year is as a thousand. "Say your mother is sixty; in twenty years she will be eighty, if she is here. Five years—five Fourth-of-Julys." They sober up; they begin to realize it. "Any man can get out in a year, if he is fit to go. Now, do this little thing, and be very careful not to neglect it; otherwise you get a 'chocolate' (offence), and one chocolate report means, you have lost a month." This process involves a perfect record every month in demeanor, labor and school. A man comes with weak will-power; falls month after month. The warden says, put him in a higher grade; five straight months of the best conduct, which means "rationalistic regeneration." On leaving, a position is found him; the employer knows all about him. The prisoner must correspond with the warden each month, with the certificate of his employer. At the end of six months, if he is all right, he goes scott free. If he breaks his parole, he is brought in again. They all obtain positions. Results: We correspond with all of the 2,000 men we have sent out. For 874 men we have the account for each year. We received 76 in 1880, 9 not reformed; 99 in 1881, 10 not good; 85 in 1882, 9 not good; 109 in 1883, 13 went wrong; 121 in 1884, 19 went wrong; 86 in 1887, 3 went wrong.

When the prisoner is readjusted, reformation in the state sense is accomplished. Scientific reformation is based on physical culture and labor in a way that approaches as near as possible the natural relation of labor outside of prison. The prisoner has what he earns and pays for what he gets, supplemented by a complete course of scholastic education.

Individual System. WARDEN CASSIDY. Proceedings of National Prison Association of the United States, for 1884.

Prison labor and free labor are precisely the same thing. The public account system is the only one the state has a right to employ. In the contract system everything is for the interest of the contractor. Prisoners should not be transported if they are near their families or relations, who can come to see them, as this is helpful. In the Pennsylvania system there are no hospitals; each man is treated in his own room. We have tried the piece-price plan. It works as far as the prison and prisoners are concerned. When a prisoner leaves us he is not known, so his chance for employment is as good as anyone's. The reconvictions at the Pennsylvania prison are not over 25 per cent. for men discharged from the prison; but is as high as 50 per cent. for men who had been in other prisons.

The individual system is the least expensive in the end. There is less reason for punishments, as the prisoners are alone and easily managed. It does not promote lunacy, as sometimes asserted. There is a persistent opposition to this system in the United States, due to political partizanship. All changes tend towards individualization. First, herding is abandoned, and grading introduced; the further step is separation. No two persons are alike; many who come to prison are no worse than the men in the community where they live. They should not be compelled to associate with people who damage them; who would blackmail them afterwards by means of their knowledge of them.

Prison Punishment. WARDEN BRUSH. Proceedings of Nat. Prison Assoc., 1884–85.

The dark cell tends to brutalize and injure the intellect. Some prisoners care nothing about dark-cell punishment. Handcuffing men and standing them around the cell is the best method. If this does not work, we raise the man off his feet a little, which makes him yield. A man should be told that nobody desires to punish him, but the discipline of the prison must be upheld. The whip takes away the convict's manhood. In whipping, one loses the sympathy of the inmates; you must have them upon your side.

Contribuzioni allo Studio delle anomalie del pterion nel cranio umano, ricerche di anatomia. DRS. F. MARIMO e L. GAMBARA. Archivio per l'Antropologia e la Etnologia. Firenze, 1889.

The anomalous data of the wormian bones of the pterion are found in almost all races, and prevail in the inferior races. As to the greater frequency of these bones in criminals as compared with normal men, Lombroso finds 16 per cent. in normal men, 23 per cent. in criminals, and 18 per cent. in the insane. Out of 114 craniums these authors found 28 with this anomaly (24 per cent.). The wormian bones of the pterion are more frequently united to each other in criminals than in normal men; according to Lombroso, 59 per cent. in criminals, and 68 per cent. in the insane, and 28 per cent. in normal men. These authors find the anomaly in prisoners 71 per cent. The presence of the wormian bones in the pterion is associated with the occipital median fossa; in normal men 4 per cent., in criminals 16 per cent., in savages 26 per cent., in the insane 14 per cent., in monomaniacs 16 per cent., according to Lombroso. The authors find that, in connection with the greater frequency of the pterion bones in criminals, there are other defects or arrests of development, and that this coincidence occurs more frequently in criminals. One thing that gives especial value to these results is, that the authors had access to a number of Italian museums.

Ueber ein Universal-Kraniometer zur Reform des kraniometrischen Methodik. DR. AREL v. TÖRÖK, Professor der Anthropologie, Budapest. Leipzig, 1888. pp. 135.

A universal method for measuring craniums is certainly a desideratum for the criminologist, since the results of one method are often incomparable with the results of another. The author says that there is no craniometrical work which treats in systematic connection the single problems of craniometry, which are taken up by different authors and on different occasions. Craniometrical technics is under such suspicion, that the most elementary questions cannot be solved without difficulties. To carry out a unified and systematic analysis from the different standpoints would fail, even if one had all the instruments and apparatus in use, because the instruments have been constructed for a special end, and therefore only a special result can be reached. The purpose of the author is not only to make a systematic investigation of the problems of craniometry up to the present time, but also to consider a whole series of problems which have hitherto been inaccessible on account of the craniometrical methods employed. There are those who allow their national spirit to control their scientific spirit, and those who treat the ideas of craniologists as naïve. There is no essential difference between the French and German systems, scientifically considered; one is as good as the other. The results of study on the cranium should be brought into more certain connection with the head of the living man. The German horizontal plane has great practical value, because it can be employed upon the cranium, and at the same time upon the head of the living man. The French horizontal plane is valuable, since, of all horizontal planes, it possesses the greatest stability with the plane of the orbital axes. But the assumption of the one plane does not necessarily exclude the other, as the "Frankfurter Vereinbarung" publicly declares.

Owing to the great complexity in the form of the cranium, and to the fact that the different racial craniums in many of their morphological variations can only be distinguished by the value of a differential, it is evident that the craniometrical characteristic of a racial cranium cannot be given by means of the single profile-angle and by the carrying out of the few (30) prescribed linear measurements. The two principal craniometrical problems are asymmetry and correlation. By making practical use of both the French and German systems, with the addition of a few new measurements, a large number of linear and angular measurements are given.

As the author gives that which is essential to all previous craniometrical methods, the work is valuable for any independent worker. His practical conclusion is, that one-sided craniometrical eclecticism must be abandoned, and the universal craniometer employed.

Der Schädel des Raubmörders Schimak. PROF. DR. MORIZ BENEDIKT. Medizinische Jahrbucher, v. Heft. Wien, 1888.

The author describes the cranium of a robber who had committed murder. It has interest, as being a very full description, by means of an apparatus of precision for measuring craniums, and further, on account of the individual. It is a small cranium; its development from behind forward decreases, so that the forehead is the least developed; it is very asymmetrical; the development of the hemispheres is inferior to that of the mass-development. From the above facts it follows that Schimak's cranium is of a high degree of inferiority.

Cervelli di Delinquenti (superficii metopica); recherche di anatomia. PROF. L. TENCHINI. Parma, 1885. pp. 118.

The writer gives the results of investigations on the frontal convolutions and fissures of 32 brains from the prison of Parma. His conclusions do not accord with those of Benedikt, according to which the first and second convolutions should be doubled, but are in harmony with those of Flesh, Giacomini and Rüdinger. Yet cerebral anomalies are more frequent and varied in criminals than in normal men. The ascendent frontal convolution appears on the surface better defined in its outlines, and more independent of adjacent convolutions. There are four examples of supernumerary convolutions, but only one offers the characteristic anomaly. The author gives a carefully arranged and detailed table, showing the age, stature, weight, crime, along with the cerebral anatomical peculiarities.

It seems to us that while there is not exact agreement between Tenchini and Benedikt, the results of the former are not a strong argument against a cerebral criminal type, since comparatively so few brains of criminals have been studied.

Anatomische Studien an Verbrecher-Gehirnen, für Anthropologen, Mediciner, Juristen und Psychologen. MORIZ BENEDIKT. Wien, 1879. pp. 151.

That man thinks, feels, wills and acts according to the anatomical foundation and physiological development of his brain was a doctrine of faith among the ancients. Owing to the meagre development of anatomy and physiology, this doctrine remained latent for many generations, until the founding of cranioscopy by Blumenbach, and the impetus which Gaul brought to the study of the brain. In spite of all contradictions in detail, the ancient faith doctrine has been more and more strengthened by the results of modern investigations. It is desirable to inquire if the study of criminals' brains will not strengthen still more this faith.

The want of power to resist criminal acts, and the want of feeling the wrong, together with having a clear knowledge of it at the same time, are the two main psychological characteristics of criminals. This defect in moral feeling and willing can be concealed by a superior psychical organization and ability, latent or through complication with insanity. The following facts show defects in the brains of criminals: a defective development of bridges, and thereby an excessive development of fissures; these are found throughout the whole brain. A priori, this would be expected, because otherwise the tendency to defective acts would have been compensated for by other parts of the brain. Criminals are not analogous to monomaniacs, but their actions follow from their whole psychical organization, and in their special manifestation are the product of social conditions. The details of the following results will probably be found to unite with those in epileptics, insane, and in members of encephalo-pathological families. The physiological-psychological value of single facts is not known.

That an atypical and defective brain can function normally, is out of the question. What we do not know is, why such a brain functions this way and not that; and why, under certain psychological conditions, it functions just in this way. From the detailed examination of 19 criminals' brains, two things are established: 1. A type of the confluence of fissures. 2. That those 19 brains belong to this type.

The chief characteristic of this type is, that if we regard the fissures as rivers, floating bodies can pass into almost all the other fissures; also bridges are wanting, which means the lack of important brain substance. The three important fissures of the outer surface, that is, the central fissure, the third frontal fissure and a portion of the interparietal fissure, show a great tendency to unite with the Sylvian fissure, so that we have not only an anterior and posterior rising branch, but also three other branches. Since the third frontal and interparietal fissures tend further to lengthen upwards towards the superior median border, there frequently arise three central parallel fissures, of which the third frontal one appears pre-central, and the interparietal fissure as post or retrocentral. The last formation does not arise through lengthening, but by a flowing together, and partly of fissures that are scarcely seen in the normal brain. In the frontal region, the one or the other frontal fissure is united with this central fissure. In some of the brains the inferior fissure becomes long and deep; this cuts often into the superior part of the anterior central convolution, and participates in the formation of the precentral fissure. Thus we have four frontal convolutions, as is the case in the beasts of prey (cat, fox). It is true that a large number of fissures is a sign of development, where a new typical fissure appears; but around fissures where no new development takes place, and especially where the union of the different typical fissures takes place, a large number of fissures means a defect, through the failure of bridges.

The second type was in embryo. Rüdinger has shown that brachy and dolicocephalic brains manifested their characteristics in the fœtal life. It would be important if comparative brain anatomy could show the prevalence of this second type in the lower races. It may be said that there is no fissure idea in the architecture of the animal's brain that may not be seen in the human brain. Since five races are represented in the brains examined, and the deviations from the normal brain are so similar in each, we may conclude that the brains of criminals show variations from the normal type, and the criminals are an anthropological variety or species, at least of the civilized races. This investigation is on the a priori assumption that the criminal is abnormal, but the abnormity is not a disease but a predisposition to it. After a somewhat detailed criticism of Broca's work, the author comes to the question whether from the atypical relations of the cranium one can make any conclusion as to the atypical form of the brain. In the normal brain and cranium the bregma is 4.5 cm. in front of the fissure of Rolando, and the intersection of the sagittal and lambda sutures in the highest point of the perpendicular fissure. The question is, does this relation exist between the atypical cranium and brain? As yet there is no answer. Yet a parallelism between cranium and brain can be assumed, but not a definite correspondence. The results of this investigation, the author thinks, may call forth objections from the side of ethics. He says: "We will not appeal to the facts of empirical criminal psychology, nor to the premises of the psychology of nature, which support our position. Kant's antinomies place freedom and necessity as justified, and at the same time contradictory; these antinomies, however, are the end and purpose of knowledge, and not its premises. One can hold that psychical freedom is only the expression of the psychical realm, but that all psychical antecedents are the expression of certain natural laws, and so one can swear allegiance to an absolute psychical freedom. Kant freed humanity from metaphysical intolerance, but it did not enter into its inheritance; but this generation is entering into a metaphysical neutrality as regards the question of free will."

In closing, the author emphasizes the fact that to correct the criminal and protect society, the criminal must be studied scientifically; hence there should be in universities and higher courts of justice and in prisons, places for instruction and investigation.

Ueber die Beziehungen der Schädellehre zur Physiologie, Psychiatrie und Ethnologie. Dr. Rieger. Würzburg, 1882.

In describing the different points of view in craniology, the writer says, that ethnology is concerned strictly with morphological craniology, enquiring how far cranial forms can serve as race characteristics. Psychiatry has more complicated questions as to the relation between cranium and brain, and between cranial abnormalities and psychical conditions. Here physiological as well as morphological questions must be touched upon. Ethnology assigns too much importance to the cranium and psychiatry too little. Bordier finds that none of his 35 craniums of criminals were microcephalic, while Lombroso finds that criminals are microcephalic and brachycephalic. The idea of a criminal type is to be ridiculed, and atavistic ideas are a swindle. The only case in which the coincidence of cranial anomaly and psychical defect is without exception is the higher degree of microcephalia. Craniology is a pure mechanical science. Psychology has as little to do with craniology as with brain cells.

In answer to the author we can say that, as far as our knowledge goes, brain cells are an absolute condition to every act of thinking.

Psychologie naturelle, étude sur les facultés intellectuelles et morales dans leur état normal et dans leurs manifestations anomales chez les aliénés et chez les criminels. PROSPER DESPINE. Paris, 1868, (3 vols.)

This is an epoch-making book in criminal psychology, and though not a late work, is full of valuable information. Vol. 1 takes up normal psychology; Vols. 2 and 3, abnormal psychology.

The author defines psychology as the science of the mental faculties, and of their diverse manifestations; psychology should not depart from the study of nature; all metaphysical questions must be set aside, since they do not come from observation. There are two species of psychical faculties, the intellectual and the moral. The intellectual are perception, memory and reflection. The moral faculties are instinctive. The moral sense is the only one of the instinctive faculties which is not only moved by an egotistical motive, but by the idea of duty and obligation, and this in spite of the pain it causes.

The author believes in freedom of will, when the feeling of duty enters in; but in case of simple desire there is no freedom. Freedom of will, or moral liberty, is the power which decides between the good and the evil after a deliberation made clear by the sentiment of duty. Much emphasis is put upon this point. Criminal psychology is treated somewhat extensively, taking up especially parricides, homicides, infanticides, suicides; incendiaries, thieves, prostitutes; prisons, death penalty and prevention. The author, although a spiritualist or idealist, confines himself to the facts of natural science. Insanity is the involuntary blindness of the mind by the passions, which inspire false ideas; but its essence is the absence of moral opposition, of reason, and of light, clarifying the mind.

Most of the facts, taken from the account of criminal processes in the "Gazette des tribunaux" from 1825 to 1868, lead the author to hold that the great malefactors are deprived of the noble sentiments of humanity, especially of the moral sense, and so are not responsible. This is shown, first, by the absence of moral reprobation before the crime, and second, by absence of remorse after the crime. Perversity, which gives the idea and desire for crime and moral insensibility, including the absence of elevated moral sentiments, are the two conditions necessary to the commission of crime.

On account of the grave moral anomaly of the great criminals, punishments are not suitable; but moral treatment is required. The purposes of this treatment are: to cease to punish cruelly the moral insane or criminals, for it renders them worse; and to ameliorate them as much as possible, that they may not be returned to society unless they are capable of conducting themselves well. It is an honor to humanity that the moral laws are not seriously violated by crime, for these laws are not in the consciousness of criminals. The author concludes his whole work in saying that the psychological ideas set forth do not touch in the least the eternal principles of morality and justice which God has placed in human hearts. According to these principles, individuals deprived of free will should not be punished, but treated morally; individuals, who possess free will, and who at the same time freely commit faults should be punished, in spite of their sincere regret, for these punishments are merited.

The State of Prisons and of Child-Saving Institutions in the Civilized World. E. C. WINES, D. D. Cambridge, Mass. 1880. pp. 719.

This work is the result of eighteen years of study and observation. It contains a large number of facts that can be trusted, as they are taken either from official communications of various governments, or from specialists. By far the larger portion of the work is given to the history of criminology in all civilized countries, which gives it additional value. As to prevention and repression of crime three problems present themselves: (1) how to educate all children of the state; (2), how to save destitute, harmless, neglected and vicious children from a first fall, and if fallen to rescue them from a criminal career; (3), how to bring adult criminals into a better condition during imprisonment. There are always a number of children, who are not reached by public instruction; their destitution, vagrant life, depraved habits forbid their reception; they are brought up to crime and continually supply criminals. Such children should be reached by the infant nursery, kindergarten, orphan asylum, industrial schools, etc. These institutions should be multiplied and aided by the state. The state should assume the control of children under fourteen, who are without proper guardianship.

Preventive institutions should be for vagrant and deserted children; reformatory institutions for all children declared not responsible by the courts. The bases for reformatory prison discipline are hope and sociability. The first stage of imprisonment should be penal, to show the prisoner that the way of the transgressor is hard. The second stage should have inducements to industry, obedience, shortening of sentence, increased earnings, improved dress and dietary; lifting of restraint, enlargement of privilege, anticipatory of the idea of liberty. Maconochie says, "only in society can man be trained for society." But promiscuous and unchecked intercourse must be prohibited. The wills of prisoner and keeper must be in accord. There must be tests of reformation; the passage from imprisonment to freedom should be gradual; the latter part of the imprisonment should be as near as possible to ordinary life. The indefinite sentence assumes the principle of the diminution of crime by the reformation of the criminal. The definite sentence gives freedom to dangerous persons.

Religion is of prime importance, because most potent in action on heart and life; it calms the restless irritation of vice, which saps the moral forces in criminals with strong impulses. Education affords a substitute for vicious ideas and amusements. The benefits of regular labor are self-evident. The state should aid discharged prisoners in finding employment. Innocent persons suspected and arrested should be paid for their loss. Habitual drunkards should be confined in asylums or reformatories only, and held under mild treatment until there is reasonable assurance of reformation. The general conclusions are: to lessen crime by reforming the prisoner; to prohibit political interference and consequent instability in prison administration, and to train prison officers for their work.

Female Life in Prison, F.W. ROBINSON. London, (4th. edition revised). pp. 384.

The book is a faithful transcript of authentic details, putting into shape the utterances of one who was a prison matron. There are women in prison mourning over petty thefts; and murderesses defiant, cheerful and even light-hearted. It is the humble officers in the prison who know the true character of the prisoners, as they are constantly with them. The directors, governors and chaplains are misled every week in the year. The chief reason for writing this book is to give the true character of the prisoners, as seen by those in constant companionship with them. The details of the whole prison life are brought out, giving an insight into this life as it is.

V.—HEREDITY AND SEX.

JULIUS NELSON, PH. D.

In the previous section (this JOURNAL, III, 97–114) we found that not only did the problem of heredity involve psychic or metaphysical elements, but that a rational explanation of the facts of heredity is possible if such psychic powers are assumed to lie at the foundation of the whole matter. The reactions of living protoplasm to the stimuli of the environment are most easily understood, or at least designated, if we use terms familiar to the student of purely mental phenomena, such as, "association" of ideas, "memory," "education," etc.

Reproductive cells are to be considered as similar to the protozoa, but with a more complicated education, their offspring knowing how to associate themselves into the form of an organism, in which each cell, while inheriting all the knowledge of its parent, finds itself choosing a specific occupation, determined by conditions of which we are as yet ignorant. In this statement possibly lies a harmonization of the Kölliker and the Weismann views. The cytoplasm is undoubtedly differentiated, but it does not follow that the idioplasm is so also, although the training this idioplasm receives becomes more and more special as development proceeds. *Reproduction in its widest sense* is nearly equivalent to nutrition, and consists in the multiplication of idioplasm molecules, that is, the growth of protoplasm, by which ordinary food particles become organized, related, and subservient to the forms of motion peculiar to the specific kind of protoplasm, whatever it may be. *Actual cell reproduction* is a secondary adaptation resulting from the limitations of nutrition, and dependent ultimately upon assimilation. *Ordinary reproduction*, as we know it, is the multiplication of the individual organism, and is a tertiary acquirement. It follows that the problem of heredity in its widest sense involves that of assimilation as its physical side. This use of the term heredity includes all that lies at the basis of biology and psychology.

But so far, the idea of sexuality is not necessarily involved in the theory of heredity, and it must be admitted that a careful study of the evolution of sex in the lower forms of life shows that sex is an acquired characteristic, useful for certain purposes, such, for example, as the securing of variation. The fundamental fact of sex is the uniting of idioplasms, usually accomplished by the fusion of cells produced in two different organisms. These cells are mostly unlike, as is often the case also with the cell-producing individuals; and our idea of sex is attached to this third differentiation. But sometimes both kinds of cells are produced by one individual, which is then hermaphrodite or "bisexual." But there is here no double individuality, the hermaphodite being as singly an individual as any animal, and properly has no sex whatever.

Students of heredity are familiar with the idea of the character of one sex lying "latent" in, or "transmitted" by, the opposite sex. A little thought will show that this phenomenon is exactly the same as that above noted, when we supposed all the cells of the body to have the same idioplasm, but only special portions of the cell knowledge ever to come to application or development. The idioplasm in each cell of a male of a species does not differ materially from that in the cells of the corresponding female, but is "hermaphroditic," to use an abused and misunderstood term. In a similar way the idioplasm of a nutritive zooid of a hydroid colony is similar to that of a defensive or of a reproductive zooid.

Just as everything in biology may be considered as growing out of assimilation by differentiation of primitive methods and organs for securing nutrition, so everything in psychology has likewise been evolved out of the psychic forces that we may suppose needful to secure a primitive act of assimilation, all the while remembering that the psychological side of the fact is the deeper or more significant. An elaboration of these two sciences along the lines of natural development as thus indicated remains to be made, and for biology can fairly be said to have begun.

In this introduction we have merely suggested certain general foundations upon which the facts brought out in the following reviews may rest in a related manner. The facts will be treated in the following order: First, the sexual phenomenon among the protozoa and the relation of these to the phenomenon of fertilization are considered, to show that sex is a secondary specialization. We next inquire how such secondary differentiation is brought about and as to our ability to control the production of the sexes. Then follows a consideration of the significance of menstruation, leading us naturally into the larger field of physiological and psychological periodicity. Next we take up the subject of ecstasy and of the perversions of the sexual instinct. Then the field offered by anthropological and social facts is outlined, including mythological phenomena. Finally we conclude with pedagogical, hygienic, and other practical aspects of the question, especially family life.

For a consideration of sex among the unicellular animals, consult the following works: *Significance of Sex*, Nelson, Amer. Naturalist, Jan., Feb., Mar., 1887, (noted in the first section of our review). *La vie psychique des micro-organismes*, Binet (noted in first section). *L'instinct sexuel chez l'homme et chez les animaux*, Tillier (noted below). The general facts are presented by the second and third of these authors; the first presents special facts to prove that "sex" as it is ordinarily understood cannot apply to the cells, but only to the gametaphores or the higher organisms. But the author further shows that the fundamental thing which caused the development of sex is the union of idioplasms of diverse experience, but of similar morphological or hereditary education; and this union, he thinks, is not only illustrated by conjugation of cells, but also by the phenomena of karyokinesis which precedes the division or multiplication of cells. The author does not wish it to be understood that he dogmatically denies the existence of a true "sexual" (in a broad sense of the word) differentiation of protoplasmic gemmules (plastidules), but that the facts, so far as we have them, are explicable on a simpler assumption.

Almost all unicellular organisms that are not parasites, exhibit at times the phenomenon termed *conjugation*, *i. e.*, two cells melt together to form one, in a manner very different from what happens when one cell eats another. With some of the ciliated infusoria the cells are united only temporarily while a mutual interchange of nuclear material takes place. In all cases a new cell nucleus is formed, consisting of material from two different cells. With the vorticellas the nucleus buds off microspores that become the fertilizing elements of some other macrospore, and then (itself having become a macrospore) is fertilized by a microspore from some other individual which is preferably not in the same colony with itself. Here it looks as if there were two sorts of protoplasm, the ordinary vorticella being hermaphrodite; but in other cases the entire cell splits up into microspores, or into macrospores; and in still other cases there is no difference in size or appearance between the conjugating cells. What happens in the case of vorticella is clearly an adaptation useful to a sessile condition. The difference between a macrospore and a microspore is seen to be mainly in the amount of cytoplasm present; the nuclei in the majority of cases are equal. This difference may be readily accounted for when we reflect that the microspore must be a swimming organism, and must find the macrospore, largely by chance, in a large volume of water, hence a great number of microspores must be produced.

In the case of the metazoa conjugation is always secured by the fertilization of a macrospore (ovum) by a microspore (spermatozoon). When the former is utilized as a storehouse for nutriment (yolk or deuteroplasm) for the developing embryo, the size (as in the case of the hen's egg) becomes relatively enormous, but the amounts of idioplasm that unite are approximately equal, and represent in each case all the characters of the species, including those that are peculiar to each sex. That conjugation is not an absolutely necessary occurrence is shown by the fact that if it is prevented the egg often develops as if it had occurred, and in many instances parthenogenesis is normal, as in the plant lice; and furthermore, in some of the lowest plants, where the embryo is very simple and does not require the large store of deuteroplasm, even spermatic parthenogenesis occurs, especially in the case of microspores of the algæ.

Thus we are excluded from the hypothesis that there are two sorts of protoplasm, the union of which, is needful for life. But what is the significance of conjugation (or fertilization)? Evidently the idioplasms of the two cells have had different experiences. The chances are that many cells have "gone to the ground" while this experience has been acquired, and that if each cell before conjugation had to encounter the trials the other has surmounted, it might succumb. How easy to unite the two experiences and enlarge the life. "Two heads are wiser than one," is the law even among the protozoa. Hermaphroditism is usual with sessile organisms like mollusks and barancles; and is understood to be an adaptation to a fixed condition, mutual fertilization being advantageous. When the ova are fertilized while yet in the body and the spermatozoa are conveyed to them the production of a smaller number of fertilizing cells is required. A further advance is possible by substituting for a large yolk, the uterine gestation of the embryo. These advances cause the acquirement of special organs that become the external signs of sexual differentiation, both psychological and physiological. To apply the idea of sex to the cells is misleading. Even the human embryo is hermaphrodite (properly non-sexed), and rudiments of the organs of the opposite sex are present in all animals. In cases of monstrosities these rudiments suffer more or less of development as may be seen by consulting "*L'hermaphrodisme*" by Debierre.

If sex is caused by secondarily acting extraneous forces, it becomes an important inquiry to investigate what such forces are, and how they act. This has been done in the most able manner by the following author.

Die Regulierung des Geschlechtsverhältnisses bei Vermehrung der Menschen, Tiere und Pflanzen. DÜSING. Jena, 1884, pp. 364.

There appears to be a fixed ratio between the number of male and female births which in many instances approaches equality. For man this ratio is 106 boys to 100 girls. What circumstances cause this ratio to vary? The reproductive organs are very sensitive to variations in the amount of food, and it is of advantage to a species to accommodate the number of offspring to the supply of food available. The number of offspring depends primarily on the number of females, hence there must exist an association between the tendency to the production of ova and the fact of increased food supply if any regulation of this sort is present. Facts show that such is the case. In general terms the law may be stated thus: good nutrition and moderate exercise of the reproductive organs produces a tendency to the production of females, while poor nutrition and excessive exercise of these organs produces a tendency to the production of males. The eggs of the queen bee receiving an accession of strength through fertilization develop into females. During development a special feeding of the larva produces a complete female or queen; a poorer feeding produces incomplete females or workers. The development of males only from unfertilized eggs is known as *arrenotoky*. In the more ordinary forms of parthenogenesis exhibited by plant lice the production of males drops out altogether, and unfertilized eggs produce females only, this is known as *thelytoky;* and it arises through the easy conditions of nutrition brought about by a parasitic life. Parasites are remarkably fertile in eggs, and usually, also, parthenogenetic, *i. e.*, reproduce by *agamogenesis*. (Sexual reproduction is termed *gamogenesis*). The male has been termed the "hunger generation," arising either exclusively or in increased numbers when the conditions of life become hard. This may explain the excessive mortality of male infants both before and after delivery. The male embryo is a higher development than the female and requires better conditions, yet paradoxically, is produced under unfavorable conditions. In gamogenesis we have two degrees: favorable conditions producing females and unfavorable ones males; but gamogenesis itself arises under relatively unfavorable conditions, while parthenogenesis on the one hand, or simple cell multiplication (resulting in growth in multicellular animals and asexual reproduction in protozoa) on the other, arises under the most favorable conditions. Thus it results that in animals that multiply exclusively by gamogenesis, as does man, that plethora produces sterility, and the change merely from an animal to a vegetable diet has cured it. The poor have large families. It would be interesting to group the working classes into the "comfortable" and the "very poor," and compare the sexual ratio. It may almost confidently be predicted that the male excess will be greater and the number of children per marriage less with the very poor than with the moderately poor. In a general way increased nutrition tends to increase reproduction at the same time that it favors female births. Temperature affects reproduction by acting on nutrition, less energy for maintaining the body temperature being required in high temperatures. Haycraft has shown that a rise of 1° effects a rise of five per cent. in the births. The yearly curve of the birth rate is highest in summer and lowest in winter, the maximum and minimum points are at the beginning of these seasons (as respects the climate, not astronomical seasons), in June and October respectively. A series of curves for a long succession of years representing the variations in the harvests, the marriages, the births, the living births, the ratio of girls to boys (and inversely of boys to girls) are all parallel. There is always a rise in the male births after a war.

Another phase of the same fact is known as "Thury's law," which is, that *young reproductive cells tend to produce the same sex, and old ones to produce the opposite*, *e. g.*, if animals are paired so that the male is in the beginning of heat and the female is near the close of heat, the forces from both parents tend towards male offspring. The "Hofaker-Sadler law" is still another phase of this same principle (that delayed conception of the female tends towards male offspring), applied to the relative ages of the parents, as based on statistics of the age of the wife at the time of the first child, compared with the age of the husband, *e. g.*, the wife older than the husband, or relatively old when married, tends to produce male offspring.

Düsing would regroup the statistics and modify the form of the law as follows: Each sex at the time of its highest reproductive vigor tends to produce the opposite; and variations in both directions, either younger or older, are unfavorable to reproductive activity. First-births are excessively boys, due to the relatively higher continence of the female. The strength of crossing, as compared with in-breeding, is favorable to the production of females. This explains why the excess of boys is greater in the country than in cities. The variety of conditions of life acts in a manner similar to the effects of crossing, while the monotony of country life co-operates with the scarcity of new blood toward the opposite effect. Legitimate children are to a greater extent males than illegitimate ones. This is explained by the fact that marriage tends to obliterate differences between the partners. The very hereditary principle or idioplasm of the female is so profoundly assimilated to that of the male, that the children by a second husband partake of the characteristics of the first, a law well known to stock breeders. This is a fact that no theory of heredity has yet tried to explain.

Here we are tempted into a digression. If the character may be modified by circumstances, so that conditions of life may replace crossing, as when an organism transplanted to new countries multiplies (often asexually) with extreme vigor, may it not be well to investigate what effect associations of the parent may have upon the character of the child. The whole subject of the effect of the life activities of the mother on, not alone the nutrition of the child, but upon its idioplasm, is as legitimate an inquiry as the effect of such conditions on the ovum before or during fertilization. Neither inquiry has as yet been handled with sufficient scientific skill to warrant positive statements. The belief that the imagination of the mother may mark her child in a definite manner, is universally held by unscientific people, or such as are not informed of the results of scientific investigation in this direction; but these experiments (like Galton's experiments to disprove pangenesis) are too meagre, and of simply negative nature. The subject is one so complex, that a renewed investigation with enlarged methods is required. The questions here raised suggest a connection with telepathy or sympathetic psychic response—a subject not yet properly investigated by either friend or foe—as do also the phenomena of sexual attraction.

Returning to Düsing from this digression—the most powerful factors determining sex are those acting on the reproductive cells, but it frequently happens that the algebraic summation of these leaves the ovum so near equilibrium that subsequent forces acting on the embryo determine the sex. Hence the reason of the prolonged hermaphroditism of the embryo, that all the forces may be summated. It is found that twins are generally of the same sex, because of the similarity of the nutritive conditions. *Multiparæ* are a general evidence of vigor, and hence show an excess of girls for twins, but for numbers higher than triplets the nutrition of each embryo is correspondingly limited, and here a great excess of boys occurs. In thelytoky, where the approach of winter causes males to appear, as *e. g.*, in *Cladocera*, the males appear gradually, and some are hermaphrodite. Sometimes insects are found in which different sectors of the body are of different sex. This may be explained by opposing tendencies of the idioplasms of the parents, (one tending toward female, the other toward male production), and an incomplete mixture of the two in fertilization, so that the first plane of segmentation (which has been shown by Rauber to furnish the two ancestors of the cells of the right and left sides of the body respectively), has distributed the two idioplasms unequally. This unequal distribution may be seen even when the sexual tendency is harmonious, whenever the peculiarities of the parents appear separated in different portions of the body. One force cannot be regulative, but the interaction of many forces tending in opposite directions is needful to hold the balance near the position of numerical equality. These forces act upon the race. In a given instance, it would be impossible to predict what the result will be, owing to our ignorance of the value of the forces that have been operating, (just as the table of vital statistics can show how many persons are to die during a fixed period, but cannot point out the individuals). There are plenty of theorists who have tried to teach how sexes could be produced at will, among which consult,

Die willkürliche Hervorbringung des Geschlechts bei Menschen und Hausthieren. JANKE. Berlin, 1889. pp. 579.

This work is a synopsis of various theories of sex. About 400 pages are introductory to the main thesis, and about 100 pages are devoted to notes supplementary to the introductory matter, which treats of the history of sex and heredity theories from Aristotle down. Then follows an historical section on fertilization and causes of sterility, sections on menstruation, the how, when and where of fertilization, followed by sections on artificial fertilization, stirpicultural and other social developments connected with the relation of the sexes. Further sections on the origin, regulation and differentiation of sex lead to the main thesis, which is, that the mother's influence is represented by male offspring and the father's by female, and *that the more finely nervous organization overcomes the more plethoric and determines the sex.* This is almost the identical conclusion advocated by Starkweather in his work on the *Law of Sex*, in which typical couples are taken and the sex of their offspring predicted. The weakness in this work lies in the method of treating the temperament. So many factors are taken into consideration, that the data presented by any family whatever can easily be made to substantiate the theory; but when we try to apply the theory in special cases, we necessarily meet serious difficulties in the many positive and many negative quantities, each of unknown value, to be considered. Fiquet, Hanssen, Lehndorf, the Talmud, and others agree with the above mentioned authors in believing that sex alternates, and that the stronger of the two factors prevails in the determination; but Düsing has shown that the facts that favor such views are really the outcome of the general laws of sex with reference to nutritive states. If the tendency to alternation could be proved, it would account in a simple manner for the numerical equality of the sexes. A thorough acquaintance with biological facts gives precedence to the principles enumerated by Düsing, and such alternation would itself ultimately rest upon alternations of the nutritive conditions. A census should be taken of the order of the sexes in births, to ascertain if a tendency to alternation exists. Nearly all the facts adduced by the thousand and one theorists in support of various fantastic views are assimilable with the Düsing principles, as for example, the following: artificial fertilization produces males; female slaves produce an excess of females; the longer the pause between births the greater the number of female births; tropical peoples bear more females (this, too, with a desire for males so strong that female infanticide is practiced); the parent of strongest passion (reflex action of vigorous sexual elements) determines the opposite sex. Criminals (who are of strong nature) beget daughters in excess; second marriages produce boys in excess, etc. Some thinkers, like Retzius, affirm sex of the different organs of the body, the endoderm being female, the ectoderm male. Others, like Heincke, go further, and affirm that the right side of the body is male and the left female, so that the union of spermatozoa from the right testicle with ova from the right ovary produces males. Stockton-Hough (*The Laws of the Transmission of Resemblance from Parents to Children*, N. Y. Medical Record, August, 1873) believes in an alternation of the sexes due to the effect of the preceding child in its influence upon the development of the subsequent child. Other authors have held an alternate action of the two sides of the body; but cases of ovariotomy have failed to substantiate their views. Millot and Roth believe that sex is determined by the relative positions of husband and wife during sleep; the magnetism of the right side of the male, acting on the left side of the female, produces females. But the number of ridiculous theories is nearly endless, and we stop here. Connected with these theories are formulæ for making the children resemble either parent. These have been stated in a most complex manner by Girou, but are too lengthy for presentation. The gist of them lies in his view that the internal organization is most often transmitted to the same sex, the external to the opposite, and heredity plays a great rôle; if a father resembles his mother, his daughter will resemble him, etc. This subject, like the rest, has received a good deal of attention from theorists, but the entire matter is confused and contradictory, both with facts and with itself in any one author, and becomes chaotic when different writers are compared. This part of the subject awaits scientific investigation.

On the physiology of menstruation, consult, besides Janke,

Physiologie der Zeugung. GRÜNHAGEN. Leipzig, 1883.

This author presents in a condensed form what is known through various investigations upon the subject of ovo- and spermatogenesis, menstruation, methods of reproduction, etc., etc. Concerning the simpler phenomena of ovogenesis, there is considerable agreement, but hundreds of investigations have been directed toward the solution of certain problems connected with spermatogenesis. We may roughly recognize the following schools: (1) Those who, like Biondi, believe that only one sort of cells exists in the testicular epithelial layer, and that the large cells near the wall of the follicle bud off nuclear bodies, each of which, by karyokinetic division, finally produces a group of cells from which the spermatozoa arise by direct metamorphosis. These cells or *spermatoblasts* are arranged in a column whose base embraces the perennial mother-cell. (2) Those who think the basal cell is the female part of the original germ-cell, and will be thrown off. (3) Those who think the basal cell is a distinct kind of cell with which the spermatozoa produced outside it have secondarily conjugated for nutritive purposes. (4) Those who believe these cells are only supporting elements, furnishing a sort of spongy net within the meshes of which the spermatozoa are held until discharged. It is the first two schools whose difference is of radical interest, though it may be mentioned that Balbiani thinks the "yolk nucleus" sometimes seen in eggs represents an epithelial (male) cell from the mother which has fertilized the egg, and that a similar fertilization of female protoplasm from the father takes place in spermatogenesis. But we pass on to the main subject, and refer mainly to Tillier's work.[1] In animals there are definite seasons when the reproductive activities are at their height, the physiological state being known as "heat" or "rut." This period has been established in connection with nutrition and climatic conditions favorable to the rearing of the young. These periods usually occur at the same time in the two sexes. Both undergo the profoundest physiological and psychological changes, everything seeming to subserve reproduction. (On many of these points, cf. Darwin). When we turn to man, do we find anything comparable? At the period of puberty, the human youth of both sexes develop special characters that have a reproductive significance, but these characteristics are practically permanent. In the female, however, there is a monthly rhythm supposed to be comparable to that in animals. The medical dictum now is that menstruation is ovulation, or marks the successive completions of maturations of ova and the bursting of a Graafian follicle, setting free the ovum. The ovum is received by the Fallopian tubes and carried to the uterus by the action of cilia. Meanwhile the spermatozoa, if present, swim actively against the ciliary

[1] For title see below.

current, and meet the egg either at the surface of the ovaries or in the tube, or at times only in the uterus. The point of meeting determines the relative ages of the two elements, and is supposed to be of significance in determining the sex of the product. The egg, when fertilized, is an independent being that becomes parasitic upon the uterine walls, causing the neighboring cells to proliferate and grow around it, and successively to develop the placenta. This effect of the egg upon the tissues is exerted upon other organs, as seen in abdominal pregnancy, and is in itself a very remarkable phenomenon, which can be understood only when the general principles of parasitism as exhibited throughout nature are understood. Fertilization has other effects, such as may be felt by the mother, but its first evident effect is the suppression of the menses. How is this accomplished? Menstruation is the periodic congestion of the uterus and ovaries, succeeding a gradual hypertrophy of the uterine walls and ending by a sloughing away of the extra growth. What is the significance of this? Theory alone gives its uncertain answer to both questions. We know but few facts in addition to the above enumerated ones. We know that conceptions are most frequent just immediately succeeding the flow. Pflüger thinks the old mucosa has been taken away to prepare a fresh surface for the attachment of the egg. But cases of conception at any portion of the period are known, and if such occur just before a flow, the flow is still suppressed. Lowenthal's view is that the length of the period is fixed by the length of time an egg may remain unimpregnated in the uterus before it dies. The egg, on this theory, is supposed to fixate itself before fertilization and to cause the mucosa proliferation (just as if fertilized), but when fertilization is delayed until the egg dies, an abortion takes place which is menstruation. Then the uterine congestion affecting the ovaries causes a new follicle to burst, and the experiment is repeated. Similarly Flesch holds menstruation to be a washing away of an egg too old for fertilization. Cases are known of menstruation continuing after complete removal of both ovaries, which fact seems fatal to this ingenious theory. To be sure, the menses, like other sexual characters, have become established because of the presence and development of the ovaries. (See PALLEN, "*Philosophy of Menstruation, Conception and Sterility*," in Dr. Serguis's series of American Clinical Lectures, Vol. III, No. 3, N. Y., 1877). Once established, there seems to be a sort of independence in the activity of both organs which usually coincide in their periods; such is the view of Beigel and Reinstadter, but Foekkistow thinks the fact that ripe follicles have been found in the intermenstrual period, shows that ovulation is not periodical but continuous. Carpenter advocates the view that the egg does not reach the uterus to be fertilized until a week or more after the cessation of the flow, and hence the Levitical prohibition of coitus until after this time. On the other hand, Loewenhardt thinks the egg leaves the follicle before menstruation; and the independence of ovulation from menstruation is shown, according to Winckel, by the occurrence of ripe follicles in females who have never menstruated. Sappey has shown that at three years of age the ovaries are furnished with their complete stock of eggs (nearly a million), and Morgagni relates a case of a babe four months old which menstruated. Cases of continuous menstruation as well as continuous lactation are known. Nursing usually stops menstruation, and if excessive, may cause atrophy of the ovaries; or if suddenly stopped, causes ovarian inflammation. The reflex connection of the breasts and reproductive organs is also testified in other ways. Excessive continence, as well as excessive venery, causes a cessation of the menses, accompanied by sterility. Fertility is related to the vigor of menstruation, but not in an absolute manner. Conceptions of non-menstruating women are known, but cessation of menses, of fertility and of ovulation occur simultaneously at the change of life (See Tilt in first section). This is about the extent of our knowledge, but no theory has satisfactorily combined these facts into a harmonious whole. Cases of male menstruation are known; the reviewer has given reason for believing in the presence of a monthly rhythm that affects all the psychic as well as biological activities of both sexes. (*A Study of Dreams.* This JOURNAL, vol. i, 1888. pp. 387 *et seq.*).

Let us look a little further into the subject of periodicity, which is so closely related to or dependent upon the presence of the reproductive organs. First consult:

Periodische Psychosen. KIRN. Stuttgart, 1875.

Esquirol has formulated the laws of periodicity in disease : disease may be 1st, intermittent due to the cylic development of parasites; or 2nd, due to definitely recurring causes, or 3rd, as related with menstrual periods, or 4th, due to other diseases themselves due to periodic conditions, and 5th, due to no assignable cause. The length of the periods may be very variable from hours to days or weeks or months or even years. The length of the relation of the depressed, the normal and the exalted portions of the periods of cyclical insanity may be various and may change progressively during the run of the affection. Certain general observations may be made. Periodic diseases, (mental diseases, or those in which psychic symptoms are very prominent, form the largest class of periodic diseases), develop usually during the adolescent stage of human development and are common again at the climacteric; more than half of the cases are accompanied by sexual exaltation or by a desire for stimulants. Cases often show an alternation of melancholy and mania separated by clear intervals. Such cases are graphically represented by a curve rising and falling successively through a normal level. A typical case of cyclic or circular psychosis presented a normal interval of some months followed by melancholy that turned to mania with a couple of days clear interval separating the two states, at the same time the sense of double personality was intense in both conditions of abnormality. The periods themselves may be grouped; several fall close together and then follows a long free interval succeeded by another group of waves. Small waves may be found superimposed upon the larger ones. Finally cases are considered in which each wave begins with either exaltation or depression and ends with the same phase, the opposite condition forming the middle of the wave. These cases are united with disease of the reproductive organs and occur in connection with the menstrual period. Krafft-Ebing refers the sexual trouble to a neurosis; but Kirn reminds us that this neurosis was stimulated by the periodic ovulation causing a wave of cerebral hyperæmia. One case showed that the brain congestion was due to a periodic swelling of the thyroid, pressing the jugular veins.

Ein Beitrag zur Lehre vom menstrualen Irresein. BARTEL. Inaug. Dissert. Berlin, 1887.

After noting that one-third of the cases of female insanity are traceable to menstrual disturbances this author classifies cases of periodic disease into those whose period coincides with the menstrual month, and those that do not. The first-class has two sub-divisions, those truly insane and those nervously disturbed without real mental alienation. The brochure is in the main a detailed study of a single case.

An able handling of the subject is seen in the next work.

Ueber die Gesetze des periodischen Irreseins. KOSTER. Bonn, 1882.

The moon is from 47 to 55 thousand miles nearer the earth in perigee than in apogee and exerts a correspondingly greater effect ($\frac{1}{6}$) upon the state of the earth (magnetic and gravitational). The time of completing a revolution about the earth is called an *anomalistic period* and varies from 25 to 29 days, average 27½ days. The moon's phases form the *synodic period* of a little more than 29 days. (The anomalistic period is the same as that called a physiological month, of four weeks or 28 days, by the reviewer, in the article on dreams noted above.) Koster takes the week of 7 days as the anomalistic number and using it as a divisor ascertained the fact that nearly all periods observed in periodic diseases, no matter of what length, are compounded of various multiples of this number of days. It is unfortunate that the number is so small, because a variation of only three days is sufficient to nullify the generalization. The reviewer has hinted in the article on dreams that the periods may vary, being shortened and lengthened by different causes; this swing of a monthly period may be as great as seven days, *i. e.*, menstruation in place of coming on the 28th day may be delayed as much as a week. Such variations are probably present in the majority of cases cited by Koster and explain the following statistics. Out of 942 waves recorded, 129 coincide with the anomalistic period, 335 fall one day out of the way (exacerbations beginning at night often recorded next day); 306 fall two days out and 172 fall three days out. An inspection of Koster's tables shows that in the main the anomalistic law governs, but from the nature of the case the method of summation presented in the statistics as just recorded, is hardly a fair showing for the theory and does not weigh much in favor of the real facts. Koster has failed to realize that these periods are not related to the astronomical facts as the tides are, but are independent associations obscured by many secondary reactions of living matter. Darwin has sought to account for the menstrual period by the effect of the tides upon our distant aquatic ancestors, but there is no need of going so far away. The effect of the moon's phases and also of sabbatical observance acting through the mind upon the body, or else as favoring certain sexual activities is sufficient in itself to account for the existence of the period. That meteorological conditions act on the body is not denied, but they are in no sense to be taken as producing inevitable effects. Association can over rule a purely physical effect upon the body. There are marked diurnal waves of fever exacerbation and of the temperature in normal cases as from 7-10 A. M. and 3-6 P. M., but here also are great individual variations. The time of perigee or apogee is recognized as peculiarly critical especially in mental diseases. Dr. Solviette has called attention (from seven years observation) to the parallel variations of the earth's magnetism and of psychic disturbance. The spirits of some people rise and fall with the state of the barometer and it is said that bees indicate a coming storm even more certainly than that instrument. Suicides are most frequent near the summer solstice, (compare the curve indicating the reproductive activities). Observations of the same data are needed for the southern hemisphere to show whether this is an effect of heat or of the relative distance of the sun, but we may venture to prophesy that the position of the sun will be found of no importance except as it affects temperature. The eleven year periodicity of the sun spots is known to affect the earth's magnetism and its climate. A study of the movements of civilization is needed to ascertain to what extent this period is represented in biology. Another period is presented by the alternation of quadrature and syzygy of sun and moon with our planet. Here is a field for considerable statistical study.

At this point we may conveniently consider:

Zusammenhang der Geschlechtskrankheiten mit nervösen Leiden und die Castration bei Neurosen. HEGAR. Stuttgart, 1885.

Castration does not always eradicate sexual feelings. Neuroses that begin with puberty are related to the periods in some definite way either occurring during menstruation or in the interval or else during pregnancy only, and are dependent upon the sympathy between all the organs of the body as excited by the pathological changes occurring in the reproductive organs. Pressure upon the ovaries can produce or can stop convulsions. Here we may refer the reader to certain aspects of hypnotism and the so called "hypnogenic zones." Dr. McKenzie has shown that nasal disease is dependent on genital irritation. The deductions are plain, viz.: that the reproductive organs are in nervous connection with various parts of the body, and hypnotism which has received much light from comparison with the phenomena of normal sleep, ought also to be viewed from the sexual standpoint. The school of hypnotists (Nancy) that interprets the phenomena as forms of true sleep, also state that men are as susceptible as women. The belief of the mesmerists that women are the more susceptible may in part be explained by their methods, which in many instances lead to scandal. In this connection we may naturally consider the subject of ecstacy.

Ekstasen des Menschen. MANTEGAZZA. Jena, 1888, pp. 461.

Ecstasy is defined as a worship, a giving up of the will to the dominance of an emotion; but that emotion should be of an elevating sort. Examples are: the different sorts of love and friendship, patriotism, self-sacrifice, religious vision, contemplation and prayer; esthetic raptures in relation to music, color, symmetry, etc; the intellectual ecstasies, as displayed in eloquence, action, pursuit of truth, science or philosophy, and in mental creation. The ecstasies of animals are connected with sexual reproduction; the love songs and love bowers may also be referred to. Among children is found the ecstasy of play and motion which may be termed "muscle drunkenness." Home sickness, joy, love of solitude or of society are brought under the categories of ecstasies. Friendship is a "Luxusgefühl." Love is a necessity growing out of the union of parts needful to form a complete man. The soul is sexed as well as the body, and soul union may be felt in which the slightest bodily contact (even a kiss) would be felt to be earthly. The work is poetic and beautiful as a literary production, but hardly as valuable as his anthropological studies. The same author's "Hygiene der Liebe" and "Physiologie der Liebe" are not the equals of the "Ekstasen," neither from a scientific nor from a literary standpoint. The effects of ecstasy when excessive are injurious to health. Among abnormal ecstasies is to be classed that artificially produced, which in its lowest phases is presented as alcoholism, morphinism, etc.

These phenomena have important bearings on many of the problems of sex which we cannot now stop to point out. The craving for stimulants has very evident analogies with the impulses accompanying perversions of the sexual instinct, of which a word:

As in its normal development love between the sexes is the most charming and universally attractive of human emotions, so in its perversions it is the most disgusting and repellant. The abnormalities have received a certain amount of attention from alienists, but the amount of information as to normal action which the study of these states can yet furnish is insufficient to justify a detailed consideration of them here. Those desiring to pursue the subject further may be referred to the following:

De l'inversion de l'instinct sexuel. CHEVALIER. Paris, 1885.

Die krankhaften Erscheinungen des Geschlechtssinnes. TARNOWSKI. Berlin, 1886.

Physiologie de l'amour. GLEY.

Le fétichisme dans l'amour. BINET. In his Études psychologie expérimentale. Paris, 1888.

Psychopathia sexualis. KRAFFT-EBING. Stuttgart, 1887.

The chief points of interest to psychology may be very briefly summarized. These pathological cases show that the emotion normally felt toward an individual of opposite sex may suffer change in its whole character, or may be transferred (together with the feeling of shame and the whole complex of associated feelings) to an individual of the same sex, to a lower animal or even to inanimate objects, including corpses, and be felt with reference to such things alone. Cases of all degrees between the normal and these remarkable extremes are found. In many cases it seems as if sufficient knowledge at the start might have prevented their development. These conditions arise through anatomical lesions or defects, through disease (especially disease or breaking down of the central nervous system), by congenital tendency and by direct acquirement. Some have speculated that the mind is sexed and may be of opposite sex from the body. Others look to the principle of atavism, similar things being wide spread in the customs of lower races, and having had parallel even among the more cultured people of antiquity. The efforts of the mediæval church for the eradication of lust by the separation of the sexes in convents and monasteries frequently resulted only in its transformation. The work of Krafft-Ebing is at present the most complete upon the subject, bringing in the anthropological as well as the pathological aspects of the question. Binet finds a latent possibility of these perversions in normal people, in that they tend to give exaggerated importance to subordinate matters, which in his term is "fetishism." Cases of perversion are rare with savages, and, he believes, occur chiefly with those persons who allow imagination to replace a sensation by an image, a process allied to the tendency to abstraction. We now turn to a consideration of the anthropological side of the subject.

L'instinct sexuel chez l'homme et chez les animaux. TILLIER. Paris, 1889. pp. 300.

The author introduces the subject with this thought:

The organs of the body have reference to two great ends, one the preservation of the individual, the other the preservation of the species. The latter is the more important function, the former being subordinated to this end. Then follow chapters on the origin of sex, fertilization, the reproductive instinct, the sexual instinct, etc., etc., most of which we have incorporated in its proper place. He considers that Darwin has stretched a point in supposing the females exercised a choice of the males, the acts of "courtship" tending rather to excite passion. Perversion of sexual instinct are often seen among animals. The subject of animal marriage concludes the zoological portion of the book. Both polygamous and monogamic families exist among the animals, and each sort may present social or solitary methods of life. The necessity for rearing the young, in order that the species might be properly maintained, required the development of those psychic powers, that unite the members of the family, and the members of the troop. How wonderful the psychic powers of such colonies as the bees and ants are is well known. In apes the physiology and psychology of sex closely resemble those of man. The basis of sex love among men is reproduction, and among savages exists as such and nothing more. The successful fertilization of the ovum by artificial methods shows that the psychic accompaniments are not biologically necessary, but are the activities of a developed psychic organism. The following elements have been important in developing present conditions: (1),the standard of beauty leading to ornamentation and pomadization; (2), the sense of shame in connection with the public gaze—the result of education, as witness the innocence of children; (3), the authority of parents and parents-in-law; (4), the necessity of rearing the offspring, at first entirely left to the mother and in some cases developing a communistic relation among the members of a tribe (Andaman Islanders); (5), jealousy, leading to the appropriation of the weaker sex exclusively by the stronger males causing the punishment of adultery; unappropriated females still remained common property, (primitive prostitution). With respect to the procuring of the wife—she is at first taken prisoner in war and like other booty distributed in the division of the spoils. As such she is a slave simply. In case friendly relations exist between tribes the wife may be secured by purchase. (Curiously enough in some places a mock battle often constitutes the wedding ceremony as a reminder of an ancient method.) The law of supply and demand now rules, and if wives are much desired they bring a corresponding price to the father fortunate in a large family of girls; the reverse conditions gave rise to the dowry. The following work, though more special, treats of the evolution of love among men and animals and may be inserted here.

Romantic Love and Personal Beauty. FINCK. London, 1887. pp. 560.

The main thesis is that beauty in the offspring is dependent upon the development and free sway of romantic love. By romantic love is meant the love treated of by poets, the impulsive play of the emotional nature. This love is a modern development according to Finck; and in the main he is right; it is the evolution of the esthetic nature of man as seen also in the development of music. But this position should not be held in too strict a sense. The same love undoubtedly beat in the heart of Jacob, when he toiled fourteen years for Rachel, although he may not have composed poems or manifested other extravagancies of modern love, which are in a great measure due to an over excitable nervous system. The great majority of successful marriages are probably not preceded by the extreme manifestations of romantic love, but by those more quiet bonds of friendship that join hands with reason and sense, and which are older than history. Beauty which is an index of health is dependent on the free play of those psychic forces that impel to reproduction, universally operative, manifested even down to the protozoa. It is the restraint of these forces by scheming parents who make marriage a pecuniary speculation that unites natures more or less sterile with each other; or that, if fertile, produce second rate offspring. This work is evidently written for the people. A spirit of levity, however, detracts from its dignity, and its facts are culled from various authorities and are not always handled with scientific acumen.

Anthropologisch-kulturhistorische Studien der Geschlechtsverhältnisse des Menschen. MANTEGAZZA. Jena, 1886, pp. 380. Translated from the Italian.

The author has travelled extensively and, together with collections from other authors, presents his observations in a most clear and fascinating manner; the work is undoubtedly the best that has appeared from his pen, and it deserves an English dress. The first chapter of the seventeen is devoted to a description of the rites with which savage people celebrate the establishment of puberty. In all the anthropological relations, the Australians hold the most important position; their highest development being on a level with the lowest seen in other races; and at the same time their various tribes present all the links of the different stages of development, from the most primitive and purely animal stage upward. The Malays and negroes come next in order, the American aborigines and the Turanians next, and then we begin with the Hindoos and travel westward with the tidal waves of Caucasian civilization. The ceremonies of the puberty-declaration constitute, with the Australians, a sort of an initiation, secretly conducted (the women being never allowed near), of the youth to membership in the tribe, who henceforth has the privilege of being a warrior and of stealing a wife. The ceremonies consist in the removal of the hair or beard with a sharp stone and often some teeth are knocked out, and other mutilations (sometimes crippling) are suffered. When the girls of Victoria attain an age of twelve years they undergo a somewhat less Spartan trial, but like their brothers are more or less besmeared with filth, the removal of which constitutes the closing ceremony. Similar rites have been observed among the Indians of California. The sense of shame is very feebly developed and while dress is sometimes worn it is only for purposes of protection; yet in some tribes the women use dress for purposes of concealment. In higher races the law holds that the female is more modest than the male. This sense of shame extends even to the face with Mohammedan women. The Japanese are said to be without shame and yet are clothed to an extreme extent. Strange co-existence of the sense of shame with reference to certain relations and not with others of like nature are found nearly universally. Among some peoples continence and virginity are considered as vices, while with others there are laws by which those losing their virginity (females always) are put to death if they desire to become married. Among semi-civilized, and sometimes among barbarous people, laws limiting the times and seasons for exercising the reproductive functions have been enacted and enforced with great stringency. The death penalty was inflicted for the violation of the Levitical ordinances in this regard. Times of prohibition include the periods of menstruation, pregnancy and lactation. A variety of mutilations from circumcision to castration have at one time and another been practiced. It is supposed that these practices were for the sake of political separation, to make a peculiar people; they seem to have been undertaken from religious motives, although some writers suppose circumcision to have a hygienic significance. The origin of the rite of circumcision seems lost in antiquity. The Egyptians, who circumcised soldiers and priests only, may have received it from Abraham. But some South American Indian tribes, many of the Polynesian tribes, the Caffres and some of the African tribes, and the Australians near the bay of Carpentaria practice it in various ways. Among the savage peoples, it is purely a puberty-rite conducted by priests with great secrecy. In its development to the Jewish form the novitiate has been operated upon at an earlier and earlier period. Stages of this precession are preserved with various tribes. According to Waitz many African tribes practice also clitoridektomy.

Circumcision is considered a hygienic measure by Jaffe (*Ritualle der Circumcision*, Leipzig, 1886). But hygienic considerations do not explain the operation as performed upon the females, and we know that other mutilations accompany the practice with the lowest tribes; and constitute pretty nearly the whole of what may be called religious ceremonial of such tribes. Cases in which castration has been performed as a religious rite fall into two classes, those in savage tribes, in which it is important to keep the birth rate as low as possible and those where it is practiced as an antidote to lust. It is very general to require continence of the priest and this has been secured through means both psychical and physical. The Scopts of Russia afford a remarkable instance of all the members of a sect receiving this sign of their regeneration. Nevertheless among these persons passion is not eradicated. The assimilative forces assume a preponderance, as represented in the increase of adipose tissue in the body and the acquirement of wealth in the society.

A very interesting chapter is the one which treats of the customs connected with the wedding ceremony. Mantegazza considers them survivals of the primitive mode of obtaining a wife, viz., by capture, as various features of the modern dance may be referred to a primitive erotic dance. There are certain social laws whose object is to secure cross fertilization, and which have undoubtedly been evolved in a manner analogous to that of the morphological and physiological characters in the lower animals that serve the same purpose. The passions, even of esthetic love, are strong in the bosoms of several negro tribes. Among certain Australians (and somewhat similarly with some North American Indians) all the members of a tribe are known as brothers and sisters, and are forbidden to intermarry; the result is *exogamy*, either by capture or by purchase. On the other hand, in Egypt, Persia and Peru the marriage of brothers and sisters was allowed. It is remarkable to what extent very different forms (sometimes in one and the same tribe) of various social customs coexist among primitive peoples. The children may be betrothed by parents while infants, yet after they are grown up great freedom of choice is allowed. Even after marriage the husband may grant a divorce if he finds his wife loves another. The position of the wife varies greatly; she may be used (like cattle) as money and be a slave simply, or may have the power to nullify the business transactions of her husband, or sit with him in legislative councils. Polygamy may be practiced only by the rich, who can support so many wives, or may be a means of enriching the husband where they do his work. On the other hand, in Thibet a woman marries a whole family of brothers on the theory that one man is unable to care for one woman. It has been supposed that primitive man was without marriage, and the children were reared by the mother, who was the matriarch; and naturally the custom of polyandry arose in one direction and polygamy in another. Mantegazza ridicules the "promiscuity theory," and thinks the facts with regard to the sexual relations among the lower animals are conclusive against any such view. The facts are that among savages monogamy is the rule. Marriage is everywhere recognized as an institution for the proper rearing of children, and has no other significance; but outside of wedlock a great deal of promiscuity is allowed, without any sense of shame thence arising. As soon as a woman is a wife, she is expected to be and is absolutely true to her husband. The limitation of intercourse with one who is thus actually set apart for breeding purposes (being returned to her parents if sterile and paid for only if fertile) have caused the various legal privileges of the possession of secondary wives or concubines as a restriction upon promiscuity. But a limited promiscuity still existed, as for example, in hieratic prostitution. In esthetic Greece prostitution developed into the second or epicurean stage, with many gradations of this relation. Then came Christianity and a struggle between sense and spirit which is as if only just beginning, and prostitution entered on its third stage—that of sufferance or license. But society at large has still all the tendencies of the savage, barbarous and cultivated peoples of the past.

The following work is standard on sexual anthropology:

L'Evolution du Marriage et de la Famille. LETOURNEAU. Paris, 1888. pp. 467.

This work begins with the animals, traces the love and reproductive relations systematically, and concludes that love is the same in men and in animals. Some birds die of sorrow if their consorts die. The chimpanzee is sometimes monogamous and sometimes polygamous; the old male who is despot of a clan, is finally routed and killed by the young males. The author agrees with Mantegazza in denying the existence of a primitive universal promiscuity, but does not believe in the existence of real love among savages. Among the ancient Mexicans four degrees of marriage existed: (1) monogamic marriage, the offspring declared legitimate; (2) semi-legitimate marriage, (3) legitimate concubinage, (4) free love or prostitution. In Rome three sorts of sexual relations were recognized: *usus*, cohabitation without ceremony; *coemptus*, by purchase and ownership; and *conparreatio*, full marriage, solemnized by religious ceremony. The following are the stages in the evolution of divorce: (1) wife displaced or killed, (2) repudiated, (3) divorced with limitations, (4) for certain reasons only and with limitations, (5) by her consent as well as that of the husband. The natives of Borneo live in herds, and the strongest male drives out the rest, who are thus compelled to capture wives from elsewhere, and start clans of their own. There is no real family; both matriarchal and patriarchal forms of the family seem to be incipient in this stage. A curious form both of polygamy and polyandry exists in those tribes where all the women are the wives of each male, and all the men the husbands of each woman—a sort of communism. There must have been a long struggle between the maternal and paternal filiation, in which the weaker sex finally succumbed, as the individual, in contradistinction to the clan, became prominent. In later times the personality of woman has been gaining power, as shown by the increase in the divorces. In France these doubled in thirty years, and in Belgium quadrupled. This is held as pointing to the evolution of free love—a conclusion perhaps not shared in by other specialists of equal note.

The evidence for the opinion that primitive religion had a sexual basis is more especially treated in the two following works:

Primitive Symbolism. WESTROPP. London, 1885.

In mythology there is a universal attribution of sex to all things of nature. The sky is father, the earth mother. The sun is the generator; time, fire, intellect and mind are male; matter, water and lust are female; at the beginning of all things stands the eternal asexual One who differentiates into male and female; these assume the relation of husband and wife, and thus become the creators of all things, which in turn retain the sexual nature. Some of the offspring rebel against the authority of the original Will and, being expelled from the hierarchy, wage eternal war against him and seek to ensnare mankind. To oppose this power of darkness, incarnations of the divine were made at different periods, known in India as *avatars*. Sometimes the male, sometimes the female power is given precedence, and the ancient wars are supposed to represent struggles between devotees of one or the other principle. As symbols of these powers, rude representations of the reproductive organs were chosen, and, after being consecrated, could be worshipped in the visible form. Hence the origin of idolatry. The horizontal line, the inverted delta, an oval or circle, a boat, box or ark, ponds, caves, enclosures, flat-roofed houses and temples symbolize the female; a vertical line, a rod, a pillar, a pyramid, an obelisk symbolize the male. The union of these symbols, sometimes with one or the other the more prominent, symbolized the generator or the act of generation, and represented the complete factors of worship. Such symbols are the Greek and Latin crosses, the temple with its columns, towers or steeples. At first the pillars were not erected as a necessary part of the structure, but stood by themselves. The symbols often appear in images and ornamentations. Primitive peoples had serious religious ceremonials that degenerated into mere obscenities in the festivals of the more luxuriant stages of their history.

A more thorough discussion of these facts is made by the following author:

Phallicism, celestial and terrestrial, heathen and Christian; its Connection with the Rosicrucians and the Gnostics, and its foundation in Buddhism, with an essay on mystic anatomy. JENNINGS. London, 1886. pp. 298.

"Religion is to be found alone with its justification and explanation in the relations between the sexes," says Jennings; in substantiation of which thesis he traces with great detail the phallic element from ancient religions down to its most unsuspected modern survivals. The Hebrew prophets struggled to free the Israelites from the dominion of the sexual worships in the external form. The Levitical law is minute in its regulations of such relations, and Christianity began in a most evident manner (as note the First Epistle of Paul to the Romans) as a deeper struggle against lust, and hence we must approve of Jenning's definition, with which he opens his book. The key to mythology also lies here, but this subject presents so many transcendental and mystical features that a modern scientist is incapable of understanding them, and still less of sympathizing with that action of the imagination, common with ancient peoples, which gave rise to the mythologies. There is one modern writer, however, whose method of dealing with facts is similar to this action, but who, in addition had a scientific training by which he attempted to organize this method into a science, viz., the "Science of Correspondences." We refer to

The Delights of Wisdom pertaining to Conjugial Love and the Pleasures of Insanity pertaining to Scortatory Love. SWEDENBORG. New York, 1885; translated from the author's Latin edition of 1768, pp. 472.

This is the most readable of Swedenborg's Theological Works, the characteristics of all of which are a heavy minute style, ungarnished with figures, although the author claims to hold the key that unlocks the meanings of all figurative and symbolic expressions. He deals with conceptions beside which those of the Divina Comedia are limited. The chapters are interspersed with "relations" that are records of his visions and serve to illustrate or confirm the philosophical parts. Everything seen in the Spiritual World has the same ponderous characters. The speakers in dialogue are always talking Swedenborgianism. This peculiarity alone, is sufficient to demonstrate that his "spiritual world" was a subjective state, and justifies our calling his "visions" hallucinations. The "opening of his spiritual sight" seems to have followed in consequence of a severe struggle with his lusts, which he finally succeeded in completely subduing. (See pp. 173–197, Worcester's "*Life and Mission of Emanuel Swedenborg.*" Boston, 1883). According to Swedenborg, the oneness of the Creator, results from the conjunction of two principles, Wisdom or Truth and Love or Goodness. From this union results a perpetual "proceeding" or activity, the Life of the Universe; and created things are necessarily dual in nature (of form and substance) corresponding to this original bisexual Creator, who is represented in material form by the Sun, from which in conjunction flow Light and Heat, in correspondence with the Wisdom and Love. This is not a mere analogy created by man's fancy, but the actual appearance (on the plane of physical sensation) of forces that in reality exist only as the conjunction of Wisdom and Love in the Spiritual Universe. Consequently all physical things have their spiritual counterparts, and the obliteration of the spiritual would cause a cessation of the existence of the physical. Sex is in all things and is derived. If the soul were not sexed neither would the body be sexed[1]. True marriage is therefore not changed by death. By Conjugial Love is meant the primary spiritual attraction between persons of opposite sex. Each person and thing is such through the union of masculine and feminine forces; but this new unity is either masculine or feminine, relative to a union of which it becomes a factor. The Lord himself is male over against the female Church, bound to him by "love truly conjugial." The inversion of love causes repulsion. Hence the origin of Hell, which necessarily has

[1]Swedenborg makes a radical distinction between *conjugal* and *conjugial*.

just as many organs and regions as the church or Heaven, because formed of individuals in all parts of the Grand Man, (that higher social complex in which each person is a gemmule). The inversion of conjugial love is caused by the ascendency of the love of self, as noted in our review of the Rational Psychology. Equilibrium and spiritual freedom result from the fact of man's self-consciousness arising in the rational mind between the spiritual mind on the one side and the animal mind on the other. In the spiritual universe there is a mutual attraction or aggregation of similar natures. The consequence is that Hell is in conjunction with the animal mind, and Heaven with the spiritual mind. The process of allowing the lower nature to dominate takes place according to complicated laws; and the process of redemption is no less subject to biological laws. A consideration of these points must be waived here. Suffice it to say that conjugial love figures as the principal factor. By the state of that love men are judged, and gravitate to Hell or rise to Heaven. In adulterous or Scortatory Love, from which Hell is, are to be recognized a series of degrees, each lower psychologically than the preceding, although from the legal standpoint this fact could not be ascertained. The highest degree is fornication; lowest is the "love of seducing innocencies" (in which the desire is to despoil innocence because it is innocence). These appear in the spiritual world as serpents. This whole system might be termed transcendental phallicism, and is according to the author the primitive religion of man from which have arisen all forms of mythology by a degradation of self-consciousness into the sensory plane of life. The law of sexual health and vigor is plainly stated to be the cultivation of love to God.

We turn at this point to the subject of sexual hygiene.

Effect on Women of Imperfect Hygiene of the Sexual Function. TAYLOR. Am. Jour. Obstet., Vol. XV, No. 1, Jan., 1882.

Three out of every four married women suffer from sexual ill health due to ignorance before and after marriage. A nervous state or loss of tranquility has come with civilization. Girls utterly fail to connect erotic sensations with the reproductive organs and yet these feelings are deeper in the female than in the male. This last fact explains why restrictions for preserving chastity are more stringent as applied to girls than to boys. The result of all this repression of the physical feelings leads to an intensification of the more intellectual emotions; esthetic crazes and the like being the outcome. Morbid self-consciousness, fears, loves, morbid desires, a fondness for love stories, all exemplify a life run to emotion and never culminating in executive work. An inflamation and congestion become chronic, and disturb the health of the entire body. The obvious remedy is first, education and knowledge, so that the true nature of these feelings may be realized, and second, engagement of the mind in some occupation,—work, the grand remedy for all troubling thoughts of this or similar nature. In the male (see Taylor, "Genital Irritation," Annals of Anat. and Surgery, July, 1881), genital irritation caused by phimosis is frequently the cause of as serious a train of troubles, leading often to self-abuse, sometimes to reflex paralysis of the walking centers. No one can study a work on the treatment of sexual diseases both in man and woman, prepared for the medical practitioner, without being convinced that abnormal conditions here affect the body more profoundly than such conditions anywhere else. One might say with a considerable show of truth "*if your sexual life be pure and healthy, you are every whit whole.*"[1]

[1]The reviewer desires to call attention to the fact that general inferences, criticisms, and the like are often incorporated with matter more strictly the teaching of the work under review, without being specially designated as extraneous,—a method, having advantages that outweigh its defects, when authors are second in importance to their ideas.

The effect of the body and mind upon these organs is likewise as profound; and finally their abuse is more easily accomplished and is more direful in its effects than the abuse of any other organs. These physiological observations tally well with the morphological theories that make the body either a modification of sexual cells, or an organ subservient to the reproductive organs. Many diseases that are apparently localized in some organ or other of the body and which fail to yield to treatment directed to that organ disappear miraculously when the treatment is directed to the generative organs.

In perhaps a majority of cases there is no definite disease, but only a general feeling of debility. In the field of quackery the treatment of sexual disorders naturally takes the first place, and ignorance is to be blamed largely for the existence of the diseases themselves and certainly for the encouragement quacks receive. This ignorance is universally deplored by all writers upon these subjects and referred to the very deep feeling of antipathy that exists toward the broaching of any subjects that suggest sexual relations. The feeling of shame has developed with such intensity in the highest civilized communities that all possible methods are used to conceal from consciousness the fact of sex. The feeling of modesty has undoubtedly been of use in the evolution of the race, but at the expense of occasional victims who fell because of ignorance. *The mistake is made in ascribing immodesty to knowledge.* Many writers are of the opinion that the opposition to the proper diffusion of knowledge of the laws of sexual hygiene among the masses comes most strongly from a prudishness that is the outcome of a mind not truly chaste. The following author dwells on the effects of prudish education.

Adolescence. Part I of "The Physiologist in the Household" series. FOTHERGILL. London, 1880.

The efforts to avoid certain subjects, unduly emphasizes them, "Virtue preserved by artificial contrivances is liable to fail." "Nothing but an entire revision of our educational arrangements for girls can give a girl a sure protection against her own passions." The subject of sexual precocity is treated at length. "From such conditions come the criminal classes. "One boy or girl can corrupt a whole school."

The Importance of Knowledge Concerning the Sexual Nature. GERTRUDE KITZ. Printed for the Washington Society for Moral Education. New York, 1884.

This pamphlet instructs superiors in regard to the proper training of children relative to these subjects. Some excellent suggestions are given. Other books recommended by the society are Dio Lewis "On Chastity," and Spencer "On Education."

Sex in Education, or a fair chance for girls. CLARKE. Boston, 1875.

Much of the ill-health of women is due to lack of care during each menstruation, and particularly the first one. But our schools for coeducation take no notice of this, and make the girls stand during recitation, climb stairs and pass examinations while the menstrual period is lasting. The nervous energies are whipped up to the highest pitch of excitement in our competitive prize contests, and the girl-graduate is a physical wreck. She should be taught to rest at every period; she should not be required to compete with boys in the same studies. Her education should be adapted to her nature and to her life work. This is not to be construed as an argument against coeducation of the sexes, but rather against "identical education." Jean Paul says, "To insure modesty, I would advise the education of the sexes together; for two boys will preserve twelve girls, or two girls twelve boys, innocent amid winks, jokes and improprieties, merely by that instinctive sense which is the forerunner of matured modesty. But I will guarantee nothing in a school where girls are alone together, and still less where boys are."

This is the greatest argument for coeducation. The natural association of the sexes is the preventive of sexual perversion, (by the mutual interaction of souls, the mystic will say in explanation). The scandals of society are largely due to an ignoring of this law, and where similar cases arise in coeducational institutions, they have in all probability germinated outside, or are from diseased conditions inherited from parents who have themselves perhaps "been more sinned against than sinning."

There has been no lack of able works written for the guidance of the masses in sexual matters. For very young children (from 10—14) no literature is better adapted than the two following little pamphlets: "*A Father's Advice, a book for every boy*," and "*A Mother's Advice, a book for every girl*," by Dr. and Mrs. E. P. Miller respectively, New York, 41 West 26th St., 1881. Prof. Wilder's book, *What Young People Should Know*, has passed through several editions, and contains much biological matter about the evolution of sex in lower organisms that could profitably be incorporated into the common school physiologies.

The two following works, prepared by Dr. Napheys, are the best popular treatises extant:

The Physical Life of Woman, 426 pp., and *The Transmission of Life; or counsels on the nature and hygiene of the masculine function*, pp. 362. Philadelphia, 1887.

In these works general subjects like heredity, production of sex, etc., occupy special sections, and each chapter is followed by a bibliography.

In England, two corresponding works of marked excellence have appeared, viz.,

Advise to a Wife, by CHAVASSE, and *The Functions and Disorders of the Reproductive Organs, in Childhood, Youth, Adult Age, and Advanced Life*, by ACTON. Seventh Edition, 1888. pp. 263. Republished in Philadelphia, by Blakiston.

In addition to these, there have been numerous special publications, some of which are noted below, and in America mention must be made of the itinerant phrenological lecturers and a host of quacks, who have in their degree enlightened the public. Fowler's prolix *Science of Life.* is representative of this class, and from a moral standpoint is unimpeachable, whatever its scientific weakness. There has, therefore, been considerable teaching of the public in this regard, but of course in an incomplete, often perverted form. This suggests that text-books by competent authorities should be used by school teachers in private classes. The appendix to "*The Human Body*" (MARTIN) is a step in the right direction. The duties of parents are in no wise to be entrusted to teachers, for we learn that children of a tender age are frequently addicted to sexual vices, often most innocently falling a snare to their older associates. It is pretty certain that however carefully a boy is kept in ignorance of these relations, he is sure to learn from playmates and by overhearing conversation between men of unrefined nature, what is a very one-sided and degraded knowledge. Herein lies the necessity for proper training, which is perhaps the strongest force with which to combat certain social and solitary vices. There are also very lax and erroneous ideas extant about the injurious effects of continence, which are combatted by the following pamphlet:

A Physician's Sermon to Young Men. PRATT. New York. pp. 48.

The next pamphlet, a production of the pietistic sect of Germany, is a model of its kind, and an example to other ministers of religion of how to deal with subjects that so closely concern them as spiritual advisers.

Wahrnung eines Jugendfreundes vor dem gefährlichsten Jugenfeinde. KAPFF. Stuttgart, 1842.

Tissot and Zeller appear to be the main authorities upon which Kapff has relied for information, but the method of treatment is original, and a model of pedagogical insight.

We now approach a subject of the highest importance to the welfare of a nation, viz., the family. That marriage is an institution for the ultimate purpose of keeping up the succession of generations of mankind is the expression of the wisest and best thinkers of all times; but there are firmly rooted in society views and practices that are subversive of this end. Such practices include all forms of incontinence, prostitution, free-love, abortions, and all sexual relations in which the ultimate purpose of reproduction is thwarted. In this connection we take the following work as representative, although were it not for its great popularity, it would not be worthy of consideration:

The Elements of Social Science; or Physical, Sexual and Natural Religion. An exposition of the true cause and only cure of the three primary social evils, Poverty, Prostitution and Celibacy. By a DOCTOR OF MEDICINE. Dedicated to the poor and suffering. Twelfth Edition. Translated into many European languages. London, 1875. pp. 592.

The anonymous author professes to be a Comtist, and writes with true religious fervor in favor of a better physical development ("physical religion"). By sexual religion is meant the application of medical means to cure sexual diseases. By natural religion he means the abolition of restrictions upon free love. The primary thesis is that the celibate life is one of suffering, and matrimony is monopoly. That such a book represents a most powerful pernicious influence, dangerous to society, goes without saying. A simple inspection of medical works like *Excessive Venery*, HOWE, New York, 1884, pp. 299, and others reviewed below, will show that much of the misery and degradation of society is traceable to the very things advocated by this author. The injunctions of religion are justified by the principles of physiological science. The *Symptoms of Sexual Exhaustion* are considered by Beard in the May and June numbers of the *Independent Practitioner*, 1880. Such symptoms are, lack of mental control, defective memory, irritable heart, wandering of attention, excitable pulse, dimness of vision, morbid fears, softness or weakness of voice, sweats, cold hands and feet, paralysis of will from anxiety, besides the legion of diseases directly caused. Just what constitutes an abnormal exercise of the reproductive functions leading to disease, and how such disease is produced, is an unsettled and extremely complex problem, and certainly offers a field for investigation.

The Jukes, a study in Heredity, Pauperism and Crime. DUGDALE. New York, 1877. pp. 120.

This interesting study of a large family of hundreds of criminals that could be traced to a common ancestor who was a harlot, and whose descendants were largely harlots and criminals, shows most vividly the close association existing between prostitution and crime. Pauperism is shown to be the result of weakness or sexual exhaustion. Among the valuable conclusions reached the following may be noted: Early marriage tends to extinguish harlotry. A favorable environment in early life may counteract the tendency of heredity. Usually the heredity exerts itself in creating an environment favorable to its own development. It is the environment that works badly for the illegitimate child, for if favorably placed he may succeed. The diseases that cause pauperism are due to licentiousness. Induced pauperism, caused by the bringing up of a child in the poor-house, is easily reverted to, and becomes hereditary in the offspring. The illegitimate lines furnish the most criminals. Men become moral by patient training, leading to the organization of habit. Reformers should make reform easy; for development is in the direction of least resistance. The Jukes are sexually precocious. Many of the effects ordinarily termed hereditary are due secondarily to other forces that are alone truly congenital. Hence education can step in and direct the stream of development.

Le Marriage au point de vue de l'heredité. BATTESTI. Paris, 1886.

The main part of this brochure is devoted to stating and illustrating the laws of heredity. The author holds the view that mutilations and acquired characters may be transmitted. The subject of transmission of psychic conditions is quite fully treated. He is not in favor of early marriage; 25 for the woman and 35 for the man are optimal ages. Twice as many girls married before the age of 20 die, as of celibates, and that too in the face of the fact that celibates are often such from having weakly constitutions deterring them from marriage. Characters that develop late, and are confined to one sex, appear in the same sex and at the same age in the offspring; but characters that appear early in either sex are transmitted to both sexes. Syphilis is used as an illustration to confirm this law; but we fear that the author has not analyzed the question thoroughly enough. The outcome of the paper is, that a knowledge of these laws should govern in marriage. Unfortunately, all efforts to breed human beings fail, even after the obstacles that emotion throws in the way are overcome; as witness the failure of the Oneida Community. Natural choice is based upon attractions that represent real affinities between the persons in love, and this unreasoning choice is far wiser than the greatest learning could make any person at present. There is need of studying what this attraction is, to discover the laws that govern its operation. Even prostitutes form special attachments that are apt to result in fertility. A clear determination of the relations of love to fertility must have pre-eminent interest from a legal as well as a psychological standpoint.

The subject of divorce is painfully frequent in its exemplification, yet we are assured that only a fraction of unhappy marriages come before the public. Such a state of things shows a deplorable want of a high ideal among the masses as to the obligations and significance of the marriage contract. This wrong is not easily righted by legislation; but in the proper training of youth there is promise of better things.

Of the greatest importance also is the subject of abortion. An earnest protest was made in 1867 by Dr. Storer of Boston in two small books ("*Why not?—a book for every woman*," and "*Is it I?—a book for every man*"), in view of an alarming increase in this practice, the number of cases involved in the United States having been estimated by the hundreds of thousands. This could not happen were it not for the direst ignorance prevailing among the people, concerning the development of the embryo and the danger of interfering with the important functions of gestation. The subject has wide historical and anthropological bearings, as the following works show:

Die Geburt bei den Urvölkern. ENGLEMANN. Wien, pp. 197.

This work is a valuable exposition of obstetric methods used by uncivilized races. The Calabar Indians give drugs in the third month of pregnancy to test the viability of the fœtus. Should the fœtus survive there is great care taken to prevent mis-carriage. Such practices show that abortion among savages has a close association with savage infanticides, and it has a similar reason for being.

Zur Geschichte der Verbreitung und Methode der Fruchtabtreibung. PLOSS. Leipzig, 1883.

Abortion as well as infanticide is widely practiced among savages, the two being mutually supplementary. In New Zealand infanticide is more frequent. The Papuans think two children are enough and regularly destroy by abortion all the succeeding. In the Sandwich Islands one-fourth of the women are childless. A few of the Pacific Island groups are free from this practice. Both abortion and infanticide were frequent with the American aborigines. In Brazil one tribe of Indians regularly destroy the fœtus in women under thirty years of age. To have a family is a sign of old age and the women wish to be thought young. Among the Winnebagoes an average of one child per woman was found and two children among the Chippewas. Half-breed children are regularly aborted, their large heads being fatal to the mother. Among African tribes there is great variation. Abortion is less frequent than infanticide in India. Chinese medical works describe methods of securing abortion. Mohammedans do not believe there is any life in the fœtus before five months. In Persia abortion is contrary to religion. The methods of securing abortion are various; in the United States quacks advertise their trade in the public newspapers.

Facultative Sterilität. (With supplement). HASSE, (Pseudonym). Leipzig, 1883.

This pamphlet describes an instrument for producing abortion and the general conditions that justify abortions are discussed. It is to be feared that the methods are applied in cases that do not justify any such radical treatment. In general it may be stated as certain that the risks to the health and life of the mother are vastly greater in case of abortion than in natural birth. In the United States an admirable study of criminal practice has been made by Eli Van de Warker.

Affaiblissement de la natalité en France. NADAILLAC. Paris, 1886, pp, 150.

From a statistical study the author shows that there has been a steady decline in the ratio of births to population during the past century amounting to over 25 per cent. in France. A similar study of other countries shows that France heads the list in the amount of this decline. In 1884 the ratio of marriages to 1000 of population was 66 for France and only 60 for Paris, where the ratio of illegitimate to legitimate births was as 17 to 46. This decline can be due to the action of no Malthusian principle, because wealth has increased; but the standard of comfort has been raised. The author of Sexual Religion thinks his principles have made great progress in France and felicitates its people. Nadaillac sees in this enfeeblement of the birth rate a menace to the welfare of the country.

In the *Popular Science Monthly*, December, 1889, Grant Allen argues that the state of matrimony must for all time be the normal and necessary one for all women to enter and that our education for girls should be directed towards preparing girls to be good mothers. At present there needs to be four children born for every woman, to keep the race just stationary in numbers. Consequently every woman who chooses a celibate life is responsible for increasing the burdens of her married sisters. The fewer the children the better they will be reared and the more leisure for general culture there remains to the mother, all of which is much to be desired. We may modify this view to the extent of substituting two for four children per woman, because the excessive infant mortality of to-day is largely, if not entirely, due to present ignorance of various laws of life. As many women naturally have large families it follows that there is plenty of room for women with intellectual pursuits, but the home must remain the keystone of society.

In closing we desire to draw attention to the vastness of the field of sex as a subject of investigation and the undoubted importance of the results of investigations in this line, not only in their bearing upon scientific and philosophical questions, but more especially as such results affect the general happiness and progress of the race. All other reforms really wait for sexual reform to lay the foundations. This reform has begun to take active shape in the world's work in such organizations as the White Cross League; and the old forces of prudery are beginning to weaken. There must however be more open and free delivery of facts before investigators in the field can make much progress. The laws of Natural Selection will vindicate the right by the constant destruction of lines of degeneracy as well as conditions of stagnant conservatism. One fact comes out clearly and that is that biology is the beginning of psychology, sociology and kindred sciences.

Appendix: While no attempt has been made to include all important papers bearing on these subjects, but rather to give a brief hearing to a few or sometimes a single work in each line, it was my intention to note Galton's work in heredity more carefully than was done in the first section. This author appears to me to have been led into a fallacy in considering that as we have two parents, four grand-parents, eight great grand-parents, etc., it follows that our distant ancestors are each represented by an infinitesimal factor in us. Our thesis is that the whole of each of all our ancestors is present in each of us, but that which is truly individual, i. e. our contribution to the continuous training of the generations of gemmules from Adam down, is infinitesimal. Consequently each of our parents passed over to us Adam's body (hereditarily) plus the increments successive generations had added to this ancestral stock. Almost the whole of the body of the father is therefore identical with as large a part of the mother's body, and the two coalesce as one in the child to form the oldest and best fixed of its characters. The child starts with this species-stock, plus all the increments that have been added on the father's and on the mother's side since their gemmules, which were once associated in a single remote ancestor, parted company, at first by cell division in the ovaries, etc., and later were still further separated by the development of these cells into distinct individuals. Such is an outline of the method of organic evolution, which may be completed by the addition of a few simple specifications, such as, that the characters in ontogeny are unfolded in the order of phylogenetic differentiation and that while thus unfolding, any portion of the history may be cenogenetically revised.

The following *errata* occur in the first section: p. 98, line 14 from bottom, "became" should be "become;" p. 102, line 11, "this" should be "the above;" p. 106, line 10 from bottom, "(cytic)" should be "(cyclic);" p. 108, line 8, "evolution is its" should be "evolutionists." The author of "La vie psychique," etc., is BINET. Lines 11, 9 and 8 from bottom, "experienced" should be "exercised;" "*nasulum*" should be "*nasutum*," "trichocytes" should be "trichocysts," "prendopodia"—"pseudopodia." JULIUS NELSON.

Ein geschlechtlich erzeugter Organismus ohne mütterliche Eigenschaften. Dr. BOVERI. Gesellschaft für Morph. und Physiol. zu München. July 16, 1889.

Boveri brings forward a crucial experiment into the much disputed fields relating to the functions of nucleus and cell protoplasm and the parts taken by the male and female nuclei in reproduction and heredity. The most direct way to ascertain whether the cell nucleus, the protoplasm, or both contain the elements which characterize the cell is to take the nucleus out of one cell and put it into the protoplasm of some other cell. This is what Rauber attempted to do when he interchanged the nuclei of toads' and frogs' eggs, his purpose being to see whether the protoplasm of the toad's egg would cause the product to take the form of a toad, or the nucleus of the frog's egg would shape the embryo to a frog, or whether both nucleus and protoplasm might act to produce a hybrid. Rauber's experiments failed, as might be expected in dealing with such highly specialized structures.

The year following, however (1887), the Hertwigs discovered that fragments of sea urchin ova containing no part of the nucleus might be fertilized, and they then segmented and developed like normal eggs or fragments which contained female nuclei. In order, then, to settle the question propounded by Rauber, it only remained to fertilize a denucleated fragment of the egg of one species of sea urchin with the spermatozoon of another species and keep the larva until it showed unmistakable specific characters. This is what Boveri set himself to do. The species which he found to suit his purpose are *Echinus microtuberculatus* and *Sphaerechinus granulatus*. Thus not only different species but different genera were employed, and easily recognizable characters make their appearance in the forms of the skeletal spicules by the third or fourth day, and Boveri was able to keep the larvæ for a week.

If, now, a large quantity of *Sphaerechinus* ova are shaken in a test tube with milt from *Echinus*, many of the ova will be broken and some of the fragments will contain nuclei, others not. A part of the ova remain intact and but few of these are fertilized. The nucleated and denucleated fragments, however, are fertilized in great numbers, and give rise to *dwarf larvæ of two entirely distinct types*. One class of dwarf larvæ shows an exact middle form, and since the same form, not dwarf, may be obtained from cross fertilizing intact ova, it is safe to assume that this type is developed from *nucleated* fragments. This is no more than we should expect, an intermediate form, where a cross of this kind can be effected. The interesting fact now comes to light that the other large class of dwarf larvæ *conform wholly to the male type*. This whole class must arise according to Boveri from a male nucleus developing within a *denucleated* fragment. All his attempts to demonstrate this by isolated cultures failed, but the author considers it sufficiently proved by the large numbers of male-type larvæ which made their appearance in the gross cultures, by the distinctness of the two types, and also by the interesting fact that the cell nuclei in dwarf larvæ of the male type, as shown in sections, were only about half the size of ordinary nuclei. The experiments are further confirmatory of the Hertwigs' observations and on the whole there seems little ground to doubt their validity. The experiments of Boveri, then, prove: *First*, that in this particular case, at least, the nucleus alone conveys specific characters to the offspring, and that the cell protoplasm, although essential to development, has no formative influence whatever, *i. e.*, "protoplasm is nutritive but not formative" (Weismann). *Second*, that in the above mentioned species the male and female nuclei are approximately equivalent in formative power.

The truth of the first has long been supposed, and many facts in the development of the subject point significantly toward the truth of the second proposition. The very discovery by Van Beneden (*Recherches sur la Maturation de l'Œuf et la Fécondation.* Arch. de Biol. Gand, 1883, pp. 265-640, 13 pl.), that the chromatin loops or filaments are equal in the male and female nuclei argues strongly for its validity, as also the work of Platner (*Die Karyokinese bei den Lepidopteren als Grundlage für eine Theorie der Zelltheilung.* Internat. Monatschr. f. Anat. und Hist. III, 347–587, 2 pl., Leipzig, 1886), in showing that important steps in the perfecting for conjugation of male and female nuclei are identical. In short no difference of male and female can be discovered in the nuclear structure of male and female reproductive cells by any known method. This has lead to the oft repeated statement, "chromatin is not sexed." As the writer of this section might put it: ultimately male and female protoplasms are different only in past experiences, and such differences are not observable with a microscope.

At first thought such a case of male parthenogenesis as is brought to light by Boveri's experiments seems to invalidate all theories of sex which would make the male and female factors in reproduction fundamentally different; for example, the well-know theory of Dr. Brooks that the female is in general more conservative than the male while the male tends to vary more than the female. "If a perfect animal could be developed" says this author (*Heredity*, p. 102), "from the spermatozoon of a male parent, as it can be, in cases of parthenogenesis, from the ovum of a female parent, we should have a means of proving that each sex transmits its entire organization to its offspring." "The phenomena of parthenogenesis, or reproduction by virgin females, as in the case of bees and wasps, show that the ovum alone may transmit all the established hereditary structure of the species, but there is and can be no evidence that the male element can accomplish the same thing," (p. 125). It now appears that the spermatozoon is able to do what it seemed safe enough to assert to be impossible in the nature of the case. But it must be admitted that we should not resort to the stable and ancient *echinodermata* to study variation and especially any variations which may depend upon sexual differentiations. It may well be that the male has been specialized to function as a progressive or variable factor in some species and not in others. Such an experiment as Boveri's, however, seems to preclude the universality of a principle of this kind; and still this very experiment proves more than the equivalence of the male and female element; the male nucleus being able to build up its entire structure; while the female nucleus, accepting Whitman's theory of polar globules, is able to make only a feeble effort at segmentation. This would seem to indicate a prepotency in formative power on the part of the male nucleus, which may be confined to certain species or may be a general characteristic, hitherto not so clearly revealed, but present in all male reproductive nuclei.

The work of Boveri certainly opens a new line of experiment in this interesting field. The method must be applicable to other forms, and until more experiments of the kind are made, it is useless to attempt to reason further as to the general bearings of his discovery upon questions of heredity and sex. C. F. H.

VI.—MISCELLANEOUS.

Die naturwissenschaftlich-psychologische Weltauffassung der Gegenwart, von Dr. HERMANN WOLFF, Dozent an der Universität Leipsig, 1890. (2 vols.)

Whatever criticism may be made of the work before us, it is certainly large in range; and as its title indicates, represents some of the most recent phases of philosophic and scientific thought. Zeller says, that through the great development of the sciences new questions arise for solution, new means are required, and a partial change from the former experience of philosophy is possible; and so it must enter into closer relation with the sciences. The recent investigations on the organs of sense and the brain make necessary a renewed proof of the psychological and metaphysical foundations of idealism. Exclusive idealism must be supplemented by a healthy realism. Wundt says, that philosophy must take as its foundation the whole range of scientific experience; then it will be the science of sciences in the true sense of the word. Science has incontestably the ruling interest of the day; and with reason, because of the exactness of its method and the certainty of its results. But science at its zenith ends with unsolved problems. These limits are in the words of Du Bois-Reymond: (1) inertia, matter and force; (2) the inconceivability of a passage from the mental to the material; (3) the origin of motion; (4) the genesis of life; (5) the arrangement of the world according to a purpose; (6) the origin of rational thought, and of language; and (7) the problem of free will. And Hæckel rightly says, that these phenomena are not fully explained by heredity and selection. This lies in the fact that our knowing faculty is absolutely limited and has only a relative extension. It is conditioned above all, by the nature of our sense-organs and brain. Bunge in his treatise on physiological and pathological chemistry also says, that the mechanism of the present brings us with certainty to the vitalism of the future, but that the essence of this vitalism consists in a going out from the known, the inner world, to explain the unknown, the outer world. The above ideas are an acknowledgement from the side of science itself, that its continuation and completion must be found in philosophy. Science without philosophy ends in unsolved problems; philosophy without science lacks a sure foundation. Both are children of the same mother; both work for the solution of the same secrets. But in what philosophy shall science find its continuation and consummation? It is the very nature of science to rest on experience; and this philosophy therefore must be based on facts; in a word, purely empirical. With such a philosophy only, can science go hand in hand. Such a philosophy, the author says is set forth in this work. The foundation of ethics (treated of in the second volume) must come from the results of science and philosophy; the proof of truth must be derived from metaphysics (*sit venia verbo*). The moral act expresses the deepest nature of humanity, and is inseparably connected with the sense-phenomenal and psycho-metaphysical nature of man. Morality cosmologically considered brings to light the essence of man; and thus the investigation of moral problems leads to the study of anthropology, cosmology, psychology and metaphysics. In order that the whole may have a logical connection and a systematic unity, the author investigates in like manner the object as the methodological problem, the transcendental problem and the epistomological. He then considers the analysis of the Microcosmus, that is, of the individual man according to his physical and mental content, as expressed in the conscious *ego*. This is followed by an analysis of the Macrocosmus, both of the organic and inorganic part. Since here is shown how the being and functioning of the objective world is imaged again in scientific consciousness, this part also can be designated as a microcosmus in subjective relation with the first part as a microcosmus in objective relation. A unified system of philosophy with the name of "empirical psychical realism" will be, as Hæckel says, the philosophy of the future; and is nothing further than a complete system of monism.

Les lois de l'imitation; Étude sociologique, par G. TARDE. Paris, 1890. pp. 431.

In this work the author has endeavored with as much clearness as possible to bring out the purely social side of humanity; abstracting that which is simply vital or physical. But he finds, that the point of view, in favor of which he could mark this difference, shows between the social and natural phenomena the most numerous, constant and natural analogies. This pure sociology is general; its laws are applicable to all actual, past or possible societies, just as physiological laws are to all species. The philosophy of history and the philosophy of nature, as generally understood, present the historical and natural phenomena in such a way as to preclude the possibility of a wholly different grouping or succession.

The real is only explicable by being attached to the immensity of the possible, that is to say, of the necessary under conditions, where it swims as a star in infinite space. The idea of law is the conception of this firmament of facts. Certainly all is rigorously determined, and the reality could not be different, its primordial and unknown conditions being given. But why these, and not others? There is irrationality at the basis of necessity. Also in the physical and living domain, as in the social world, that which is realized, seems to be only a fragment of that which can be realized. The mind does not admit the relation of cause to effect, except where the effect resembles the cause, repeats the cause; as an undulation gives rise to another similar undulation. Each time that "produce" does not signify to "reproduce," all becomes dark to us. There is only science of similitudes and phenomenal repetitions. (1) All the similitudes in the chemical, physical and astronomical world have for their explanation and possible cause periodic and vibratory movements. (2) All similitudes in the vital world result from hereditary transmission, from intra or extra-organic generation. (3) All the similitudes of social origin are the direct or indirect fruit of imitation in all its forms: custom, sympathy, obedience, instruction, education, social imitation or reflective imitation. In short, every social similitude has imitation as its cause.

A social group may be defined, as a collection of beings in so far as they are imitated among themselves, or, without actual imitation, in so far as they resemble one another, and their common traits are ancient copies of the same model. Society is essentially imitation. The brain is an organ which repeats sensitive centers, and is itself composed of elements that repeat themselves. Memory is purely a nervous habit; habit is a muscular memory. Thus every act of perception supposes a sort of habit, an unconscious imitation of one's self by one's self. Society is a memory, a habit not individual, but collective. What is the nature of this imitation, of this suggestion that constitutes the mental life? We do not know. For if we consider this fact in its purity we are brought to a phenomenon, much studied at present: somnambulism. If one will read the books of Richet, Binet et Féré, Beaunis, Bernheim and Delbœuf, he will be convinced that it is no fancy to regard social man as a veritable somnambule. The social state, like the hypnotic, is only a form of dream. Sympathy is mutual imitation, mutual prestige, according to Adam Smith; prestige is at the base and origin of society.

From archeological and statistical considerations, history may be defined, as a collection of things that have been done most; that is to say, initiatives that have been imitated most. History is the destiny of imitations.

Considered logically or teleologically, (1) internal models will be imitated before external, and (2) examples of persons, or classes, or localities considered superior will take precedence over the inferior, and (3) superiority is sometimes attached to the present, sometimes the past, and is a powerful cause of favor, of a considerable historical influence, as examples of our fathers or of those of our contemporaries.

This imitation from the within to the without signifies two things: (1) That imitation of ideas precedes that of expression, (2) that imitation of purpose precedes that of means.

The classes or nations which are imitated most are those in which imitation is the most reciprocal. A large city is characterized by an intensity of internal imitation in proportion to the density of population and the multiform multiplicity of the relations of its inhabitants. Thus there is an epidemic and contagious character given not only to its diseases, but to its styles and its views. Aristocratic classes were once remarkable for an analogous character, and to an eminent degree the royal courts.

After considering, from the point of view of imitation, language, religion, government, legislation, usages and needs, morals and arts, the author finishes his work with some general remarks and corollaries:

The supreme law of imitation appears to be its own tendency to an indefinite progression. This sort of immanent ambition, which is the soul of the universe, and which is transformed physically by the luminous conquest of space, vitally by the claim of each species to fill the entire globe with its examples, seems to push each discovery or each invention (even the most insignificant individual innovation) to scatter itself indefinitely in the whole social field. But this tendency, when not seconded by logically and teleologically auxiliary inventions, or by the favor of certain prestiges, is hindered by diverse objects. These obstacles are either logical and teleological contradictions, or barriers which a thousand causes, principally prejudices and pride of race, have established between families, tribes and peoples. It results from this that a good idea, arising in one of these groups is propagated without trouble, until it reaches the frontiers. But fortunately this arrest is only slackening of pace. War is often more a civilizer for the conquered than for the conqueror, for the former often borrows its ideas from the latter. Each germ of imitation in the brain of the imitator, under the form of a belief, aspiration or idea, develops into exterior manifestations, into words, actions, which are impressed upon the nervous and muscular systems according to the law of march from within to without. Each act of imitation makes each new act more free and rational, more precise and rigorous. These conditions are the gradual suppression of barriers of caste, class and nationality; the gradual diminution of distances by the rapidity of locomotion and the density of population. Suppose all these conditions reunited and pushed to the highest degree, the imitative transmission of a good initiative over all humanity would be almost instantaneous, like the propagation of a wave in a perfectly elastic medium. We are hastening to this strange ideal, and already we meet indications in the world of savants, where although far separated, they touch each instant by mutiple international communications.

Psychopathologie des Bewusstseins für Aerzte und Juristen, von Dr. F. C. Müller. Leipzig, 1889. pp. 190.

The author considers first the nature of consciousness itself, taking up the different theories of the concept "consciousness" from the medical, legal and philosophical standpoint. He then studies the conditions in which consciousness experiences a derangement, or is abolished; and concludes with a short résumé of the different opinions as held by physician and judge in respect to these exceptional conditions of the *psyche*. Consciousness is a function of our mental life and communicates with the outward world through the organs of sense. Its elements are the representations that it changes into concepts. Its location is in the brain; it can perceive and reproduce; it is the relation of a single changing cerebral act to the whole content of the brain. The highest grade of consciousness is self-consciousness; then come personal consciousness, time and space-consciousness, and world consciousness. In pathological cases, the result of the unconscious cerebral mechanics penetrates to consciousness, then it is in general unconsciousness; or it is grasped indirectly by self-consciousness, then it manifests itself as hallucination or as executed impulsive action. Finally the functions of consciousness, to wit, attention, reflection, artistic reproduction can be wholly nullified as in fever delirium, epilepsy, alcohol-intoxication and dementia. In the chapter on intoxication, the author mentions, among other poisons, opium, morphine, chloral-hydrate, chloroform, cocaine, ether and alcohol; and says that none work so often and with such degenerative results as alcohol.

Three points are emphasized: (1) The concentration of the poison; it makes a great difference whether one drinks beer, light wine, or whisky. (2) The momentary condition of the individual can be greatly modified by hate, love, joy or sorrow. (3) The outer surroundings, as great heat or great effort.

In 1874, in Germany, there were 32,837 prisoners of whom 13,706 were drinkers, of these last, 7,269 were occasional drinkers, and 6,437 habitual drinkers. In the last chapter is given a short and clear consideration of the legal side of insanity in different times and countries. In ancient times hypnotical, hysterical and epileptical persons were looked upon as supernatural, as possessing powers; but the middle ages tried them for witchcraft; the psychically abnormal man was in continual danger of being sacrificed at the stake. But modern legislation has brought a change.

Stammbaum der Philosophie, von den Griechen bis zur Gegenwart. Dr. F. SCHULTZE. Jena, 1890, (14 tables).

This work is a most complete and thorough tabulated plan of the history of philosophy up to the present time. Like a traveling guide to the voyager, it will be of practical value in hearing lectures or in reading large works on the history of philosophy. It gives the foundation thoughts in the philosophical development in general and of each system in particular. It is especially useful for review and for preparation for examination. The last and most interesting table, on the development of philosophy since Kant, gives the names and points of view of not only modern philosophers, but those at present living. This last point would be of special value to one proposing to pursue philosophical studies in Europe. The tables on the rise and development of Christian thought, and on the church philosophy of the middle ages are valuable for students of theology.

Pawnee Hero Stories and Folk-Tales. GEORGE BIRD GRINNELL. New York-Forest and Stream Publishing Company, 1889.

In the present volume Mr. Grinnell gives the results of his interesting investigations on the customs and beliefs of the Pawnee, the bulk of the book being a collection of tales and traditions. The second part of the work contains a most interesting description of Pawnee life and customs, as observed by the author during his long and frequent stays among this tribe. We mention the chapter on religion, in which the subjects of belief, ceremonies and mystery are treated separately, as particularly important. When referring to the ethnological affinities of the tribe the author places the Pawnees erroneously with the Tonkaway and Lipan, with whom they are in no way related. The interest of the book centers in the chapter on folk-tales which the author collected in the spring of 1889. He has endeavored to retain as much as possible of the original form of the tales. He has succeeded in telling them in an attractive form, although they retain throughout the stamp of the peculiar culture of the Indians. Here is the most formidable difficulty to the collector of Indian myths and tales,—to make his book intelligible and readable, and still not to introduce ideas foreign to the mind of the Indian. Certainly the only way that seems free from most objections is the collection of Indian texts, and even here the individuality of the observer makes itself felt. But if we should confine ourselves to this method, all hopes of a sufficiently extensive collection of American lore would have to be abandoned, as the number of languages is a formidable obstacle to a successful carrying out of such a plan. The most notable among the tales recorded by the author are those referring to the Nahurac, animals in human shape, who live at certain places underground, where they have their council lodges. They are endowed with supernatural power and it is told how they restore men to life and from them are derived the teachings of the secret societies.

The Cherokee Ball Play. JAMES MOONEY in the American Anthropologist, Vol. III, p. 105.
Cherokee Theory and Practice of Medicine. JAMES MOONEY. Journal of American Folk-Lore, Vol. III, p. 44.

These two articles which the author publishes as an earnest of the results of his investigations among the Cherokee, carried out under the auspices of the U. S. Bureau of Ethnology, bring out in the most emphatic way the close connection between religious life and the customs of ordinary life among primitive men. Mr. Mooney describes in great detail the ceremonies connected with the ball play, which seem to have escaped all former observers. There is a myth according to which the bat and the flying squirrel at one time helped the birds to win a game of ball against the quadrupeds. Consequently their skins are considered powerful amulets for ball players. The players are trained, but have at the same time to go through certain performances of a religious character, abstaining from certain food and certain occupations, ceremonial bathing and bleeding. The night preceding the game a dance is held by the whole tribe in which men and women take part and which has evidently a religious significance.

The author records the ever-recurring idea that diseases are believed to be produced by witchcraft or by the influence of spirits; but what is most curious is the method of selecting certain cures for specific diseases that are considered to be due to natural causes. The connection between the medicine and the disease treated is generally that of some analogy, real or fancied. Thus heart-troubles are believed to be due to the lungs becoming wrapped around the heart. Fern is used for treating these diseases, "because the leaves when young are coiled up, but unwrap as they grow older."

On poisoned arrows in Melanesia. R. H. CODRINGTON. Journal of the Anthropological Institute, Nov. 1889, p. 215.

We learn in this paper a curious example of the conception of poison in primitive man. In certain parts of Melanesia arrows are used which are smeared with vegetable juices, that are generally considered to be poisonous. According to the native theory the actual poisonous principle of the weapon is the point which is made of human bone. After a man is struck by such an arrow, the ghost of the person whose bone was used in making the arrow gains control over the wounded person. The enemy who wounded him makes certain incantations and consequently the ghost kills his enemy. The method of treating the wounded is quite analogous. The ghost is kept from the hut in which the sick person lies, by means of rattles made of shells which are fastened to the roof of the hut. The bone is extracted from the wound and kept at a cool place as a prevention of fever. The enemies on the other hand, will heat the bone and drink hot, irritating juices, in order to bring about inflammation of the wound.

Climatic Influences in Primitive Architecture. BARR FERREE. The American Anthropologist, Vol. III, p. 147.

Everywhere a certain connection between climate and architecture may be observed, even among civilized people. This influence is far more evident among primitive people. In warm climates man may content himself with a simple rectangular wall for protection against the wind. In colder and windy climates he will endeavor to make the walls of his abode impermeable for the wind and avoid all unnecessary openings. In rainy climates pitched roofs are used very generally, or other devices are applied which serve the purpose of carrying off the rain. Difference in material of construction is principally due to geographical causes. Lack of wood led to the development of the art of using skin and, later on, clay. The author passes in review a number of similar phenomena, and points out the importance of sociological facts in the development of architecture.

Erfahrungen zur Entwickelungsgeschichte der Völkergedanken. K. VON DEN STEINEN. Globus, Vol. 56, p. 11.

The author of this ingenious paper has won well deserved renown by his expeditions through the interior of Brazil and the conclusions which he draws from his wide and varied experience will not fail to attract the attention of anthropologists. He claims that "animism" necessarily developed, as soon as man began to speak, because the similarity of speech and the production of sounds by other beings must lead to this belief. He assumes, and this is, we believe, an original idea of Von Steinen, that a limitation of the idea of animism followed the invention of instruments, of objects which do not develop or come into existence, without the co-operation of man. The author believes that when objects were first made or modified by man, according to the will of man, the idea of causality first originated. We do not see quite clearly why such should have been the case, as animism is certainly an attempt at explaining the phenomena of nature. Besides this, utensils were considered by many primitive tribes as possessing souls, sometimes even more than stones, wood and similar natural objects. The *apeçu* gives a number of ingenious ideas which supplement those developed by Spencer and other authors.

The Psychology of Prejudice. Prof. G. T. W. PATRICK. Popular Science Monthly, March, 1890.

Prof. Patrick explains the phenomena of apperception, with ample illustration and agreeable style, especially in the fields of opinion and action, where they appear as prejudice and habit.

European Schools, or what I saw in the Schools of Germany, Austria and Switzerland. L. R. KLEMM, Ph. D. International Education Series. Vol. XII. New York, 1889.

This note-book is of unusual value. The author records facts not theories, describes concrete lessons not school curricula, and, instead of padding his book with pedagogical platitudes, gives three or four hundred pencil sketches of educational devices, samples of pupil's drawing, and the like, personally observed. A large part of the book is devoted to German schools. The work described shows that in Germany the effort is made to base education upon psychology, and that the teachers have at least learned to utilize the spontaneous interests of children. The description of the School for Dullards at Elberfeld, and the concrete examples of work done at the *Francke Stiftungen* are of special psychological interest.

Zur Psychologie der Taschenspielerkunst. MAX DESSOIR. Nord und Süd, Heft 155, 1890. pp. 29.

In this very readable essay Dessoir has attempted an analysis of the points of psychological interest in the performance of the ordinary stage conjurer. The essay begins with an historical sketch of conjuring and conjurers, showing the steady improvement in the tone of these performances, an improvement largely consisting in the substitution of psychological for purely mechanical modes of deception. The successful tricks of to-day are in their construction essentially psychological. They are arranged so as to precisely imitate the condition of affairs under which the most natural inference would be the true one, and yet the circumstances really make it as false as possible. Of course manual skill always has been, and still is, one of the essential requisites, but manual skill alone never makes a conjurer of the highest order. The by-play and the mode of presenting a trick so as to divert attention from the real doing of it are far more important; the truly great conjurer produces an atmosphere of confidence in what he says and does, and at the same time such a feeling of bewilderment and astonishment that the simplest trick is invested by the spectator with a halo of the miraculous. To illustrate these general principles a number of tricks are analyzed and a number of the rules of the trade are brought together, all tending to show the psychological insight of these adepts at deception. To simulate the ordinary forms of perception and inference, these must be correctly understood both objectively and subjectively, and hence the importance of the psychology of deception.

Recherches sur les mouvements chez quelques jeunes enfants. A. BINET. Revue philosophique. Mars, 1890.

The observations of M. Binet cover four topics: tne movements of walking, bilateralism, automatism, and reaction-times. The age at which a child begins to walk is not fixed and certain, but depends on its strength and many other circumstances among which the psychic character of the child (its power of attention) has a place. Binet like Preyer finds these movements not acquired by imitation, but instinctive. In a baby only three weeks old, so held that the soles of its bare feet received the stimulus of contact, he noticed the alternate movements of walking. In another child of about the same age the movements were not to be observed; in still others, however, even younger they were seen. Spontaneous movements in very young children are almost always bilateral, (simultaneous or alternate) as any one may prove to himself by counting, but are almost entirely unilateral in a child of three years. Some of the actions that Binet describes as *automatic*, *e. g.*, the unconscious closing of the hand when an object is placed in the palm, seem more properly reflex. Between these and the automatism of double-personality cases, the author suggests a possible similarity, though he would not press it too far on so few observations; also between the preservation of attitudes (as when a child remains immovable in the midst of some action half performed, because its attention has suddenly been diverted) and the fixed attitudes of catalepsy. In the infant this splitting up of the psychic activities into independent groups would be a sign only that the fixed systematizations of the adult mind were yet to come. The reaction-times of children from three and a half to seven years old to sound, registered with a Marey tambour, were from .440 to .660 sec., against .140 for grown persons using the same apparatus, results similar to those reached by Herzen. The maxima and minima were .750—1.300 and 190—200 respectively, and the reaction-times quite irregular. The contraction made in response seems to last longer with the child than the adult and to reach its maximum amount less quickly. The most rapid rate of closure of the thumb and finger upon a rubber tube was for children 7-12 in four seconds, for adults on the average 18. Binet observed in a child less than three weeks old, who had never been allowed to fall, an instinctive dread of being held in an insecure position.

Education of Laura D. Bridgman.

Almost the only sources of first hand information in regard to the beginnings of Laura Bridgman's education are the reports of Dr. Howe, which have for a long time been practically inaccessible. These have now been collected and reprinted in a volume of 233 octavo pages, with a preface by Julia Ward Howe, and a brief obituary notice of Laura Bridgman by another hand. Besides the reports, the book also contains a number of paragraphs upon various aspects of Laura's condition and training, found among Dr. Howe's papers and probably intended by him as notes for his own use in the preparation of a contemplated book upon this subject. It is a matter for congratulation on the part of pedagogy and philanthropy alike that these original records of a masterpiece in both have been collected and republished. There is no publisher's name upon the book, though it can probably be obtained from the Perkins Institute for the Blind, South Boston, Mass.

Versuche über den zeitlichen Verlauf des Gedächtnissbildes. Dr. J. PANETH. Posthumously communicated by Prof. Exner. Originalmittheilung; Centralbl. f. Physiol., Bd. IV, No. 3, 10 Mai, 1890.

The interesting question of the rate at which the memory images of sensation fade has several times been made a subject of experiment; as early as 1851 E. H. Weber tested it for weights and the length of lines. Later experimenters in several instances have found the strange result that for sensations to which attention is given the decline in exactness is hardly appreciable, and with these the experiments of Paneth range themselves. He worked on the memory of time intervals ranging from a fraction of a second to several whole seconds, the strength of the memory image being measured by the ability to reproduce the given standard interval after a longer or shorter pause. The pauses varied from a fraction of a second to five minutes, and within these limits the fading of the image was scarcely to be appreciated. Toward an explanation of this persistence, the like of which Exner reports to have been found in the case of areas and of intensities of light in yet unpublished experiments of Dr. Wahle, it is suggested that the quantitative relations of any sensation to which we give attention are immediately registered in their proper places in the great mass of recollections already present, and what is afterward recalled is not so much the original sensation as these places. The "primary memory image" of a sensation, if unfixed by attention, is a very transient affair.

La morphinomanie. BALL. Paris, 1885.

Morphinomania holds the same relation to morphinism that dipsomania does to alcoholism; but dipsomania is intermittent, while morphinomania is continuous. The effects of opium upon the intellect are slight at first, but hallucinations come in later that may rise to acute mania as, *e. g.*, the "running a muck" of the Malays. The drug has a paralyzing effect upon the organs of vegetative life, and the moral sense is obliterated. The habit once formed, abstinence causes the same painful symptoms as abuse. Opium, hashish, tobacco, alcohol, tea and coffee seem to have many characters as nervines in common. As stimulants, they produce euphoria; excessive use (and abstinence after moderate use) causes insomnia, motor troubles, hallucinations, delirium, etc. The sexual passions are enfeebled; a temporary abstinence acts aphrodisiacally. The strength of the dose needed to produce full effect requires to be gradually increased in case of opium, sometimes a decrease as small as one-twentieth of a centigram is felt keenly. Two methods of cure are used. A sudden cessation accompanied by careful nursing and medical attendance, is short but risky; and the author recommends the gradual diminution of the dose even if the cure is protracted and painful. Tonics should be given, but nothing stronger than coffee. The paper concludes with an interesting review of cases of "*folie gemellaire*" in which twins, even though separated, were attacked in precisely the same way at the same time, and the development of the mania leading to suicide was parallel in the two persons. Cases of this sort show a great susceptibility to nervous contagion. Cases of similar dreams in two or more individuals more or less in the same physiological state have been known.

PSYCHOLOGY IN AMERICAN COLLEGES AND UNIVERSITIES.[1]

PSYCHOLOGY AT THE UNIVERSITY OF WISCONSIN.

By Professor Joseph Jastrow.

Courses: (A) General course in Psychology for such students as take no other Philosophical work. Fall term: daily (about 65 hours); largely elementary work by recitation. Prof. *Stearns* has the class half the time, taking general topics in Psychology, and such as have a philosophical bearing. Murray's Handbook of Psychology is used as a basis in this work. My own part of the work is by lectures, covering the following ground: (1) The Senses (following Bernstein's Five Senses of Man), laying stress upon the psychological interpretation of sensations; (2) the Nervous System treated somewhat as in Carpenter's Mental Physiology, ch. II., not in detail and with some comparative and developmental considerations, and laying stress upon reflex, automatic (and secondary automatic), and voluntary acts, as well as on the general discussion of higher and lower centers and localization, (1 and 2 cover about three-fifths of the course); (3) the Psychophysic Law and Experimental Psychology, accentuating the importance of methods and the relations between the senses; (4) Time Relations of Simple Mental Phenomena, simple reaction, distinction, choice, association, etc.; (5) Experiments with Higher Mental Processes, memory, attention, association of ideas, etc.; (6) Animal Psychology (1 lecture); (7) Infant Psychology (1 lecture); (8) Morbid Psychology: diseases of speech, of memory, of will, of personality (Ribot) as illustrating normal Psychology (3 lectures); (9) Anthropological Psychology (1 lecture). Only such experiments and demonstrations are performed as can be shown to a large class at once: the simple phenomena of sensation, with models of sense-organs, simple reaction-time experiments, and the like. The class last autumn numbered ninety-seven.

(B) Advanced Psychology: Lectures two hours weekly, and one afternoon in the laboratory for winter and spring terms; about forty-five lectures and half as many demonstrations in laboratory. Students must have taken course (A) to enter course (B). Ladd is used as a reference book for students. The topics are covered in a very much more thorough manner than in course (A), and in all points in which the same topics occur in the two courses the elementary parts are hastily reviewed and the topics then resumed. As far as practicable each student repeats for himself all experiments and observations. A list of topics in order is as follows: (1) Nervous System, covering the ground in Ladd, sections are examined, models used, and the simpler physiological experiments performed; (2) Senses, with very full tests of experiments, the students making the usual designs for the stereoscope, rotating discs, color experiments, test weights, etc.; (3) Reaction-times as in course (A), but more detailed, and with variety of experiments; (4) Psycho-

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[1] It is only fair to state that the accounts given below were for the most part received by the editor two months ago.

physic Law: full experimental treatment; (5) Experiments with Higher Processes. This experimental portion occupies the entire winter term. Topics taken up in the spring term are: (1) Comparative Psychology (attempts will be made to have a few instinct studies going on); (2) Morbid Psychology, including psychic research problems and defectives (visits to neighboring insane asylums are contemplated); (3) Anthropological Psychology (Tyler as basis); (4) Psychological Theories. One afternoon in each week is devoted to the tests above mentioned, to demonstrations or other laboratory exercises. Where the topic does not admit of such illustrations, a lecture or report upon literature will be substituted.

At present the library facilities are inadequate, but my own library is at the disposal of students.

The laboratory consists of one large room on the second floor of Science Hall, and an ante-room for quiet, undisturbed work. It is proposed to fit this also as a dark room. Apparatus is constantly being added. We have in use now the following: Hipp chronoscope with fall apparatus, also long fall apparatus of my own construction; Yung triple rotating apparatus, two full sets color discs, etc., Yung clock-work for rotating discs; Holmgren color-blindness test, Joy-Jeffries color-blindness chart, Oliver test-letter chart, Snellen's Optotypes, apparatus for testing blind-spot (own construction), model of eyes in motion, six stereoscopes, Wheatstone stereoscope, two æsthesiometers (own construction), two muscle sense apparatuses (own construction), apparatus for bilateral asymmetry, two pressure sense apparatuses (our construction), Verdin rotating drum, Marey tambour, Deprez signal, three metronomes (with Marey attachment), Féré dynamometer (with Marey recording attachment), Savart's wheel, color contrast apparatus, psychophysic law apparatus, colored papers, drawing instruments and usual supplies. Many of the instruments of the physiological department, especially models, are used.

Laboratory work: Besides the weekly demonstrations and the repetition of experiments by students, original research is undertaken under my personal guidance. Students meet by appointment and do as much as time allows. I spend three entire afternoons in the laboratory throughout the year. A Fellow in Psychology and Philosophy has been appointed. Private research is engaging several advanced students. The "Studies" which have been printed in this JOURNAL give an idea of this work. An evening Psycho-philosophical Seminary is contemplated. Plan: one-half term to a selected topic discussed throughout the season; other half to literature, mainly that of the periodicals.

PSYCHOLOGY AT THE UNIVERSITY OF NEBRASKA.

By DR. H. K. WOLFE.

In the University of Nebraska the first attempt to introduce the study of Physiological Psychology and Psychophysics was made in the fall of '89. As a preparation for the specific work of the year a course of five general lectures on the following subjects was given: 1, Philosophy; 2, Psychology; 3, Biology; 4, Embryology; 5, Development of the Individual Human Nervous System. Ladd's Physiological Psychology was recommended as a guide, and, except in the succession of topics, represents the work done by the average member of the class. During fourteen weeks about one-half of the text was completed. The subject will be continued one term longer for the general student, and will be followed by special work for those desiring it. References were freely given to THE AMERICAN JOURNAL OF PSYCHOLOGY, *Mind*, *Philosophische Studien*; to Foster, Gray, Balfour, Wundt, Schwalbe, Hermann (Handbuch), *et al*; yet only occasionally was work outside of text book *required* of the student. Considerable extra text work was required where Ladd's treatment was deemed too brief, as in reflexes, development, and especially the sense-organs of sight and hearing.

The class room work was informal, having for its object the elucidation of obscure points rather than the discovery of indolence and ignorance in the student. As aids the department has (a) a set of Marshall's charts and numerous home-made drawings (chiefly embryological), besides several hundred painted squares and discs for color sensations; (b) Azoux's Synthetic Preparation of Brain, Eye, and Ear; (c) Hipp's chronoscope; (d) the nucleus of a psychological library. Several pieces of apparatus for original research are in process of construction. Not a few instruments belonging to the departments of Biology and Physics can be used as required.

For the term beginning Jan. 2d there were offered; (a) the continuation of Physiological Psychology; (b) a four hour course in Experimental Psychology; (c) a special course of lectures on Sight. Next year (a) and (b) together with a course on Pedagogical Psychology will extend throughout the year.

Besides assisting in the cultivation of the general student, it is expected that this department will render material aid to scientific pedagogy; furthermore, that its work will have a practical bearing on methods in the public schools of the state. The plan includes, therefore, three more or less distinct objects, viz.: general cultivation, pedagogical foundation, original research. It is intended to equip the laboratory as fast as funds can be obtained. After next year post-graduate work and opportunity for original research will be offered; the lecturer has considerable material on hand, and is now engaged on a subject of apparent fertility.

DEPARTMENT OF PSYCHOLOGY AT THE NEW YORK COLLEGE FOR THE TRAINING OF TEACHERS.

By W. L. Hervey.

As the New York College for the Training of Teachers is a professional school where none but professional branches are pursued, Psychology is studied solely as a branch of Pedagogics. Only so much of Philosophy, Physiology and Rational Psychology is introduced as is necessary to enable student-teachers to derive the principles of Pedagogic Science. The data for these fundamental principles are gained partly by reading and lectures but largely by induction by the class from personal experience and from observation of children. At the beginning of the second term of the first year students are given blanks, with definite time and opportunity to study the children and record observations. To aid them further in finding out the contents and workings of children's minds, sets of questions, which suggest ways and means of investigation, are placed in the hands of all. A large Model School in connection with the College affords ample opportunity for profitable work in this direction. The special Kindergarten students are also required to make definite record of all observations in the course of their almost constant intercourse with children. It is thought that this study of children, which has hitherto been largely overlooked, will result in important contributions to educational science.

PSYCHOLOGY AT COLUMBIA COLLEGE.

By Professor Nicholas Murray Butler.

Psychology is one of the subjects included in the work of the philosophical chair and up to the present time has not been organized as an independent department. This is a step in advance which it is hoped to take in the near future. Up to the present time no laboratory or apparatus has been provided for the study of Experimental Psychology, but the present incumbent of the philosophical chair (who has been at the head of the work for but a short time) has already laid the matter before the President and Trustees and hopes to secure within a few months not only a specialist in Experimental Psychology, but a well-arranged laboratory and a fair stock of apparatus. When this has been accomplished, it is the intention to organize a thorough course of three years in Experimental Psychology modeled after the best American and European courses. The first year of this course will be elective for members of the senior class in the college; the two remaining years will belong to the graduate or university work. Of course the laboratory and apparatus will also be available for independent investigation and research by specialists attached either to this or other institutions. Arrangements are also well under way by which the results of any original observations or experiments may be promptly published by the department. It is hoped that this course, when established, will be specially attractive to many of the students in the medical school of the College.

The library facilities are and will continue to be unexcelled. As rapidly as possible the standard psychological works, journals and reports are being collected, and funds will not be wanting to supply any reasonable demand of this kind.

At the present time only the introductory part of the course referred to is being given, and that without any adequate supply of apparatus or illustrative material. The instruction is wholly by lecture and covers the general relations of body and mind, the gross anatomy of the cerebro-spinal system, the anatomy and physiology of the end-organs of sense and of motion, and the simpler problems of cortical localization and of psycho-physics.

PSYCHOLOGY AT HARVARD UNIVERSITY.

By Professor William James.

The Corporation of Harvard University have recognized the position of Psychology as an independent science, by creating a new professorship bearing its name. Professor *William James* was appointed Professor of Psychology last December; and it is hoped that the department will start next fall with a laboratory amply furnished and endowed, and the beginning of a library for the exclusive use of its students and additional to the University library. These so-called departmental libraries are already in existence in many of the branches of instruction at Harvard. This year the psychological instruction is in the hands of Professors *James* and *Royce*, who each give to the undergraduates a course in Logic and Psychology for three hours a week throughout the year. The Psychology occupies about six of the eight months during which lectures last. Both instructors use Ladd's Physiological Psychology as a text book, and accompany it with comment and experimental demonstration. The subject is decidedly popular with the students, 175 of whom have elected it this year.

The graduate course is given by Professor *James*, this year to six graduates, and to two seniors specially privileged. The method is the so called seminary-method, no two men doing just the same work. Brain-anatomy, however, forms an obligatory part of the course, and human brains are dissected instead of the sheep's brains used by the undergraduates. The class meets two hours weekly at the Professor's house for lecture and discussion, and the students do their laboratory work at special individual hours. This course lasts two years. Two of last year's students attend this year. The papers by Mr. Delabarre in this Journal (Vol. 2, pp. 326, 636) are fruits of last year's work.

PSYCHOLOGY AT YALE UNIVERSITY.

By Professor George Trumbull Ladd.

Any fairly complete account of the study of Psychology at this University should include the following particulars:—

A. An Elementary Course. This course is prescribed for all Juniors in the Academical Department; it covers three hours of class-room work a week during the entire year,—if, as in my opinion is certainly just, we include under the head of Psychology those mental phenomena ordinarily assigned to formal logic, logical praxis, and descriptive ethics. It is taught by Mr. *Duncan*, with the free use of several text-books; and it is designed to open the field before the students, and enable each man intelligently to choose whether he will accept or reject the offers of further work in the subject.

B. Supplementary and Allied Courses.—During the same (namely, the Junior) year, and for a year following, several courses in biology may be pursued. These cover the ground of experimental inorganic and organic chemistry, especially of physiological chemistry under Professor *Chittenden*, of human physiology, and of comparative anatomy and histology under Professor *S. I. Smith*. The courses are all conducted with a large amount of laboratory work, demonstrations, illustrative experiments, and lectures. Nearly all the men who take my course in physiological psychology have these courses, four hours a week, for two entire years.

In this connection should be mentioned certain work done in the Sheffield Scientific School and in the Medical School. In the former, Professors *Chittenden* and *Smith*, with the aid of their pupils, are constantly making and publishing researches in physiological chemistry and biology. In the latter, Professor *Thacher's* work in physiology, and the work of Professor *Lee* in histology, are worthy of special mention.

C. Advanced Courses.—With a class composed partly of undergraduate and partly of graduate students, I go over the ground covered by my "Elements of Physiological Psychology." This course is two hours a week for an entire year. Part I of the book is supplemented by lectures and demonstrations from charts, a complete set of the Boch-Stéger models, and a small but choice selection of histological preparations. For displaying the preparations I find one of Zeiss' hand-microscopes, with objectives and eye-pieces that enable me to go as high as 250 diameters, exceedingly convenient. In teaching Part II I have to rely upon charts (illustrating optical illusions), machine for mixing color-sensations, etc. I regret to say that Yale has not yet established a separate laboratory for researches in experimental psychology.

Dr. *Porter*, whose work of teaching has for several years lain largely in the line of ethics, offers at present an advanced course in psychology. It is designed to afford the student opportunity to re-examine with a critical spirit some of the questions which have been raised by the earlier study of psychology. I have also a course, two hours each week for the entire year, which takes up the psychological problems anew for discussion from the philosophical point of view. Mr. *Duncan* has a somewhat similar course,—though briefer and with less attention, perhaps, to the philosophical implications.

In Pedagogics, as considered from the point of view of psychology, I have a course, which perhaps should be mentioned in this connection.

I do not think it in place to mention apart several other courses in philosophy, and the history of philosophy, taught by lectures and by "seminary" methods, in which psychological and ethical problems have a prominent part. Nor need there be more than a reference to most of the large amount of work in physics, chemistry, biology, comparative anatomy, histology, anthropology, neurology, etc., which is going on in the several departments of this University. I will only add that Professor *Hastings* has been making special researches in optics, which are soon to be published; and that Professor *Sumner's* course in anthropology, in which Ratzel's *Völkerkunde*, Lippert's *Kulturgeschichte*, and Ranke's *Der Mensch* are used as text-books, with illustrative lectures and detailed study of special topics, is deservedly popular.

The facilities of the library are on the whole very good, although it does not by any means contain all the past and current works on Empirical Psychology. The great "archivs" and quarterlies and reports—anatomical, physiological, biological, etc.—are well looked after; it being the policy of the library to accumulate a collection of such books. Within reasonable limits I can have ordered what I desire. My private library contains a good many of those smaller (but sometimes very valuable) monographs, which a large public library is apt to overlook.

PSYCHOLOGICAL AND ANTHROPOLOGICAL APPARATUS NOW ACCESSIBLE TO STUDENTS IN WASHINGTON, D. C., IN THE OFFICE OF THE SURGEON GENERAL.

Psychological and Physiological Tests. Set of whistles of Galton to test hearing, Cattell's reaction time apparatus, æsthesiometer of Jastrow, kinesimeter of Hall and Donaldson, Jastrow's instruments for measuring muscular sense (Nos. 1 and 2), Salter's dynamometer to test pull, Salter's dynamometer to test squeeze, Galton's apparatus to test swiftness of blow, Galton's test type, Galton's test of estimating squareness, Galton's test for judgment of eye, optometer of Taval, optometer made by Giering & Co., Snellen's phakometer.

Experimental Physiology. Kymograph, Keyt's compound sphygmograph, and four others, Kuhne's "optical" eye.

Instruments to Measure the Living. Wooden rod on standard for stature, etc., Mathieu's anthropometer (Broca's pattern), British weighing and measuring machine (by Casella, London), height scale after Galton, scale for span of arms after Galton, Broca's graduated plank for anthropometry, Broca's directing square for anthropometry, Broca's exploring square for anthropometry, conformateur (as used by hatters), two pair of chest calipers, Kluge's pelvimeter, cephalometer of Antelme.

Instruments for Measuring Skulls. Spengel's craniometer, Virchow's craniometer, Virchow's steel caliper, millimeter wheel, steel measuring tape, caliper of three branches, ordinary caliper, gliding caliper of Broca, Flower's modification of Broca's caliper, steel rulers in inches and centimetres, Topinard's projecting board, Topinard's craniophore, Topinard's large square, Topinard's small square, median facial goniometer, facial goniometer, parietal goniometer of Quatrefages, mandibular goniometer, apparatus (old fashioned) for studying *foramen magnum*, iron craniophore, projecting board for long bones (with goniometer).

Instruments for Drawing Skulls. Drawing apparatus of Lucæ as improved by Spengel with two orthoscopes, apparatus of the Army Medical Museum with three periglyphs, endograph, craniophore for holding crania to be photographed, stereograph of Broca, apparatus to draw axis of ends of humerus to estimate its torsion, instruments to take internal capacity of skulls, bronze standard skull of Ranke.

Set of Instruments and Materials for Shot Measurement. Hunting shot No. 8, shot jar, two-litre measure, two tin pans, two ring-shaped mats, rammer, wadding, one-litre measure, one-litre graduated glass, wooden operculum for the same, funnel (2) small, funnel (5) large, leather jacket for frail skulls, machine to drop shot into the litre can.

Set of Instruments and Materials for Water Measurement. Scales, weights, ether spray apparatus, shellac, adhesive plaster, putty, simple cerate, lard, linseed oil, bread board, rolling pin, water vessel with tubing and stopcock, half-gallon measure, pan with lip, metronome, 2000 c. c. graduated glass, wiper for the same, insufflator, powdered lycopodium, instruments to remove putty, thermometer; also, for use when required to replace either method, a quantity of mustard seed.

PSYCHOLOGY AT THE UNIVERSITY OF PENNSYLVANIA.

By Professor James McKeen Cattell.

Special courses in Psychology are given by Professor *Fullerton* and the writer. Professor *Fullerton* is giving this year two courses, one for undergraduates, the other for graduate students. In these courses special stress is laid on psychological analysis, and those regions of Psychology which border on the theory of knowledge. The writer gives three courses extending through the year; an introductory course in Experimental Psychology, a course beginning with the special study of some psychological problem, and taking up in the second half year Comparative, Social and Abnormal Psychology, and an advanced course in Physiological and Experimental Psychology. These courses include either practical work or research on the part of the student. A lecturer on Philosophy and an assistant in Psychology are about to be appointed, and additional courses will be given next year.

In addition to these special courses, Physiological, Abnormal and Comparative Psychology may be studied in the Medical and Biological departments of the University. These are probably without rival in America, and offer complete courses of lectures, practical work and clinics. Psychology borrows from and lends to all the sciences. Everyone of the large number of advanced courses offered by the University bears some relation to Psychology, and may prove useful to the student. Attention should also be called to the libraries, scientific and art collections, zoölogical and botanical gardens, literary and scientific societies, etc., of Philadelphia. The asylums and hospitals will be found of special advantage to the student of Psychology.

The new library building of the University is nearly completed. There is a special endowment for the purchase of philosophical and psychological books, and any books needed by students for special work will be obtained. The University press is about to begin the issue of a series of monographs, representing work done in the fields of Philosophy and Psychology. The first number, now in press, is a psychological study on "Sameness and Identity," by Professor *Fullerton*. Following this number will be a series of researches from the Laboratory of Psychology, and an edition of Descartes' "Meditations" with Latin and English texts and philosophical commentary.

It is possible that the readers of the American Journal of Psychology may be interested in some details concerning the Laboratory of Psychology, and the researches now in progress. The writer believes that the chief work before Experimental Psychology is the measurement of mental processes. As Experimental Physics is devoted to the measurement of time, space and mass in the material world, so Experimental Psychology may measure time, complexity and intensity in consciousness. In so far as cases are investigated in which one mental magnitude is the function of another, a mental mechanics is developed.

The laboratory possesses apparatus, which measures mental times conveniently and accurately. This apparatus has been described in *Mind* (No. 42), but since then it has been improved. The chronoscope has been altered and a new regulator made, so that the mean variation of the apparatus is now under one-thousandth of a second. New pieces have been built for the production of sound, light, and electric stimuli. Apparatus for measuring the rate of movement and for other purposes has been added. The observer is placed in a compartment separated from the experimenter and measuring apparatus. With this apparatus researches are being carried out in several directions. Professor *Dolley* is measuring the rate at which the nervous impulse travels, using two different methods. In one series of experiments an electrical stimulus is applied to different parts of the body, and a reaction is made either with the hand or foot. The rate of transmission in the motor and sensory tracts of the spinal cord has thus been determined. In a second series of experiments two stimuli are given at different parts of the body, and the interval between them adjusted until the observer seems to perceive them simultaneously. It is thought that these experiments will throw more light on human physiology than cases in which the nerve (motor only) of a partly dead frog is artificially stimulated. The times are also of interest to Psychology, as they are needed in order to determine purely mental times. Mr. Witmer is measuring the personal difference in reaction-times, and the work will be extended to different mental processes. These times seem to vary with age, sex, nationality, education and occupation, and their study may have practical value as well as theoretic interest. Length of life should be measured by rate of thought. Experiments are also being made on the variation in the reaction-time from hour to hour and day to day. With the co-operation of Dr. Weir Mitchell and other eminent neurologists the alteration in the time of physiological processes in diseases of the nervous system is being studied. It is believed that such tests may be of use in diagnosis. The nervous impulse may be sent through the system in different directions until a relative delay discovers the diseased part. Recovery and progression may be studied by noting the alteration in time.

Owing to the introduction of cerebral surgery and the advances recently made in the treatment of diseases of the nervous system, any method which may make diagnosis more exact deserves careful study. In addition to the time of physiological processes in disease, other tests of loss of sensation, power and intelligence, are made in the laboratory. The following ten tests are recommended; the methods, etc., are described in an article now in press for *Mind:* 1, dynamometer pressure; 2, rate of movement; 3, sensation-areas; 4, pressure causing pain; 5, least noticeable difference in weight; 6, reaction-time for sound; 7, time for naming colors; 8, bisection of a 50 cm. line; 9, judgment of ten seconds time; 10, number of letters remembered on hearing once. These determinations are made not only on those who are suffering from disease, but also on every one who wishes to be tested. It is hoped that the same tests will be made elsewhere, so that the results of a large number of observations may be compared and combined. The undergraduate students in Experimental Psychology undertake a course of laboratory work in which about two hundred tests and measurements are made. It is hoped that when a sufficient mass of data has been secured, it will have some scientific value. In the cases of two of the tests given above, The Rate of Movement and The Pressure Causing Pain, researches are being carried out in the laboratory. By altering the distance and nature of the movement, and the point of the body to which the pressure causing pain is applied, new quantitative results are obtained.

Professor *Fullerton* is carrying on a research to determine the rate at which a simple sensation fades from memory. A stimulus is allowed to work on the sense-organ for one second, and after an interval of one second, a stimulus slightly different in intensity is given for one second, and the least noticeable difference in intensity is determined by the method of right and wrong cases. The interval between the stimuli is then altered, and it is determined how much greater the difference between the stimuli must be in order that it may be noticeable. The rate of forgetting is thus measured in terms of the stimulus. Intervals varying from one second to three minutes have been used. For these experiments new apparatus was constructed, and it was discovered that when sensations of light are successive and last for one second, the least noticeable difference in intensity is not about one one-hundredth, as is supposed, but much the same as for the other senses under like conditions. Other observations, such as the importance of keeping the time of stimulation constant, the stronger stimulus coming before or after the weaker, the degree of confidence, the personal and daily variation, etc., have made a new investigation of the least noticeable difference in sensation necessary. This is at present in progress, while further work on memory must wait for its completion. Mr. DeBow is in the mean while making experiments determining the time of stimulation giving the greatest accuracy of discrimination.

The rate, extent and force of movement is the subject of a somewhat extended investigation, which will not be completed for some time. The maximum rate of movement has been noticed above. Experiments on the maximum pressure have been published, as also on extent of right and left handed movements. But the least noticeable difference in the rate, extent and force of movement has never been studied in the same way as the least noticeable difference in passive sensation. Yet it would seem to need such study even more, owing to the importance and obscurity of the "sense of effort."

The laboratory possesses apparatus for studying the time, intensity and area of stimulation needed to produce the just noticeable sensation and a given amount of sensation. These mental magnitudes are correlated so that one may be treated as the function of the other. The results of studying the relation of time to intensity have been published in *Brain* (pt. 31), it being found that the time colored light must work on the retina in order that it may be seen, increases in arithmetical progression as the intensity of the light decreases in geometrical progression. The relation of area to intensity and time is now being studied. Other experiments on the relation of intensity, time and area of stimulation, as determined by the length of the reaction-time, and accuracy of discrimination have been begun.

The laboratory has a valuable collection of Kœnig's apparatus for the study of hearing and the elements of music, and a spectrophotometer, a perimeter and other pieces for the study of vision. Work on hearing and vision has been begun in several directions, but is at present delayed for lack of workers. Some progress is, however, being made in studying the fusion of sensations of light, the laboratory possessing special apparatus by which colored surfaces of given areas may in any succession work on the retina for given times. Mr. Newbold, who has been helping with the experiments on memory, is about to begin a research on attention, and it is hoped that next year there will be others ready to undertake original work. Among the subjects for which apparatus has been secured, and preliminary study has been made are: the building of complex perceptions, exertion and fatigue, the measurement of contrast, the association of ideas, and subconscious mental processes.

I have written more frankly than is usual concerning researches not yet ready for publication. My wish is to secure co-operation in applying scientific methods to the study of mind. We have at the University of Pennsylvania good collections of apparatus and laboratory facilities, and these we shall gladly place at the disposal of any one prepared to use them. But the chief thing is that the work be done; where it may be done is unimportant.

PSYCHOLOGY AT INDIANA UNIVERSITY.

By Professor W. L. Bryan.

As regards the work in Experimental Psychology in Indiana University:—1. When orders now out are filled, we shall have about $500 worth of apparatus, including Hipp chronoscope, Marey chronograph with the attachments to both for studying reflex and reaction time. 2. I have been left practically free to make a course of study, except that it is expected to cover fairly the field of Philosophy for undergraduates. I have accordingly organized the work (except one term in Ethics), around the Theory of Cognition and Method of Science. The elementary work in Psychology and Logic has this direction. A year's work in the History of Philosophy is chiefly the history of theories of cognition,—viewed as a sociological development. I have only left for undergraduates one-third of the time for Experimental Psychology. I shall study such parts of Physiological Psychology as throw light upon the personal equation in its most specific and in its more general meaning. Post-graduate students, of whom I have several, will of course work altogether in this line. 3. After the elementary work, there is a review of the results of Physiological Psychology,—at present following the line of Ladd, though of course not confined to that. The larger, including the current, literature is constantly accessible, and is brought to the attention of students. They are encouraged to take collateral work in Biology and in Physics.

PSYCHOLOGY AT CLARK UNIVERSITY.

By Dr. E. C. Sanford.

The work in Psychology and allied topics at Clark University during the past year has embraced the following topics: Anatomy of the Central Nervous System, Experimental Psychology, Anthropology, Criminology, and the History of Philosophy.

In the way of instruction, Prof. *Donaldson* has delivered a weekly lecture on the first topic, giving special prominence to the embryological aspect and to the relation of structure to function, illustrating the lectures with models and diagrams and following each with dissections, demonstration of sections, exhibition of plates, etc., etc., as might best serve the elucidation of the points in hand. He has also for a portion of the year conducted a weekly seminary upon the history and more general aspects of the question of cerebral localization.

The instruction in Experimental Psychology, under Dr. *Sanford*, has consisted of two courses; one a weekly lecture during the first half year on the time relations of mental phenomena, treating the subject rather minutely and with occasional demonstrations; and the other, a course now in progress (weekly) on sight, taking up in a more general way the vision of color and space perception, with more frequent demonstrations.

Dr. *Boas* has delivered two courses, lecturing twice a week; one on the Anthropology of North America (the Eskimo of the north coast, the Pacific coast tribes, those east of the Rocky Mountains), the other on Methods of Anthropological Study. He has also conducted a weekly seminary for several weeks on "Shamanism."

Dr. *MacDonald* has lectured during the latter part of the year on Crime and Modern Theories of the Criminal.

Dr. *Burt* has lectured through the year on the History of Philosophy, at first on Greek Philosophy and afterward on Modern Philosophy before Kant. He has also conducted a seminary in which twelve dialogues of Plato were subjected to a careful and critical reading with special reference to the development of the author's conceptions; later the categories of Aristotle have been taken up.

Dr. *Cook* has also lectured on the Genetic Character of the History of Philosophy from Locke to Kant. The press of other duties has unfortunately prevented the head of the department, Dr. Stanley Hall, from taking a personal part in the work of instruction. He lead the seminary, however, for a time in the study of Reflex Action and met a number of men for a time in informal conferences.

In the way of original work and research by instructors and students: In the Neurological department, the question of the relation of the growth of a limb to the growth of its nerves and nerve centers has been studied, and progress made with an exhaustive examination of the brain of the celebrated blind deaf mute, Laura Bridgman; experiments have been continued on the effect of stimulation on ganglion cells, a portion of a history of Reflex Action has been written; and histological work has been undertaken on the cerebellum of the cat. In the Psychological department work is under way on the relation of the reaction-time to the muscular character of the response, on the relation of the concept to the simple sensations upon which it rests, and on organic memory in judgments of rhythm and time. The instructor in Anthropology has expended most of his time for research in the working up of data previously collected. Besides this original work the laboratories in each department (and especially in the last) have been used for practical work of a demonstrational character by students who propose to take up research work at a later period or whose lines of immediate interest were in other but related branches.

It is the desire of the University to provide all necessary facilities for research, and the laboratories have been furnished with that in view. The Neurological laboratory consists of two rooms, one large and one small, supplied with the reagents, apparatus and conveniences for histological and neurological work. In the way of illustrative material the laboratory has Æby's and Azoux's models of the brain in man and Ziegler's of the brain in lower animals, and a set of serial sections through the human brain is now in the making. The psychological laboratory (one large and two small rooms) is especially strong in apparatus for time measurements and psychological optics, having already or in construction most of the standard instruments of Wundt, besides many others of Donders, Snellen, Hering, Holmgren, Bowditch, *et al.* For the study of other chapters of Experimental Psychology a considerable collection of apparatus has been made and will be added to from time to time. The anthropological laboratory (two rooms) has all the essential instruments for anthropometry and craniometry. The library collection of books on all these subjects is carefully selected; all the important current periodical literature is accessible.

Next year the lectures in Neurology will continue upon the central nervous system and sense organs, though the scope and character of the course will be dictated in large measure by the wants of those that attend it. The lectures in Experimental Psychology will treat first the senses of hearing, taste, smell and touch, afterward the psychophysic law, memory, attention, etc. Those in Anthropology will cover methods, especially craniometry, the anthropology of Africa, and American myths. Work will also be continued in the history of philosophy, under Dr. *C. A. Strong*, though its precise character is not yet certain. Dr. *Stanley Hall* with the assistance of Dr. *W. H. Burnham* will conduct a course in Modern Aspects of Education.

PSYCHOLOGY AT THE UNIVERSITY OF TORONTO.

By Professor J. Mark Baldwin.

The students' work in Psychology here has been hitherto general and theoretical. The new curriculum, however, as now ratified by the University Senate, provides for more special and advanced courses and opportunity for research. The recent fire in University College postponed the equipment of the psychological laboratory which the writer had in view, but in the plans for the new buildings more ample accommodations are secured. The new laboratory is to be in the restored building in a retired portion of the first floor immediately over the rooms of the physical department. It will comprise two communicating working rooms, each 16 by 21 feet, a professor's private room, to be used also as a special psychological library under charge of a fellow or instructor, and a dark room available from the resources of the physical laboratory. The first two rooms will be separated by a hall from the latter two. This part of the building will be ready for occupation, it is hoped, in the course of the next academic year. The equipment, apparatus, etc., may be delayed in consequence of the present severe tax upon the resources of the University, but special researches will be prosecuted with the aid of adapted apparatus kindly loaned from the very complete collections of the departments of Physics and Biology.

The courses in Psychology for next year are: (a) Pass course in General Psychology on the basis of the writer's Handbook of Psychology and Sully's Outlines, two to three hours a week throughout the year. (b) Honor course in Historical Psychology and Theory of Knowledge. (c) Honor course in Experimental Psychology; first, theoretical, based upon Ribot's German Psychology and Ladd; and second, practical, involving laboratory work as soon as the laboratory is ready for occupation. All students in this course will be required to become familiar with the methods and simplest problems of Physiological Psychology, and questions for advanced study and research will be set for students who show the proper aptitude. (d) A course in the Physiology and Histology of the nervous system with special reference to Localization and Mental Disease is to be offered by Prof. *Ramsey Wright*, of the Biological School. This course serves as preparation for course (c) and for original work on advanced topics. (e) Seminary for reports and discussions of actual researches in hand—meeting weekly. The design is to encourage serious endeavor and stimulate interest in the outlying questions of the sciences, principally among post-graduates. Private facilities will be given whenever possible for experiments in Psychometry and Psychophysics. Of the under-graduates only honor men of the fourth (senior) year will be admitted. It is hoped that the work may be expanded to include problems in Medical and Abnormal Psychology, since the city and provincial institutions present abundant facilities, but nothing in this line has been projected as yet.

During the past year the students of the department have formed a "Psychological Society" for discussion and presentation of papers, conducted entirely by themselves. The object of the society is breadth of information rather than new work. They treat psychological questions, however, quite apart from speculative philosophy.

The library was totally destroyed by the fire, but the new collection is growing rapidly, especially in this department, owing to the notable generosity of friends at home and abroad. In another year it will probably be more complete in psychological publications than before. We are under especial obligations to the editors of *Mind*, *Journal of Speculative Philosophy*, and the AMERICAN JOURNAL OF PSYCHOLOGY for back sets of their respective journals. The new library building as now contemplated is to provide seminary rooms for several of the University departments, one of which (the philosophical seminary room), is to be added to the laboratory rooms mentioned above.

The teaching force is at present the writer and a fellow. After next year Prof. *J. G. Hume* is to assume his duties, and a post-graduate scholarship in Philosophy is to be established in memory of the late Prof. Young. Thus four at least will be the official force in charge.

The following are the subjects of researches now in progress: "Beginnings of Voluntary Movement in Childhood," "Sense of Effort," "Recognition"—together with special topics for the writer's proposed volume on "Feeling and Will."

NOTES.

If further evidence were needed of the vigor and development of the new psychological movement, it might be found in the inauguration of the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, the first number of which appeared on April 20 of this year. The editors are Ebbinghaus, Professor of Psychology at the University of Berlin, well known for his elaborate experimental study of memory and for his researches on sensations of light, and Professor König, of the same university, for some time assistant to Helmholtz, and the author of important studies in the perception of light and color. As co-laborers appear nine of the strongest men in the new movement in Germany: Aubert, Exner, Helmholtz, Hering, Kries, Lipps, G. E. Müller, Preyer and Stumpf. If great names mean anything, the new journal is assured a leading place. The number before us contains in eighty pages brief contributions from nearly all these investigators, psycho physical optics predominating, as will be seen below. Each article is, however, the treatment of a minor point (interestingly and scientifically done in most cases, to be sure), and there is not a *magnum opus* in the lot. How this will be in the future, remains to be seen.

HELMHOLTZ: *Die Storung der Wahrnehmung kleinster Helligkeitsunterscheide durch das Eigenlicht der Netzhaut.*—It is a well known fact that the sensibility for small difference in the intensity of light falls off as the lights to be compared become very bright or very faint. This is to be accounted for, in the first case, by the after-effects of the stimulus, and, in the second case, by the subjective light of the retina. The value found for this last by Volkmann is too small, as observation and experiments (by reducing the sensibility of the optic nerve by means of electrical stimulation) can show. The subjective light further disturbs by its unsteadiness and granular or blotchy distribution. The major part of Helmholtz's paper is a mathematical discussion of the effect of this blotchy distribution on the discriminative threshold, with especial reference to the experiments of König and Brodhun. The formula reached admits of adaptation also to the variation produced by very intense stimuli, and a table calculated by this formula shows a very satisfactory approximation to the results of experiment. In speaking of the vision of objects by very faint light, the author relates the following interesting observation. In his sleeping room, which is so thoroughly darkened that the outline of the window cannot be made out when the moon is in the opposite part of the sky, and the only things to be seen are the flecks of his retinal light, he can yet see his white shirtsleeves when he moves his arms. Considering that this happens when the source of light, the window, is quite invisible, it is a most surprising observation. A number of possibilities suggest themselves, but the actual objective character of the vision appears from the fact that when the hand was stretched toward the window and moved to and fro, its shadowy outline, and even that of the fingers, could be seen more distinctly than when stretched the other way. The meaning of this in a word is that a large faintly luminous surface *at rest* may fall quite below the intensity of the retinal light, and yet furnish enough light to show smaller objects *in motion*. The relatively rapid changes produced in the retinal sensations by such familiar and voluntary bodily movements as those of the arm are easily distinguished from the ordinary fluctuations of the subjective light.

HERING: *Beitrag zur Lehre von Simultankontrast.*—Though further demonstration of the non-psychological nature of simultaneous contrast is coming to seem to Hering like slaying the dead, he allows himself to offer the crucial experiment recorded in this paper, demonstrating that the color received by the eye is what makes the contrast, and not that received by the mind. He furnishes a different color to the mind from that furnished to the eye, by the use of binocular color-mixing, and if a psychological explanation is to be found for what he sees, it will have to be one that includes a different psychical reaction in the two halves of the visual apparatus to the same perception. The setting of the experiment is in outline as follows: Two inclined plates of colored glass are set up, something as for Ragona Scina's experiment, but inclined toward each other like a roof, so that each eye looks through a different plate, the left, for example, through a red glass, the right through a blue one. When the necessary conditions are fulfilled, the observer sees the white ground below the plates, not in the color of either, but in the color of their binocular mixture, namely a whitish violet. If now a strip of black paper is placed on this white ground in the median plane, and the eyes are fixed on a point some distance above it, the strip will appear double and at the same time, under proper conditions for showing simultaneous contrast. If the psychological explanation was correct, both images should appear a yellowish green. As a matter of fact, the one seen by the right eye with the blue glass appears yellow, that seen by the left eye with the red glass, green. The experiment in this form, however, does not exclude successive contrast. To avoid that, a sheet of black paper is laid over the whole of the white ground and the black strip, and the observer, having allowed his eyes to recover fully from previous color-sensations, puts himself in position and suddenly draws away the black paper. The colors immediately appear as before. (A practiced observer can reverse the experiment by a half-minute's steady fixation, followed by the restoration of the black paper. The left eye then sees a red, and the right a blue after-image of the strip, on a faint olive ground.) It might, perhaps, be objected, that the blue-green image of the left eye would be yellow-green (as it should be on the psychological theory), except for the binocular mixing-in of the blue sensation received by the corresponding points of the right eye, and that the yellow image of the right eye would be yellow-green, except for the red sensation received by the left eye. To this it is to be replied theoretically, that the conditions are not such as to favor the binocular mixing of the general color of one field with the image of the strip in the other eye, and experimentally, that making both plates red or both blue does not make the images of the black strip appear grayish, as it would if there were such a mixture as this objection supposes.

FECHNER: *Ueber negative Empfindungswerte. Letters written to W. Preyer, between 1873 and 1883, and now edited by him.*—This portion of the correspondence seems to have arisen from the close resemblance between the myophysic law which Preyer had determined for the extent of the contraction of a muscle under varying intensity of stimulus, and the psychophysic law of Fechner. The mathematical formulæ lead in both cases to negative values. These Preyer would entirely disregard, making his law extend no further than actual phenomena. Fechner, on the other hand, preferred to follow his formula, and regarded the "negative sensations" to which it leads as imaginary sensations, like the imaginary quantities in mathematics, or, in another aspect, as indicating the amount by which the actual conditions come short of the zero point of sensation, or, again, somewhat as a bankrupt's debt might be considered as negative property. These letters, of which five (written in 1873–74) are given, aim to explain Fechner's conceptions, and to answer the objections raised by Preyer. Some incidental reference to Delbœuf is made in the second letter. The series is to be continued in the next number.

EXNER: *Das Verschwinden der Nachbilder bei Augenbewegungen.*—Motion of the eyes generally causes the disappearance of after-images and other subjective visual phenomena, and it is not hard to see why this should be so. The perception of subjective sensations is a hindrance in all normal vision, and we neglect them. Motion of the eyes enables us to do this, because subjective images move with the eyes, those of real things do not. We neglect subjective sensations, not consciously, but rather, says Exner, "by means of a central mechanism, which (not wholly unlike a reflex inhibition) catches away such sensations from consciousness without our assistance, indeed without our knowledge." To this explanation of Exner's, E. Fick and Gürber have objected, asserting, on the basis of experiment, that the disappearance of after-images on motion of the eyes, was due to retinal restoration depending on changes of circulation, which in turn depend on changes of intra-ocular pressure caused by the tension of the ocular muscles, closure of the lids, etc., etc. In reply, Exner urges that the disappearance of after-images is only a special instance of what happens with subjective visual phenomena in general, many of which are in no sense dependent on retinal fatigue and restoration. The well known usefulness of intermittent light in bringing out Purkinje's figures and the like, depends on its excluding motion, by which their subjective character would be revealed. The last traces of after-images can be discovered by rapid winking, which is just what should not happen, according to the restoration theory. For a similar reason, such things sometimes appear on taking a new fixation point, or at the instant of opening the eyes in the morning. Furthermore, movement of the eyes with the lids closed, or rhythmical pressure with the finger, do not cause the after-images to disappear. Disappearance might also be expected in the first of these cases on Exner's own theory—an apparent difficulty, which he explains by the absence of one-half of the ordinary basis of discrimination, to wit, the images of outer objects. A further proof of Exner's general thesis is drawn from the experience of microscopists, where, strangely enough, the exact opposite of the habits of normal vision is found. Microscopists are accustomed to move continually the object examined, and finally come to entirely neglect all images in the field that do not move, though the same are readily seen by those less accustomed to the use of the instrument.

AUBERT: *Die innerliche Sprache und ihr Verhalten zu den Sinneswahrnehmungen.*—Various complex motor processes are of vast importance to physiological psychology, and among them the motor processes of speech hold no minor place. It is with reference to these chiefly that this paper of Aubert's is written. He enumerates the factors of speech and their chief disturbances, in aphasia, agraphia, word-blindness, etc., notes the postulates made in common by the various schemata proposed for explanation, and finally comes to the question of how far the control of speech-motions by the sense organs is necessary. On this point he agrees with Stricker, that such control is not necessary, though he would not exclude it from all influence, as witness the first efforts of children in written speech, and the difference in one's own handwriting when the eyes are closed. In regard to the relation of the senses and the motor-image to muscular movements in general, he holds that the admission of an innervation exactly graded to the amount of contraction of the muscle, and at the command of the motor-image, does not imply that the motorim pulse for an intended movement is therefore exact in extent, direction and time, in advance of practice, or that the extent of the intended movement is, in advance of practice, determining for space-perception as against a wrongly executed actual movement. The state of things may be quite different in respect to sensory control, when new movements are in process of learning, from what it is when they have become reflex through practice. Speaking and writing are learned at too early a stage for auto-observation, and most result is to be expected from the study of simpler movements.

LIPPS: *Ueber eine falsche Nachbildlokalisation und damit Zusammenhängendes.*—When one turns his eyes quickly from one object to another, *e. g.*, from one small flame to another, he can, if skillful enough, observe a transient strip of positive after-image which appears to shoot out from the first object, in a direction contrary to that in which the eyes move. [In trying the experiment, the reviewer finds it easier to get the phenomenon when the head and eyes are moved together; after the thing is once seen in this way, it can more easily be seen when the eyes alone are moved.] The after-image is falsely located, *i. e.*, appears on the wrong side of the object; and this view is supported by the fact that on quickly returning the eyes to their original position, a similar after-image is seen in the same place. Another feature of the experiment, however, was the first to impress Lipps, namely, that the first object seems itself to move in a direction contrary to the motion of the eyes. The two phenomena are closely related, and in explaining the second, the first is essentially explained. The author assumes, according to his theory of space-perception, (this experiment supports that theory in so far as it requires the assumption), that sensations of motion have nothing to do at first hand with visual perceptions of distance, though they may come to stand for them. Now, suppose the eye moves rapidly from a point O to a point P; the distance passed over in such a motion is *underestimated*, but at the same time the true distance from O of the advancing fixation-point is directly *perceived*, and the two united suggests a motion of O contrary to that of the eyes. But this suggestion is in contradiction with the immediate perception of the constancy of the distance between O and P; O must then appear again to return to its proper place. When the after-image is seen, its shooting out and return generally take the place of the apparent motion of the object, which is then assigned to a fixed place at the point from which the after-image appears to start. Such is the skeleton of Lipps's explanation; for the evidence supporting several of the steps, and for the results of the experiment under altered conditions, as also for a brief series of objections to the theory of the immediate perception of space by motion of the eye, the reader is referred to the original.

SCHUMANN: *Ueber das Gedächtnis für Komplexe regelmässig aufeinander folgender, gleicher Schalleindrücke.*—Dietze, Wundt's pupil, found, in experimenting on the ability to recognize the identity or difference of number in two successive groups of metronome ticks, without resort to counting, (1) that the most accurate judgments were made when the ticks were given at the rate of 3—5 a second, (2) that there was an unconquerable tendency to break up the series of ticks into rhythmic measures, and (3) that the maximum number of ticks which could be compared depended on the measure into which they fell; if into 2's, 16, if into 8's, 40. Schumann has repeated these experiments, and finds a point of difference in result 2. His subjects were quite able to receive the ticks singly, though the breaking up of the series into measures rendered comparison easier. Dietze's difficulty may have been either that a habit of receiving them rhythmically had been established, or that his ticks were not all alike in quality. The specific object of the repetition of the experiments was the study of the psychology of such comparisons. The method, according to Schumann's auto-observation (and in this most of his subjects agree), was something as follows. When a series of ticks is given, the subject usually accompanies each tick with some kind of muscular innervation, from which corresponding tensions result. When one standard group is frequently given, it and its number become impressed on the motor and sensory memory. In such a series each tick is expected and prepared for up to the last, and then the expectation and preparation cease involuntarily. Now, when the comparison series is given, the preparation goes on as before, and if the new series is shorter, the preparation outlasts it, if it is longer, the preparation stops too soon, and on this basis the subject makes his judgment. This preparation is influenced by several factors, but under favorable circumstances can be recognized after a very few experiments. One subject, who had been accustomed in astronomical observations to count seconds in groups of 10, could always indicate the tenth tick correctly. The results of Dietze fit in well enough with this explanation, but Wundt's assumption that the last member of such a series lies in the focus of consciousness, and the rest in more and more obscure regions, and that thus a means is offered for determining the *Umfang* or extent of consciousness for such impressions (implying that groups can only be compared when each can be taken into consciousness as a whole), is neither justified by Schumann's auto-observations, nor required by the facts.

Succeeding numbers of this new journal will contain regular reviews of current literature in the fields which it covers, and to this end the sending of off-prints, monographs, etc., is requested. These may be sent either directly to the editors (Prof. Dr. H. Ebbinghaus, Berlin, W. 62, Schillstr. 10; Prof. Dr A. König, Berlin, N. W. 52, Flemmingstr. 1) or through the publisher, Leopold Voss, Hamburg. The yearly volume is to be made up of six numbers, at a subscription price of 15 marks per volume. E. C. S.

The law recently enacted in New York, removing the insane from the county poor-houses to state asylums, deserves mention as a most substantial gain in the scientific treatment of the insane, and in practical ethics. In the poor-houses the insane were often treated like other paupers and sometimes not separated from them; they were without special medical treatment, exercise in the open air, work or amusement, sometimes inadequately fed and clothed, and often neglected and abused. That this state of things was a means of profit to the petty county officers, is abundantly shown by the three years of hard work required to force the law through the legislature. All credit is due to the State Charities Aid Association for this significant advance.

A case reported by F. Ziehl in the *Deutsch. med. Wochenschr.*, No. 17, 1889, is interesting for its bearings on the independence of the sensations of heat and cold. In consequence of an injury to the lower arm, a woman suffered, besides other sensory paralyses, a complete loss of sensibility to warmth in the area of the ulnar nerve. The sensibility to cold, though blunted (only temperatures of 6° R. or below were felt), was retained.

From a laborious examination of the pupils in two Berlin gymnasiums (including the lighting of the rooms, school seats, age, race, skull formation, orbital index, refractive condition of eyes, acuteness of vision, time of in-door work, business of father, optical condition of parents, grandparents, and brothers and sisters), Kirchner draws conclusions in support of the present prevailing views of the origin of near-sightedness. The following are among the points made: Race has a small effect; Jewish pupils are somewhat more apt to be short-sighted than German pupils; among the latter the blonde than the brunette. Low orbits are more frequent with the near-sighted, but this the author looks upon rather as an effect than as a cause (in this opposing Stilling). Heredity is important, especially if both parents are short-sighted. But distinctly the most powerful influence is near work with intellectual strain, especially when performed on badly made seats and in poorly lighted rooms. (*Zeitschr. f. Hygiene*, vii, 3, p. 397)

To the Editor of the American Journal of Psychology:

Dear Sir:—May I ask for the publicity of your pages to aid me in procuring co-operation in a scientific investigation for which I am reponsible? I refer to the *Census of Hallucinations*, which was begun several years ago by the "Society for Psychical Research," and of which the International Congress of Experimental Psychology at Paris, last summer, assumed the future responsibility, naming a commitee in each country to carry on the work.

The object of the inquiry is twofold: 1st, to get a mass of facts about hallucinations which may serve as a basis for a scientific study of these phenomena; and 2d, to ascertain approximately the *proportion of persons* who have had such experiences. Until the average frequency of hallucinations in the community is known, it can never be decided whether the so-called "veridical" hallucinations (visions or other "warnings" of the death, etc., of people at a distance) which are so frequently reported, are accidental coincidences or something more.

Some 8,000 or more persons in England, France and the United States have already returned answers to the question which heads the census sheets, and which runs as follows:

"*Have you ever, when completely awake, had a vivid impression of seeing or being touched by a living being or inanimate object, or of hearing a voice; which impression, so far as you could discover, was not due to any external physical cause?*"

The "Congress" hopes that at its next meeting, in England in 1892, as many as 50,000 answers may have been collected. It is obvious that for the purely statistical inquiry, *the answer "No" is as important as the answer "Yes."*

I have been appointed to superintend the Census in America, and I most earnestly bespeak the co-operation of any among your readers who may be actively interested in the subject. It is clear that very many volunteer canvassers will be needed to secure success. Each census blank contains instructions to the collector and places for twenty-five names; and special blanks for the "Yes" cases are furnished in addition. I shall be most happy to supply these blanks to any one who will be good enough to make application for them to

Yours truly,

Professor WM. JAMES,

Harvard University, Cambridge, Mass.

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ANATOMICAL OBSERVATIONS ON THE BRAIN AND SEVERAL SENSE-ORGANS OF THE BLIND DEAF-MUTE, LAURA DEWEY BRIDGMAN.

Henry H. Donaldson, Ph. D.

I.

Through the exertions of President G. Stanley Hall, the brain in question was obtained and was put by him in my hands for description. Several gentlemen whose names will duly appear have assisted by describing the sense-organs. I am under obligation to others for facilitating the work in many ways, and especially to Prof. W. F. Whitney and his colleagues of the Harvard Medical School, Prof. B. G. Wilder of Cornell University, and Prof. C. K. Mills of the University of Pennsylvania, for the privilege of examining specimens in their possession. For the opportunity to consult the literature I am indebted to the exceptional facilities offered by the Library of the Surgeon General at Washington of which I have made much use.

In the study of this case it has been my aim to give as full a description as the material in my hands would warrant, and for this purpose I have applied a large number of tests to the brain, to determine, if possible, whether the peculiar mental existence of Laura Bridgman, which was the result of her defective sense-organs, has left any trace on her brain, or whether such anomalies as may be observed are sufficiently explained when considered as the direct consequences of the initial defect alone. This is, therefore, a special study in the general field of the inter-relation of brain structure and intelligence. What might be expected to come from the various tests will be discussed under the separate headings, and I shall leave such generalizations as are possible until the special points have been set forth.

Biographical Notes.

By way of introduction, I may be permitted to state some biographical facts that will bear on this discussion. Laura Dewey Bridgman(1)* was born Dec. 21, 1829, in Hanover, New Hampshire, U. S. A. She was the child of Daniel and Harmony Bridgman, who were farming people. The parents(1) are described as of sound health, good habits, average height, slenderly built; the father with a small head, the mother with "not a large head"; both rather nervous; the mother active-minded. Their culture was such as might be found in rural districts like their own at that time. Laura inherited the physical peculiarities of her mother, and her health was delicate. During infancy she was subject to convulsions, but at the age of twenty months her health improved, and she is described as active and intelligent. She had learned to speak several words, and knew one or two of the letters of the alphabet, when, being two years(2) † old, she and her two older sisters, forming at that time the family, were attacked with scarlet fever. The two sisters died. Laura was severely ill; both eyes and both ears suppurated, and taste and smell were impaired. Sight in the left eye was entirely abolished. With the right eye she appeared to get some sensation from extremely large bright objects, up to her eighth year, but after

* The bracketed figures in the text refer to similar figures in the bibliography, where the authority is given in full. In some cases reference is made to the page of the publication cited and this is then bracketed in the text with the figures just mentioned.

† The date of this illness is a matter of some importance. As there is no agreement among the various authors on this point, I have been forced to choose an authority and have naturally taken the dates given by Dr. Howe in his Reports.

that time became completely blind. Two years passed before she recovered sufficiently to sit up all day. At the age of five years she had regained her strength. Speech was lost with the loss of hearing, and when her education at home was renewed, it was by means of arbitrary tactual signs of the simplest sort. She was taught to sew, to knit and to braid, and to perform some minor household duties. On Oct. 4th, 1837, she was brought to the Perkins Institution and Massachusetts Asylum for the Blind, and her education was begun by Dr. S. G. Howe, then director of the institution. She was now seven years and ten months of age, and in the defective condition above described. Dr. Howe ([2–p. 161]) says of her at this time: "figure well formed; nervous sanguine temperament; a large [no measurements have been preserved] and beautifully shaped head, and the whole system in healthy action."

The process of education commenced with the pasting of the name of a common object on the object, the name being in raised letters, such as are used for the blind; then the association of the name and object; then forming the name from the individual letters; and after a long time the letters themselves were learned. It was when she first recognized that the sign for an object could be constructed from the individual letters, that the meaning of what she was doing dawned upon her. From that time on her education became easier, and, indeed, she had in one sense to be held back in her work, as there was danger that her frail constitution would succumb to the too great interest in her studies. It is important to note that at this time she exhibited the various emotions by gesture and facial expression. She was fond of dress and pleased by attention. The lapse of time within the limits of the day and the occurrence of Sunday were correctly noted by her. In the report for 1839 ([2–p. 177]) it is said that she can distinguish between a whole and half note of music, and will strike the notes on the piano quite correctly. (How this interesting test was made, is not quite clear.) A test of her sense of taste at this time showed her capable of distinguishing better between different degrees of acidity than between this and sweetness or bitterness. She appeared at the same time to care rather less for eating than most children of her age.

The sense of smell seems to have been subject to some variations. During the first years of her residence at the institution it was apparently completely wanting, and there was never at any time the slightest tendency to test objects by holding them to the nose. Later (1843) she seemed able to locate the kitchen by the odors coming from it, but this sense does not appear to have ever been of any importance to her. The sense of touch was very acute even for a blind person, and she was sensitive to jar.

Dirt or a rent in her clothing caused her shame. She was familiar with those of her own sex, but distant to men, and was remarkable for her sense of order, neatness and propriety. She seemed capable of discovering the intellectual capacity of those with whom she was thrown, and quickly chose the more intelligent for her companions. Occasionally, too much attention to other scholars, in her presence, aroused jealousy on her part.

She cried only from grief, and the pain from a bodily injury she sought to annul by jumping and excessive muscular motions. So far as could be learned, she did not dream in the terms of her lost senses, and this is what might be expected, since they were lost at so early an age([3]).

She made a number of noises. Francis Lieber studied these with some care, with a view to their bearing on the origin of language([4]). It appears that Laura had some fifty or more sounds by which she was accustomed to designate people whom she knew. They were all monosyllabic. Besides this she laughed much and loud, was noisy at play, and occasionally made other emotional noises which were suppressed by her teachers. In this respect she was similar to most mutes, so-called, who appear to have a variety of sounds at their command.

In a recent article, Mrs. Lamson([5]) states that Laura once uttered the word *doctor* by accident, and her attention being called to this, she subsequently always spoke the word instead of spelling it with her fingers. The same thing happened with the words *pie*, *ship* and several others. These facts are taken to indicate that though so defective, she might possibly have been taught to vocalize, as has been done in some more recent cases. She appeared to keep constantly her relations in space, and became confused if she lost what might be called "the points of the compass." She was much afraid of animals, and when more than fifteen years of age could hardly be induced to touch a docile house-dog.

When about sixteen she is described as more thoughtful and sedate, though cheerful—a condition which Dr. Howe regards as showing that her age was to be measured by the degree of her mental development rather than by the number of years she had lived. When she was twenty years of age her regular education ceased, and the special reports by Dr. Howe stop at this time.

In 1878, President G. Stanley Hall(6) made a valuable series of tests upon her. At this time she was found completely blind and deaf, though the sense of jar was well enough developed to enable her to recognize the footsteps and sometimes even the voices of her acquaintances, her common statement being that she heard "through her feet." At this time her sense of smell was such that she could distinguish the odors of some more fragrant flowers, but eau-de-Cologne, ammonia and onions were thus recognized only when quite strong. Contrary to what was stated for an earlier period, she was found least sensitive to bitter and acid tastes, and most sensitive to sweet and salt. It was concluded that out of the four defective senses, taste alone was well enough preserved to materially aid in developing her notion of the external world. A study of discriminative sensibility for two compass points showed a discrimination in her case, from two to three times as acute as that of a seeing person. To temperature, her sensitiveness was not remarkable, and hence the "facial sense," as it is sometimes called in the blind, was not well-developed in her, though she was said to recognize the approach of persons by the undulations of the air. She was found sensitive to rotation, which made her dizzy and gave her a feeling of nausea.

In the course of her life Laura was the author of "a Journal, three Autobiographical Sketches, several so-called poems and numerous letters." The Journal covers a period of about ten years. Dr. E. C. Sanford(7), who has made a study of her writings, sums up her mental development as thus indicated, by the statement that "she was eccentric, not defective; she lacked certain data of thought, but not, in a very marked way, the power to use what data she had."

She died at the Perkins Institution, where she had spent almost her entire life, on the 24th of May, 1889, being in her sixtieth year.

Laura excited wide interest because, for the first time in her case, several experiments were tried and questions tested, with unprecedented results. Her case was used for research in matters pedagogical, psychological and theological. But these are passed over, as they lie outside our present scope.

Her defect is often regarded as almost unique. As a matter of fact, if the deficiency of smell and taste is counted with that of sight and hearing, there appear to be few cases like hers; but so small is the educational value of the first two named, that she may be fairly classed with the blind deaf-mutes, in which, for the most part, the state of smell and taste is not recorded. As Prof. Edwards A. Park says in the introduction to Mrs. Lamson's book(1), there are some fifteen cases recorded of persons who have lived as blind deaf-mutes. Dr. Howe formed his plan for the instruction of Laura from the study of Julia Brace, who was a blind deaf-mute. There were several similar cases at the Perkins Institution during Laura's lifetime, and there are two young girls in that institution now who are defective in the same way. Special descriptions of one or more cases have been given by Mareschal(8), Fowler(9), Burdach(10), Alessi(11), Sichel(12), Fuller(13) and Borg(14); and Mrs. Lamson, in the current number of the "American Annals of the Deaf,"(5) mentions a Norwegian girl, Ragnhild Kaata, who is blind and deaf, but having been taught to articulate, can no longer be described as mute. In the same article is mentioned a school in Sweden where five blind deaf-mutes are being instructed. Finally, I may call attention to the fact that in the Census of 1871 for Great Britain there are 111 returns for blind deaf-mutes(15), while in the 10th Census of the United States, in the analysis of statistics relating to the defective, dependent and delinquent classes by Wines(16), there are returned:

Blind deaf-mutes,	256.
Blind deaf-mutes, also idiotic,	217.
Blind deaf-mutes, also insane,	30.

The literature on this subject would probably be found to be extensive if carefully gathered, and the statistics, if taken from all sources, would show a very considerable number of individuals in this class. It is my purpose, however, only to call attention in a general way to this point, as bearing on our subject. Taking the Census of 1880 for the United States, Laura's case could only be compared with the simply blind deaf-mutes—256 in number—and it would need a careful analysis of this group in turn, to show how many cases were strictly comparable with hers. There is good reason to think, however, that a number of such would be found.

I do not know that we are in a position to say from sound data what the effect of loss of the senses—as in Laura's case—is on the mental integrity of the individual, but certainly the proportion of blind deaf-mutes who are also mentally defective is very large. At the same time there is reason to think that the large number of those who are idiotic were either congenitally defective (the idiocy and the other defects having a cause in common), or that they became defective shortly after birth, and were neglected by those in charge of them. Two points came out in a striking manner in looking over these cases as presented in the literature just cited. The first is, the small amount of mental pabulum which serves to keep the action of the mind normal; and second, the late stage (measured in years) at which instruction may be begun with fair hope of success, the nervous mechanism apparently retaining for an unusually long time the impressionability which in the normal person belongs to early childhood.

Physical Data and Report of Autopsy.

On her entrance into the Perkins Institution, some physical measurements were taken, which were unfortunately lost. At eleven years of age her height was 4 ft. 4.7 in. (1.33 M.). Her head measured 20.8 in. (52.8 cm.) in circumference, along a line passing over the prominences of the frontal and parietal bones. Above this line the head rose 1.1 in. (2.8 cm.), and was broad and full. From the orifice of one ear to the other, the (*shortest*) distance was 4 in. (10.1 cm.), and from the occipital spine (*protuberance?*) to the root of the nose, it was (*shortest distance*) 7 in. (17.7 cm.). The forehead was said to have grown perceptibly larger during the two years preceding ([2–p. 181]). These are the only data that I have been able to find. As nearly as I can learn from those best acquainted with her at the Perkins Institution, her height at maturity was 5 ft. 3 in. (1.596 M.), and her weight, with clothing—98 lbs. avoirdupois (44.45 kilos).

During her residence at the institution, she appears to have had no serious illness up to the time of the one which proved fatal, although often in poor health as the result of over-exertion in her study or from emotional excitement, as for example that caused by the death of Dr. Howe, to whom she was deeply attached. Her final illness lasted about three weeks, and she sank gradually to a painless death—before, it is said, advancing years had perceptibly impaired those faculties which she exercised. The autopsy was performed eight hours after death, by Dr. E. S. Boland, of South Boston, in the presence of several gentlemen. The cause of death is stated as lobar pneumonia. Aside from the lungs, the other viscera appeared healthy save the left kidney, which was slightly atrophied. The encephalon was removed in the *dura* with the eyes attached, and the petrous portions of the temporal bones and part of the ethmoid were also taken out. The cranium is described as symmetrical and of good shape and size; bones thin; diploë slightly marked; but little subdural fluid; the encephalon fitting the cranial cavity closely; *dura* normal in appearance. For the above facts I am directly indebted to Dr. E. S. Boland. The encephalon was not weighed at this time, nor was any further examination permitted. For the next seventeen hours it was kept in a moderately cool place, but not in any fluid. At the end of this time it came into the hands of Prof. W. F. Whitney, who very kindly took charge of it. The specimen was now in such a condition that it was deemed best to cut it in various directions, in order to permit the hardening fluid to penetrate. Four transverse incisions were made, the first being about 3.5 cm. from the frontal end, and the other three at equal intervals behind it. The depth was such as to open the lateral ventricles in either hemisphere without injuring the *callosum* or basal ganglia. Along the mesal surface of each hemisphere a longitudinal cut was made, extending about the length of the *callosum* and laying open the lateral ventricle on each side. The entire material was then put into several litres of Müller's fluid plus one-sixth its volume of 95% alcohol. This fluid was changed some four or five times in the period between May 25th and July 10th, at which time the specimen came into my possession. The eyes were then separated from the encephalon, and they with the portions of the bones, were treated by themselves. The encephalon was hardened for some three months more in 2½ % potassium bichromate; kept for a long time in a dilute solution of the same; finally washed out, hardened in 95% alcohol, and preserved in 80% alcohol. The majority of the measurements were made while it was in the 2½% or dilute potassium bichromate.

Photographs and Models.

In studying the encephalon, it was necessary to make those observations which required least dissection first, and so proceed that the different portions should retain their normal connections as long as possible. The results, however, under any head, will be given without reference to the order in which they were obtained. As the complete examination required ultimately a dissection of the encephalon, with consequent loss of form, I first had it carefully photographed, the encephalon being taken from six points of view, and then the mesal surface of each hemisphere taken alone. The entire exposed surface, with the exception of that covered by the cerebellum, is thus represented, and this latter surface was sketched. It would be extremely desirable to have these various views adequately represented, but since the means for so doing are not at present at my command, I have preferred to await some future opportunity rather than to represent them now by some method of doubtful value.

It was further extremely desirable to have an accurate model of the encephalon. The character of the specimen, the cuts in it and the method of preservation were all against any device for taking a direct cast of it. I was, therefore most fortunate in securing the co-operation of Mr. J. H. Emerton, of Boston, whose skill in modelling such objects is well known. He made an accurate clay model of the specimen; from this a glue mould was taken, and a number of plaster casts were at once made from this mould, before it had time to undergo any distortion, the original clay model being preserved for comparison. The results are entirely satisfactory, and we have now what is equivalent to a good cast of this specimen. In making the model, the cuts in the hemispheres were not represented, and thus the general appearance was improved without any material loss in accuracy.

Envelopes and Vessels.

Within the limits of this paper I shall have to deal exclusively with questions relating to the gross anatomy of the specimen.

Dura: Sinuses filled with blood. Normal in appearance. It was incomplete at several points on the ventral aspect of the hemispheres and the cerebellum was completely exposed, the *tentorium* and *falx* being both present. This somewhat defective membrane, including *tentorium* and *falx*, weighed, after hardening by the method above described, washing out in water, and being pressed between filter papers, 54.4 grms. No data for comparison have thus far been found.

Pia: The vessels were filled with blood. To all appearance it was normal. The adherence to the occipital regions appeared uncommonly strong, even making allowance for the close adherence which is normal for this region. The *pia* from the entire encephalon with the choroid plexuses, but without the basal blood-vessels, was treated like the *dura* and found to weigh 25.1 grms. The quantity of the *pia* obtained was estimated at about .8 of the total. That supposition being correct, the total *pia* would weigh 31.4 grms.

What the influence of the hardening process is on the weights of the membranes, *dura* and *pia*, is not known, but it is presumptively slight. Giacomini(17) has made observations on the weight of the *pia* and cerebro-spinal fluid, which I give. It is to be remembered that we have no means of knowing the quantity of the fluid in our case, though the autopsy report states that there was apparently little at that time. Confining himself to the cerebral hemispheres, which were weighed separately, Giacomini found in 30 normal brains the weight of *pia* and residual cerebro-spinal fluid (the bulk of the fluid having escaped on the hemisection of the cerebrum, and having been then collected) to be from 5 to 5.5% of the weight of the hemispheres. Where the vessels of the *pia* were congested, the percentage might rise to 6 or 6.5%. According to Calori, quoted by Giacomini, the weight of the *pia*, blood and cerebro-spinal fluid for the whole encephalon is 14% of the entire weight. This figure seems to Giacomini too high. Huschke(18) calculates that removal of the *pia* and choroidal plexuses from the cerebral hemispheres alone diminishes their weight by 50—60 grms. (This diminution is plainly in part due to loss of fluid consequent on removal of the *pia*). Bischoff(19) gives 25—40 grms. for the *pia* of the cerebral hemispheres alone. Bastian(20) gives 21—28 grms. for the *pia* of the entire encephalon. Where the brain is sliced and allowed to drain for 1—2 hours, according to the method of Thurnam(21), there is, according to Bastian, an additional loss of 28—56 grms. Bischoff(19) gives further figures from Weisbach, Hagen and Marshall, which I have not been able to verify, and therefore omit.

There is here hardly sufficient data on either hand for the purposes of comparison, but the assertion may be fairly made that the *pia* in our case shows no marked peculiarity. Unfortunately, the conditions do not permit us to follow Giacomini's (17) suggestion, and infer from the weight of the *pia* its relative thickness.

Volume of Encephalon.

On Aug. 13, 1889, while the specimen was still in 2½% potassium bichromate, an effort was made to obtain the volume. The encephalon (deprived of *pia*) was put in a large jar filled with water. On the water floated a cork, in the centre of which a long pin was stuck vertically. A ruler laid across the top of the jar formed a line to the level of which the top of the pin rose when water was poured into the jar. The encephalon being in the jar, water was then added until the head of the pin was level with the edge of the ruler. The encephalon was next removed, with all precaution as to drainage, etc., and the quantity of water was measured which had to be added to that in the jar in order to bring the pin-head to the same level. Two determinations were thus made :

Determination 1 gave volume	= 1385 c.c.
" 2 " "	= 1381 c.c.
Mean,	= 1383 c.c.

This figure, 1383 c.c., I have taken to represent the volume under the conditions stated.

The cuts in the specimen were such that there is good reason to think that the lateral ventricles were filled by the fluid in which it was immersed. The method, I am aware, was rough, but was the best at my command at that time. The most important correction to be made is that for the change of volume of the specimen due to the process of hardening to which it had been subjected. On this point some experiments have been made, which are not yet ready for publication. I shall, however, use the facts obtained without further proof, trusting that I may soon be able to give evidence of their correctness. To save any repetition, it may be here stated that the experiments just mentioned relate to the volume, weight and specific gravity of the encephalon, and will be introduced under their proper headings without further remark.

If an encephalon is treated like that of Laura (from six to twelve hours after death), the conditions for its preservation in the mean time having been good, it will show an increase equal to about 25% of the initial volume. This, however, takes place only when the specimen is fairly fresh. When it is not fresh, but still hardens slowly and incompletely, the increase may be about 2% of the initial volume. In our case it is a fair estimate that one-third of the initial mass of the encephalon is hardened so as to have undergone an increase of but 2% in volume, while the other two-thirds may be considered to have undergone the full enlargement of 25%. Making use of the above percentage for correction, the volume observed would be $\frac{88}{75}$ of the initial volume, or

$$\frac{1383 \times 75}{88} = 1178 \text{ c.c.} = \text{initial volume.}$$

The value of this figure is simply that of the best approximation which I can now make.

Weight.

At the same time that the volume was taken the specimen was weighed. The weight thus obtained (on balances weighing to 0.1 grm.) was 1389.5 grms., the *pia* being completely removed. The hardening of the specimen had caused it to increase in weight about 22% for those parts which were well hardened. The same conditions determine the amount of this increase in weight that determine the increase in volume, and when the specimen hardens imperfectly the increase in weight is a trifle less than 2%, but may be called 2% for the present purpose. Supposing, as before, that two-thirds of the initial brain-mass have increased 22% in weight, and one-third 2%, we have, 1389.5 grms. = $\frac{173}{150}$ of the initial weight, or

$$\frac{1389.5 \times 150}{173} = 1204 \text{ grms.} = \text{initial weight.}$$

Any criticism which can be applied to the volume can also be applied to the weight as thus deduced.

The initial specific gravity of this encephalon or any portion of it is not known, but if we deduce it from the calculated weight and volume, it is 1.022. This is a smaller figure than Bischoff(19) found. For female brains, his figures are from 1.0305 to 1.0478. The determination of the weight in this case is, in my opinion, less subject to error than the determination of the volume. If we consider a brain of this weight to have either of the extreme specific gravities given by Bischoff or one represented by their mean, we have for a brain weighing 1204 grms.,

sp. gr.	1.0305	giving a volume		= 1168 c.c.
" "	1.0391	"	"	= 1158 c.c.
" "	1.0478	"	"	= 1149 c.c.

Thus furnishing figures for the volume which are 10, 20, and 29 c. c. below those first calculated.

Further manipulation of these figures would be of little value. It is concluded, however, that the probable weight of Laura's brain was somewhat over 1200 grms., and that the probable volume was about 1160 c. c.

The mean weight for the English and European female encephalon is variously given. Bischoff([19]), 1244.5 grms.; Tiedemann, 1275 grms.; and Huschke, 1272 grms. Schwalbe([22]) gives 1245 grms., as deduced from a composite table of weights. This table further shows that out of the 339 cases which it includes, 283 have a weight between 1100 and 1420 grms., and the majority (two-thirds) of these in turn have a weight between 1160 and 1330 grms. Our specimen, therefore, falls within these last limits, but somewhat below the mean, 1245 grms. The figure which we have obtained will not warrant any discussion of the weight in relation to other conditions of age, body-weight and height. It may nevertheless be pointed out that our specimen had probably not undergone any important loss of weight due to advancing age, and that furthermore it is possible that the figures which have led to the generalization that at about sixty years the encephalon begins to lose in weight, may perhaps, as has been suggested, be as well explained by some relation not yet investigated, between brain weight and longevity.

Of the subdivisions of the encephalon, the cerebellum alone was weighed separately. It was separated from its connections by cutting through the peduncles as close to the hemispheres as was practicable. The portion thus removed weighed 163 grms. The increase in weight due to hardening is about 27% for the cerebellum, which would make the initial weight 128 grms. Taking the weight of the entire encephalon as 1204 grms., then the cerebellum is 10.63% of the entire weight. This percentage is exactly that found by Weisbach and 0.17% lower than that found by Meynert, as quoted by Schwalbe([22]). It serves to show that there was nothing very peculiar in the weight relations of the cerebellum to the rest of the encephalon in this case. The other weights which are usually recorded could not be taken, because further dissection of the brain was impracticable in view of the other observations to be made on it.

Linear Measurements.

On Nov. 4, 1889, the following measurements were made:

Greatest length of left hemisphere,	178 mm.
" " right "	**180** mm.*
The maximum width of cerebrum,	153 mm.
The maximum height of cerebrum,	129 mm.
The longest perpendicular distance, taken on the mesal aspect of each hemisphere, from the line measuring the length of the hemispheres to the dorsal surface, is in this case the same for both hemispheres,	73 mm.
The encephalon being in the normal position, the distance between a perpendicular plane just touching the tips of the temporal lobes and one just touching the tips of the frontal lobes was found to be	57 mm.

Schwalbe's([22]) figures for similar dimensions in the female brain are, greatest length in the majority of cases, from 150 to 160 mm., the limits being 142–189 mm. (Huschke). The mean breadth is given at 140 mm., whereas the height is given at 125 mm. For the longest perpendicular as above described, and the distance from the tip of the temporal to the tip of the frontal lobes, I find no data that are comparable. For comparison on the last measurement, I have used three male brains which were hardened in bichromate and alcohol in the usual manner, and which are nearly the same length as our specimen, (from 2 to 11 mm. longer). In these the temporo-frontal distance, if I may so call it, was respectively 47, 41 and 51 mm., as compared with 57 mm. in Laura.

Of course, the swelling of the encephalon due to hardening has increased all three diameters, and so the figures given for Laura cannot be compared with those from Schwalbe until some correction has been made in them. Such correction I am at present unable to make. Assuming, however, that the enlargement along the several diameters is proportional to their initial length, we can make the calculation for the

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* Where similar measurements for the two halves of the brain are given, the larger figure is in heavier type. It is hoped that this device will render the comparison of the two sides easier.

cerebral index, the mean length being taken as 179 mm., and breadth 153 mm. The so-called cerebral index, obtained by dividing the latter by the former, equals 85+, showing the cerebrum to be markedly brachycephalic. The excessive temporo-frontal distance appears plainly to be due to deficient development of the temporal lobes.

General Description of the Encephalon.

In order to give some data for the control of the foregoing measurements, a general description of the specimen will be useful. To the medulla was attached a piece of the cord which extended 17 mm. from the superficial caudal termination of the decussation of the pyramids. This length was about that usually obtained where the cord is cut through the *foramen magnum*. The shape of the specimen was well preserved, owing to its having been hardened in the *dura*. The angle between the stem and cerebrum was approximately normal, and the relation of the cerebellum and hemispheres therefore but little disturbed. The hemispheres overlapped the cerebellum slightly. The vessels forming the circle of Willis were certainly not large. Of the internal carotids the right was the larger, but only slightly so, and the posterior communicating arteries were small, even in proportion to the other vessels.

In passing now to the several subdivisions, no effort will be made to give a complete description, for the nature of the specimen is not such as to demand that, and all exact measurements will be left until the parts are studied histologically.

Medulla and Pons.—The nerves from this region were identified, except the spinal accessory, which could not be found, having been probably pulled away in removal of the specimen. Here, of course, it is the *glossopharyngeus*, the *acusticus* and the *abducens* associated respectively with the sense of taste, of hearing, and the external rectus muscle of the eye-ball, that are of special interest. These appeared somewhat reduced in size, though all the cranial nerves were small. On the ventral aspect of this region, neither the olivary bodies nor the pyramids were prominent. The anterior median sulcus between the pyramids was well marked, as was the ventral depression on the *pons*. On the lateral aspect, the *corpora restiformia* appear well developed. On the dorsal aspect, the floor of the fourth ventricle was seen to be clearly marked. There was a well developed *ligula* and *obex*. The nuclei of the *columnæ graciles* made evident swellings in the course of the dorsal columns of the cord, those of the column of Burdach being less marked. On the floor of the ventricle, the *alæ cinereæ* and *trigona hypoglossi* were very evident. The *striæ acusticæ* or *medullares* were particularly clear. The point is of interest, since the *striæ* are looked upon as part of the auditory path in this region. A more detailed description of them will be given later.

Cerebellum.—As we have seen, the cerebellum has thus far offered no peculiarity. The peduncular connections were as usual, and a sagittal section shows the *arbor vitæ* with the characteristic sub-divisions. In the general conformation, there was nothing to excite remark.

Mid-brain.—The oculo-motor nerves were, perhaps, a trifle small. The *trochlearis* was not found. On the ventro-lateral surface, a search for *tractus peduncularis transversus* of v. Gudden([23]), which appears to have some connection with visual apparatus, was unsuccessful. However, it must be remembered that this tract is not always superficial in normal individuals, and therefore failure to detect it is not proof that it has degenerated. On the dorsal aspect, the *frenulum* was well marked. The posterior pair of the *corpora quadrigemina* was rather small, but well rounded and both alike. The median groove, the transverse groove separating them from the anterior pair, and the *brachia*, were all well marked. The anterior pair of the *corpora quadrigemina* were much flattened towards the middle line. *Brachia* not evident.

As the result of the cuts necessarily made to allow the entrance of the hardening fluid, and the failure of this region to harden, subsequent dissection has yielded but small results. Of the condition of the *corpora geniculata* on the right side, nothing can be said. On the left side the *corpus geniculatum internum* can alone be described, and this was comparatively large and prominent.

Inter-brain.—On the left side of the specimen the *pulvinar* had been preserved, and there it was reduced in all dimensions, and but little arched; on the other side it had broken away and could not be described. The caudal portion of the third ventricle was large. There was a well developed median and posterior commissure. The general lack of development in this inter-thalamic region is not shared in by the pineal gland and its connections, the *habenulæ* and *trigona habenulæ*, which were disproportionately enlarged—an enlargement which is probably due to the removal of pressure from the surrounding structures. Turning now to the ventral surface, the *corpora mammillaria* and, it may be added, the *fornix*, were normal. About the pituitary body, there was nothing peculiar, but the *infundibulum* is prolonged ventrad to an unusual degree, and is bounded on either side by the greatly shrunken optic tracts. The relations of the anterior commissure in view of its connection with the olfactory centres would have been interesting, but the specimen did not show this commissure, owing to imperfect preservation.

Before proceeding to the *callosum* and the hemispheres, it may be well to consider what we should expect to find in these portions. There is no suggestion in this case that would lead us to anticipate appearances such as are recorded for microcephalic, criminal, or low-type brains belonging to the least civilized races. Neither is the case to be associated with those in which the defect or arrest of development was due to causes originating within the central nervous system. There was not the slightest indication of abnormal mental action, and therefore the brain would not be expected to resemble that of the insane, if for the moment we admit that the brains of the insane show gross peculiarities. What we have is the brain of a normal person who lost at about two years of age the senses of sight, hearing, smell and taste, through injury to the peripheral sense-organs, but who remained mentally balanced throughout a long life, though under conditions which would favor mental derangement, had the tendency to it existed. This loss would have but a moderate power to destroy what was already formed in the brain, though it would do so to some extent.

The chief effect would be to retard the further development of those portions which represented the lost senses, but even here the hereditary laws of growth would act to some extent independently of the modifying conditions which existed in such a case.

As a point of departure, then, it would be interesting to know what was the state of development of an average female brain at the commencement of the third year of life. If we take 1245 grms. as the average weight of the female encephalon, we find that at the commencement of the third year or end of the second, the average weight is about 920 grms. for females. [See Boyd's tables quoted by Schwalbe(22), and Bischoff's(19) table of five observations, made up from those of Huschke and Sims. The figures quoted by Vierordt(24) are not available, because no distinction of sex is made, and, as is well known, such a distinction exists at birth and even in the fœtus.] If 920 grms. is the true figure, then at this age the weight of the encephalon is about three-fourths that of the adult. As the specific gravity is somewhat less, its volume is proportionately a trifle greater.

On the relations of the nerve-cells and fibres, not much can be said that is satisfactory. Whether we have the elements all formed at birth, and they undergo simply an increase in size during the subsequent processes of growth, so-called, or whether we have new elements formed after birth, is a question for the decision of which the evidence is as yet scanty. Schiller(25), at Forel's suggestion, determined with due precautions the number of nerve-fibers in the *oculo-motorius* of kittens at birth, and cats at the end of the first year, and found practically the same number in both cases. In this animal and this nerve the number of fibers, then, does not increase after birth. In man, however, the period of helplessness and development after birth is comparatively long, and Below(26) has found in animals that the cortical cells are less developed in those born helpless than in those born in a more mature state. Incompleteness in the development of the central nerve-cells would favor the idea that they might still undergo multiplication after birth. As a matter of fact, the development of the cortical cells in the human fœtus is incomplete at birth (Obersteiner[27—p. 367]), and the development of medullated fibers far more incomplete. The medullation of fibers is continually going on during the early years of life, and there is evidence that it is for the most part completed about the eighth year. For those who hold that practically the number of elements is fixed at birth, the increase in the size of existing elements, and especially the medullation of the fibers, are the causes of the enlargement of the encephalon. If such is the case, however, and Galton's([28]) measurements on the heads of Cambridge undergraduates mean what he takes them to mean, *i. e.*, brain growth, then the process of medullation or enlargement, or both, must continue in some cases up to the twenty-fifth year.

If we turn now to the sulci and gyri, we find all the important ones present at birth [Ecker([29]), Rüdinger([43])]. At that time, the cerebral surface is marked in a typical manner, and according to Ecker the asymmetries which occur in the sulci are caused by the later development of accessory sulci. What the history of these accessory sulci may be, has not, I believe, been studied, and how far they may be developed during the first two years of life, is therefore an open question; but *a priori* one would imagine that the earliest years of life would be the time when they would appear. Be that as it may, it seems highly probable that the relations of the primary and secondary sulci are fixed to a large extent at birth, and that subsequent development has but a slight influence in altering these relations.

In the child at birth, and during the first years of life, the relative development of the several lobes of the brain is not the same as in the adult. Designating the lobes as occipital, temporal, insular, parietal and frontal, Bischoff([19]) states that it is the last two which develope most in later years, and of these the parietal undergoes the greatest enlargement; but the observations on this point are few.

Applying the above conclusions to our case, we may describe Laura's brain at the age of two years as having about three fourths of its adult weight, the cells of the cortex being fairly developed, whereas the medullation of the fibers was incomplete to a considerable degree. The primary and secondary sulci were all present, and probably some of the accessory sulci also; and the parietal and frontal lobes were less developed than they should be in the adult. If the *callosum* is commissural for the different portions of the cerebral cortex, we might expect it to accompany the cortex in development. In the absence, so far as I am aware, of explicit observations on this point, we may assume the *callosum* well developed at this age.

On such a brain as we have described, what would be the effect of a lesion, like that which occurred in the case of Laura? The nerves and their primary centres would show degeneration, and later some atrophy, then after the lapse of time, arrest of development, in so far as they were incompletely developed at the date of the injury. In the cortical regions, so far as they might be affected, we should probably expect some arrest of development which would show itself on gross examination, and certainly some histological indications of arrest and possibly degeneration. Further, as one result of the limitation in mental activity due to the great defect in the senses, a general appearance of immaturity might be anticipated, while if certain lobes were affected more than others, a disproportion in development as compared with the normal would result. It seemed advisable to make some analysis of the case at this point, in order that no ungrounded expectation of striking anomalies might be cherished, and it will be the chief purpose of the following pages to show in how far actual observations bear out the views above advanced.

Callosum.—The *callosum* was well developed. On the surface exposed by a sagittal section dividing the two hemispheres, the distance of a straight line between the extreme points was 82 mm., while a line following the dorsal curve and joining the same points, is 87 mm. long. The height or thickness, as one chooses to call it, always measured vertically (the hemispheres being in the normal position) is 22 mm. at the rostral end, 12 mm. in the middle, and 15 mm. at the splenial end. The area of surface exposed by the section was 1172 sq. mm. The linear measurements exceed somewhat those given by

Krause[30—Bd. 2, p. 965], especially those for the thickness, but I am not sure that mine were taken in the same way as his were; and furthermore, his apply to the fresh specimen, while this was swollen by hardening. Comparison with other specimens hardened in potassium bichromate, shows these figures nevertheless to be large. From gross examination, therefore, the *callosum* appears to have developed completely.

Cerebral hemispheres.—On looking at the hemispheres, the general shape appears normal, but they are somewhat flattened at the occipital pole. The temporal lobe is comparatively small, the tip being thin, and on the orbital surface of each hemisphere at the cephalic end is a marked conical elevation of the general surfaces with the apex directed ventrad. This elevation appears on either side of the median line, just in front of the point where the *sulcus olfactorius* terminates. As the formation is not usually described, and is only faintly suggested in most brains, it is probably an anomaly due, in this case, to the failure of the orbital plates of the frontal bone to develop in the usual manner, thus leaving more of a depression in the bone at this point than ordinarily occurs. To this depression the brain has accommodated itself, with the result of producing the appearance described. When viewed from above, the general effect was quite similar to the typical female brain, as depicted by Wagner[31], the chief difference being that our specimen was not quite so pointed in the frontal region as Wagner's plate of the female brain, and had the gyri in the occipital region in less relief. The gyri were for the most part widely separated from one another, especially in the frontal and parietal lobes whereas in the occipital they tended to be close together. In general, the gyri were large, but little interrupted and moderately sinuous, and the insula was more exposed on the left than on the right side. The typical arrangement of the gyri was easily followed, and the two hemispheres quite symmetrical in their markings. The symmetry of the hemispheres, the continuity and size of the gyri, may be taken as indicating an average or perhaps less than average development in these respects. Such a statement has, however, so little foundation that is measurable and exact, that it will be best to leave it in the form of a mere suggestion. There is some departure from symmetry in the two hemispheres, where, on the mesal surface of the occipital region, the ventro-caudal portion is smaller in the right hemisphere. This is shown in an exaggerated way in Plate II, Fig. 4.

As illustrating the general development of this specimen, I introduce here several measurements which were made while the brain was in potassium bichromate.

Taking the smaller angle which the *fissura centralis* makes with the middle line, following the method of Eberstaller(32), it was found to be,

For left hemisphere,	65°.
For right hemisphere,	61°.

This is smaller than is usually stated. Wilder(33) gives 67° as an average, and Eberstaller 70°–75°.

If we take the entire length of the mesal edge of the hemispheres measuring from the *trigonum olfactorium* to the occipital pole, and then the distance from the *trigonum olfactorium* to the point where the *fissura centralis* reaches the mesal surface, we obtain the following figures:

Left hemisphere, entire distance,	334 mm.
Right " " "	331 mm.
Left hemisphere, distance to *fissura centralis*,	214.5 mm.
Right " " " "	216 mm.

This, reckoned in per cent. of the entire distance, gives the last distance or extent of frontal lobe along this line, as

Left hemisphere,	64+%.
Right hemisphere,	65+%.

Eberstaller(32) gives for the female brain, 66%. Our figures, therefore, approximate closely to his average. Measuring the *fissura Sylvii* on each side from the point where it gives off the anterior *rami* to the point where it gives off the *ramus posterior ascendens*, it was found,

For the left hemisphere,	53 mm.
For the right "	52 mm.

This makes it shorter than the average figures for females found by Eberstaller(32), which was 56.5 mm.

Among these figures, one set (namely that for the position of the mesal end of the *fissura centralis*) is in percentage, and that agrees fairly well with the results of other authors. It may be presumed, then, that in hardening the encephalon has not undergone much distortion. If that is true, then the small angle of the *fissura centralis* with the middle line is probably a true relation. Despite the enlargement of the specimen, the length of the *fissura Sylvii* as measured is under the average, but the relations of the two sides are as Eberstaller found ; that is, the left is the longer.

The condition of the ventricles was not easily made out, owing to the state of the specimen and the cuts in it, which somewhat disturbed the connections here. The lateral ventricles were certainly not large. The descending *cornua* were well developed, but the right posterior *cornu* terminated 47 mm. in front of the occipital pole. In the left hemisphere it reaches to within 42 mm. of the occipital pole, and there is a well developed *calcar* which was not observed on the right side.

Description of the Surface of the Hemispheres.

As was stated earlier, it is not my purpose to describe in detail the cerebral surface in this case,—as good plates would give a far better idea than could be obtained from the text,—so that on this occasion I shall be content with some outline figures and a description of those regions which may be regarded as important. The four representations of the specimen were drawn from photographs by means of a pantograph. From these drawings the plates were made by one of the photo-engraving processes. In the figures those sulci which are more constant are put in with a heavy line, whereas the others are in light lines. In the case of the fissure of Sylvius an approximate presentation of the amount of separation of the gyri has been attempted. In the description I shall follow Eberstaller([32, 34]) in most points and also adopt his nomenclature.

Frontal Region.—In Figures I and II, the *sulcus frontalis medius*, *f* 3, is clearly marked, thus giving the four frontal gyri, (by sub-division of the *gyrus frontalis medius*,) which the more recent authors are agreed is the normal condition of the frontal lobe. [Eberstaller([32]), Wilder([33]), Giacomini([17]).] To be noticed on the left side is the union of the *sulcus frontalis inferior*, *f* 2, with the *sulcus fronto-marginalis*, *fm* 3, which appears somewhat unusual. Further, on the same side the *ramus anterior horizontalis fissuræ Sylvii*, *S* 3, runs into the *sulcus fronto-marginalis*, *fm* 1, but at the junction there is a vadum or shallow, (see Wilder, [33]) which clearly marks the usual limits of this *ramus*. Aside from these points the fissuration of both frontal lobes is quite typical. Directing attention to the *gyrus frontalis inferior* we find it well defined laterally and frontally, but as is usual, poorly defined on the orbital surface. In its entirety that of the left does not differ much from that of the right hemisphere, but there are some differences in detail. Dividing the opercular portions into the *pars orbitalis* ventrad of *S* 3; *pars triangularis* between *S* 3 and *S* 2; *pars ascendens* between *S* 2 and *d*: and the *pars basilaris* between *d* and *pci*, we find the *pars basilaris* much less well developed on the left side, being especially deficient in its ventral portions. The *pars ascendens* is deficient throughout on the left side while the *pars triangularis* is somewhat better developed on this side than on the right. A comparison of the orbital areas is not practicable in this case. It should be added that, on the left side not only is the exposed surface of the *pars basilaris* and *pars ascendens* smaller, but both these are sunken below the surrounding gyri; the former completely and the latter in its ventral portion, the frontal edge of the *gyrus centralis anterior* forming a slight operculum over the *pars basilaris*.

It is our purpose of course to determine whether these features of the left side can be properly brought into connection with the very limited power of articulate speech possessed by Laura. There is good ground for the view that in right handed persons it is the portion of the *gyrus frontalis inferior* of the left side between the *ramus anterior ascendens fissuræ Sylvii*, *S* 2, and the *sulcus præcentralis inferior*, *pci*, that is the centre for articulate speech. So far as known Laura was right handed. According to Eberstaller([32—p. 104]), the *pars basilaris* may often be sunken, but in such cases, where the brain is normal, the *pars ascendens* overlaps and more or less conceals it. In this case no such overlapping occurs. Several authors have called attention to the value of the comparison of the two hemispheres of the *same* brain where a lesion was suspected on one side, and judged by that test we certainly have defective development of this gyrus on the left side. A variation, however, which seems to me of considerable importance, is the direction of the *sulcus diagonalis*, *d*. One characteristic of this sulcus is that in the normal brain its dorsal end lies further caudad than the ventral end. On the left side in Laura this direction of the sulcus is reversed, the ventral end being further caudad and to all appearance it occupies this anomalous position because the ventral portion of the *pars basilaris* has failed to develop. On the right side it has the normal direction.

In this connection the exposure of the *insula* is significant. I estimate this exposure for Laura :

On the left side,	128 sq. mm.
On the right side,	46 sq. mm.

That is, the surface of the *insula* exposed on the left side is nearly three times that exposed on the right. In looking at the collection of brains in the museum of Cornell University—a collection which has been gathered by Prof. B. G. Wilder,—I found no exposure of the *insula* which approached even that on the *right* side in Laura, save in the *left* hemisphere of a negro (catalogue number, 322), in which the exposure was somewhat less than on the right hemisphere in our case. Of course the absolute relations of the specimens have at present no value since the Cornell brains were hardened in alcohol and therefore had undergone some shrinkage. It may, however, be permissable to conclude that on both sides the exposure of the *insula* in Laura was large, and that on the left side it was much larger than on the right.

Exposure of the *insula* may be considered in general as characteristic of incomplete development (Rüdinger[35]). According to this test, then, there is here a general lack of development which is most marked on the left side. This exposure is due, however, only in part to the small size of the *gyrus frontalis inferior* which contains the presumptive speech centre, and to which we have hitherto specially attended. Rüdinger(35—p. 45) describes for mutes that have lost the power of speech as the result of deafness and who are otherwise normal, certain slight abnormalities of the speech-centres—but seems surprised that they are not more marked. Without entering into any detail it is evident that the variations in his cases and in that of Laura are similar, and Zuckerkandl(36) also notes as defects in the development of the speech-centre some that we do not find here, but among those that we do find, he mentions the depression below the general surface of the *pars ascendens* and *basilaris*, the hiding of them by surrounding gyri, which thus form an operculum at this point, the exposure of the *insula* and failure of the tip of the temporal lobe to attain its full size. Zuckerkandl(36) has also something to say with regard to compensatory development on the assumption that such compensation may be physiological as well as morphological. Whereas the *pars ascendens* and *basilaris* are less well developed in the left hemisphere in Laura, if the *pars triangularis* of the left side is compared with that of the right it is found to be somewhat larger. It might be urged that this better development of the *pars triangularis* indicated that it had taken on some of the functions of the undeveloped portion. At the moment I am aware of no positive evidence in favor of such a transfer of function and hence do not consider the objection important. Closely associated with this region is the *insula*, but the discussion of that will be deferred until we consider the cortical development of the brain. From what has been said, then, I conclude that the centre for articulate speech in this case shows some defect, which is most naturally explained as arrest of development. The nature of this arrest will be brought up when we come to the histology of the region.

Occipital Region.—We next turn to the occipital region which is represented in Figs. III and IV. The occipital lobe, and specially the *cuneus*, in man, appears to be the cortical centre for vision,—but just what the limits of the occipital lobe are, and how much of this area is specialized as a visual centre, are not precisely determined. Ecker's(37) description of the occipital lobe has not been found satisfactory by later authors and several attempts have been made to improve on his account. Here I follow Eberstaller's description([84–No. 18]). According to him the occipital lobe is best considered as that portion of the hemisphere enclosed between the *fissura calcarina* (*ca*), the *sulcus parieto-occipitalis* (*p. o.*), the *sulcus occipitalis anterior* (*occ. ant.*) and the *sulcus occipitalis lateralis* (*occ. lat.*). The *sulcus occipitalis anterior* is the homologue of the "ape fissure" of the authors. The gyrus between the mesal end of the *sulcus occipitalis anterior* and the *sulcus parieto-occipitalis* is the *gyrus annectans superior*, while that between the lateral end of the *sulcus occipitalis anterior* and the *sulcus occipitalis lateralis* is the *gyrus annectans inferior*. The complete enclosure of the area must be to some extent artificial, but I shall make it by joining the several sulci with one another at the points where they come nearest together, using the two ends of the *sulcus occipitalis anterior* and the caudal end of the *fissura calcarina* as points from which to start the limiting lines. Of the accessory sulci within this area I have at the moment nothing to say.

The left hemisphere, Fig. III, shows a typical arrangement of the sulci bounding this lobe. On the right side the arrangement is similar, but the *sulcus parieto-occipitalis* does not show on the dorsal surface and hence there is nothing to match that sulcus on the left side. On the right, also, the whole occipital region is smaller as shown by the principle outlines, and just laterad of the most caudal end of the *sulcus occipitalis anterior* is a small group of very shallow sulci which appear hardly deeper than vascular grooves, but which section of the region shows to be true sulci.

The smaller size of the region on the right side and the peculiar sulci just mentioned are the principal points which suggest defective development, as the failure of the *sulcus parieto-occipitalis* to appear on the dorsal surface is not so uncommon in normal individuals. At the same time the fact that this same sulcus is well developed on the left side while it is poorly developed on the right is suggestive when taken in connection with the defects already noted. The gyri of this region are all rather narrow and closely pressed together, thus rendering the intra-lobar sulci inconspicuous. Eberstaller

(34—No. 19) notes that the length of the arc from the occipital pole to the point where the *sulcus parieto-occipitalis* cuts the edge of the mantel is to the entire arc, *i. e.*, to the *trigonum olfactorium* (see p. 315), as 1 to 6. Measured on the left side in Laura it is 1 to 6.1, and on the right it is 1 to 6. This for our purpose is not so significant as the arc between the caudal end of the *fissura calcarina* and the point where the *sulcus parieto-occipitalis* cuts the edge of the mantel, which is,

On the left side,	50 mm.
On the right side,	29 mm.

Showing the great reduction in that measurement of the *cuneus* on the right side. Further, whereas the arc of the *præcuneus* and that of the *cuneus* are about the same length on the left side—a condition of things which is normal,—on the right side that of the *præcuneus* is much longer than that of the *cuneus*. These relations are shown in Fig. IV, where, as can be seen, one cause of the reduction in size of the *cuneus* is its apparent displacement dorsad of the *fissura calcarina*. In the left *cuneus* I find nothing peculiar to describe. In the right side the *sulcus parieto-occipitalis* may be considered to branch just below the letter *p*. The *ramus* marked *p.o.* runs dorsad towards the edge of the mantel, but never reaches the dorsal surface, as the bounding gyrus has its concavity ventrad and its convexity dorsad. The other branch, running almost vertically in Fig. IV, appears to unite with the *sulcus* which, lying cephalad to the *sulcus parieto-occipitalis*, represents that described by Eberstaller(24—No. 18) as a branch of the interparietal, and by Wilder(38) as the cephalic stipe of his *fissura paroccipitalis*. The union is apparent only, and is caused by the extension caudad, in the form of an operculum, of the præcuneal wall that bounds these sulci. On removing this operculum, the *sulcus parieto-occipitalis* is seen to be represented by the sulcus marked *p. o.* alone and to have undergone something of a bend with the concavity caudad, at the point of apparent branching, but the relations with the *fissura calcarina* are normal. The appearance here is somewhat further complicated by a considerable development of the accessory sulci on the mesal surface. So far as we have gone, therefore, the right *cuneus* is less well developed than the left. It will be recalled that we also found the posterior *cornu* of the left side in better condition than on the right. From these facts it appears that the right occipital lobe shows several anomalies which when all are taken together indicate that the arrest of development has been more marked on this side. It will be remembered that up to her seventh year Laura was somewhat sensitive to light in her right eye while she was completely blind in the left. That sensitiveness meant the preservation of a certain portion of the retina in the right eye for some five years longer than in the left. The conservative value for the nerve centres of even such weak stimuli has long been recognized, and it is but natural therefore that the occipital lobe chiefly connected with the right eye should be better preserved than the other whose development was presumptively arrested earlier and during the years most important for growth.

Temporal Lobe.—This is disproportionately small and alike on both sides. The failure to develop appears to affect most of all the tip. In Laura's case I have not discovered anything that seemed to deserve study as an anomaly, so far as the gross anatomy of this region is concerned, and I can present nothing on the cortical centre for hearing, on the assumption that that centre is in or about the first and second temporal gyri [Horsley and Schäfer([40]), Starr([41])]. It may be that the defects in the sense of smell and taste have left their mark on the uncinate gyrus and its neighborhood, if Ferrier's([39]) localization is accepted; but it must be remembered that neither of these senses was entirely wanting, although the former was very defective. I should hesitate, however, to adduce any direct evidence from our case.

While searching for defects it is only fair to keep in mind that the centres for those senses and activities which Laura did retain might have undergone an unusual development. Nevertheless, her finger dexterity in talking would not, I should think, call for unusual control from the cortex and the refinement of touch in her case appears to have been limited to the hands and face. The portion corresponding to the finger and thumb area (see Mills [42—p. 230]) is fairly developed on the left side and not quite so well on the right, but there is nothing in the gross appearance that is remarkable. Since the interesting work of France([53]) on the *gyrus fornicatus* and the association of this with dermal sensibility in monkeys, I was led to examine this region with such care as the poor condition of this part of the specimen would permit, but with negative results.

Measurements of Cortical Areas.

Every now and then during the present century various investigators have made the attempt to get at the quantity of gray matter in the cerebral cortex, both in man and some of the animals. It has thus far proved impossible to obtain a figure for this portion of the brain which would have the accuracy, for example, of those we possess for its weight, but several approximations have been made which are of some value. The questions which such an examination was designed to answer have not always been briefly formulated and it will be as well to state at once what we expect from it in this case. We wish to know whether those portions of the cortex, which in Laura we suspect are defective and which belong to one hemisphere, will prove to have a less area, when the two hemispheres are compared with one another. We wish to know further whether the total area of the cortex is, in our case, less than the total area of the cortex in a normal brain with which that of Laura might be compared. In the statements just made the term area has been alone used, but of course if we knew at the same time the average thickness of the cortex, then the masses of the cortex might as easily be compared as the areas. These measurements are for the most part neglected in the usual description of specimens, as it takes some time and trouble to make them, and the results are perhaps not proportionate to the expenditure of energy necessary for this. Nevertheless when we get them all together there is quite an array of figures to be found in the literature.

With a view to rendering these results intelligible I shall briefly present some of the objects and conclusions of investigators in this line. R. Wagner([31]) made a number of direct measurements of the area of the convex (as distinguished from the mesal) surface of specimens in the famous Göttingen collection, which contained among others the brains of Gauss, Fuchs and Dirichlet. He was followed by his son, H. Wagner(44), who measured not only the entire exposed surface but also the length and depth of the sulci, from which the sunken surface, *i. e.*, the portion forming the walls of the sulci, could be calculated, and from these two results the total area of the cortex was obtained. In carrying this task to completion H. Wagner established several relations between portions of the cortex which subsequent investigation has tended to confirm. The main problems which the Wagners had in mind were: first, whether individuals of superior intelligence had the frontal lobes unusually developed; and second, whether, if the individuals were arranged in series according to intelligence, the figures for the areas of the cortex of the respective brains would follow the same order. To the first question the answer was negative; to the second, apparently positive. At the same time the brains of the more intelligent individuals in their series were in general heavier *i. e.* larger than those of the less intelligent and their table might as well be interpreted to mean that in general the larger brains have the larger cortical areas. From the data given by H. Wagner(44) I form the following table to illustrate this last point:—

	Weight of Cerebral Hemispheres, Fresh.	After Hardening in Alcohol.	Total Area of Cortex.
Gauss,	1492 grm.	957 grm.	219588. sq. mm.
Fuchs,	1499 grm.	895 grm.	221005. sq. mm.
Frau,	1185 grm.	864 grm.	204115. sq. mm.
Krebs,	1273 grm.	771 grm.	187672. sq. mm.

It may be noted in passing that Table VIII of H. Wagner (44) is the one that appears in the text books where the figures for the area of the cortex are given. The total area in the original table is expressed as the sum of the areas of the frontal, parietal, occipital and temporal lobes. As a matter of fact it is the sum of these plus the area of the *insula (Stammlappen)*, but the figures for the *insula* have been omitted in the printing of the original table. It thus happens that the figures representing the total area are somewhat larger than the sum of those for the separate lobes as given in the table. This omission in the original has been perpetuated by the text-books, but so far as I know attention has not previously been directed to it.

Most directly in the line of Wagner's work is that of Jensen(45) who measured the area of the cortex on six brains of the insane with a view to finding whether they exhibited any peculiarities in this respect. His results were negative. There are two points in this connection which I desire to emphasize. First, the authors who have undertaken this sort of work have at the same time realized that the thickness, structure and nutrition of the cortex were factors entirely left out of account, and probably of the greatest importance; and second, we have thus far complete measurements only on brains hardened in alcohol in which a decrease in weight of 27%—40% has taken place and consequently no results are at hand to determine by this method the area of the cortex in the fresh normal brain.

Vogt(46) in his study of microcephalics has given the areas of the exposed surface of the brains. These measurements, however, were taken not on the specimens, but on the casts of the cranial cavity. Of the other methods that of Baillarger(47) is the most direct, though not the most satisfactory. He separated the cortical surface in the fresh specimen by dissecting out the white matter from the hemispheres. This made it possible to unfold the cortex and thus get at the area by direct measurement. His figure for the total cortical area of the hemispheres is 170000 sq. mm. which he thinks may be correct within 7% for his cases. Besides these there are methods which may be designated respectively as the geometrical, physical and chemical. In a certain sense the measurements of the Wagners and Jensen were geometrical as the cortical surface sunken in the sulci was calculated from the observed length and depth of the sulci. Calori(48) reduced the exposed surface of the hemispheres to geometrical forms and measured them in that shape, using the device already described for getting the area of the sunken cortex. Giacomini is of the opinion that Calori's method is less exact than that of the Wagners and Jensen. The specimens had been hardened in alcohol. His problem was the variation in the total area according to the shape of the head. The results which Calori has obtained from a very large number, 41, of Italian brains, measured by his method, are indicated by the following average figures:

Male:	Brachycephalic,	243773 sq. mm.
Male:	Dolicocephalic,	230212 sq. mm.
Female:	Brachycephalic,	211701 sq. mm.
Female:	Dolicocephalic,	198210 sq. mm.

The physical method of getting at similar results is based on the weight of the entire brain, its specific gravity and the specific gravity of the gray and white matter that compose it. This method has been introduced by Danilewsky(49). The result is the percentage of gray and white matter in a given specimen. If now a certain proportion of the gray matter is assumed to belong to the cortex we can obtain the mass of the cortex and in turn assuming a certain average thickness for the same we can calculate the area. Omitting all detail, Danilewsky(49) found:

For encephalon weighing 1240 grm., total cortical surface, 158800 sq. mm.
" " " 1324 " " " " 169200 " "

As will be seen these figures fall below any that have thus far been given.

In the chemical method, so called, the percentage of water is determined instead of the specific gravity and from data thus obtained the mass or area of the cortex can be determined. More or less complete data for the percentage of water in the gray and white matter of the brain have been furnished by Bourgoin(50), Desprez(51) and Forster(52). Giacomini takes the view that of the last two methods the chemical one is the more exact. At his suggestion DeRegibus(17—p. 276), examined several brains and obtained the following figures for the area of the cortex:

1.	Single hemisphere,	128000 sq. mm.
2.	Both hemispheres,	278940 sq. mm.
3.	" "	245160 sq. mm.
4.	" "	217472 sq. mm.

The original weights of the brains are not given.

The figures obtained by Baillarger(47) and by those authors who have used the physical and chemical methods apply to the fresh brain, having its normal size; whereas all the other figures apply to brains shrunken by alcohol. At the moment we have no means of making the corrections required, but it would be fair to expect that measurement on the fresh brain would show a larger area than those on alcoholic brains. If that is a true inference, then it is not a little curious that of these authors just mentioned only DeRegibus presents figures which are at all comparable with those of the Wagners, Jensen and Calori, the figures from the other observers being smaller.

I pass now to the measurements of our own specimen. The questions to be answered have already been stated: 1st. To determine any differences between the areas of special regions in the two hemispheres. 2nd. The total area of the cortex.

Method of Making Measurements. Investigators have covered the exposed surface of the cortex with squared paper, tin foil, gold-leaf or something of the sort, and then by computing the number of these squares required to cover a given region have calculated the area. In this instance I moistened thin sheets of gelatine until they were flexible; these were then laid on the surface and the outlines of the exposed portions of the gyri traced on them by means of India ink. The area of a region having thus been transferred to the gelatine it was removed, a copy of it taken on tracing paper and numbered. The same area was enclosed by a line on the plaster cast and given the same number, thus each region was recorded. The gelatine sheet was placed over a piece of standard paper ruled in squares 2 mm. on each side. Under a lens magnifying 6 diameters the number of squares enclosed by the outline was enumerated and reduced to millimeters. The method proved quite practicable and accurate. In getting the area from the gelatine sheet measurements were made to square millimeters.

The length of the sulci was taken with compasses where that was permissible, but usually with a strip of tin foil marked in centimeters. The fractions of a centimeter were taken with compasses and read on a millimeter scale. The depth of the sulci was taken with a fine hard rubber probe, a trifle enlarged at the tip so that it had there a diameter of 1.3 mm. On this a button of pith which slipped easily served to mark the distance to which the probe was inserted, and this distance was read off on a millimeter scale. The majority of the sulci were sounded every centimeter, short ones at lesser intervals. The calculations of the sunken surface were made on the assumption that the lines representing the length and depth formed with one another rectangular figures. Jensen's(45) argument for considering these figures zonal segments, on the convex surface at least, was at the time unknown to me, but I think that the error introduced by the method used has in our case largely balanced out, since the direct measurement of the depth of the sulci was constantly too small. The figures were not summed until all the data were collected and they have not been manipulated in any way save as I shall in a moment state. The sums thus obtained are as shown in Table I.

TABLE I.

Total Surface, Sunken and Exposed. (Not corrected.)

	LEFT.	RIGHT.
Insula,	1760. sq. mm.	2026.5 sq. mm.
Frontal lobe,	27624.5 sq. mm.	29584. sq. mm.
Occipital lobe,	3824.5 sq. mm.	3604.8 sq. mm.
Residual portions,	51056.7 sq. mm.	47452. sq. mm.
	84265.7 sq. mm.	82667.3 sq. mm.
Absolute difference =	1398.4 sq. mm.	
In percentage =	1.8 %	

As will be seen the result shows the total cortical surface nearly alike in both hemispheres.

By "exposed surface" is meant that portion which does *not* contribute to the walls of the sulci ; by "sunken surface" that which does thus contribute. The portion of the *insula* and the *operculum* which would, under this definition, be called exposed is nevertheless counted as part of the sunken surface from its position, both in the calculations for the surface of the frontal lobe and for the entire hemisphere. In the tables for the *insula* alone a distinction is made between the sunken surface, as defined, and the other portion, which to avoid ambiguity is there called "convex surface." The total figure for the sunken surface of the frontal lobe or a hemisphere contains, then, the not-sunken or convex surface of the *insula* and also the *operculum* which, by the way, showed no sulci so far as it was in contact with the *insula.* As neither of these contribute to form the walls of sulci they are subtracted from the total "sunken surface" before the average depth of the sulci is calculated. Further, in getting the average depth of the sulci, proper correction is made for those instances where the sulcus had been considered to have but one wall, as in the case of the callosal and the cephalic portions of the Sylvian fissures.

The Sylvian fissure is considered to start at the lateral end of the *vallecula Sylvii.* The limitation of the *insula* is by the *sulcus circularis* (Schwalbe). The frontal lobe is limited by the *fissura Sylvii,* the *fissura centralis,* and the *fissura subfrontalis* (Eberstaller). The limitations of the occipital lobe have been previously described as formed by the *sulcus parieto-occipitalis, fissura calcarina, sulcus occipitalis lateralis,* and *sulcus occipitalis anterior.*

Finally with regard to the corrections in the figures obtained by direct measurement. Such correction has been made for the depth of the sulci only. This affects in the results, of course, the average depth of the sulci, the area of the sunken surface and the total area. The correction has been made by adding 25% to the observed depth of the sulci, that is, the observed depths were considered to represent 75% of their real value, and were increased so as to represent 100%.

A word of explanation is here needed. The facilities for getting the true depth of the sulci in a brain hardened in potassium bichromate are much less than in the case where the hardening has been effected by alcohol. Sulci in our case could not be opened up without fear of injury to the specimen and the resistance by which one inferred that the bottom of the sulcus had been reached was often caused by the approximation of the walls at some distance above the bottom. This error was neglected, however, until the measurements were complete, on the assumption that it would be the same for both sides. The figures obtained, Table I, justified this assumption and what we have to say concerning the relative development of the hemispheres and their sub-divisions can be equally as well based on the original as on the corrected figures ; but when we desire to compare the total area in our case with that found by other investigators as well as the relations of the exposed and sunken surface, it is absolutely necessary to use the corrected figures. The correction was obtained by measuring sulci in sections of the hemispheres and noting the difference between the true depth and the depth as obtained by the probe. This difference approximated on an average 25%, being a trifle over that figure. It is with regret that I introduce this modification of the results, but certain it is that without the correction the absolute figures would have fallen far below the truth. One point more; we are dealing here with a brain that has swollen in hardening. What the total amount of variation in the area of surface thus produced is, I cannot say, but I see no reason to think that the relations of regions at the surface of the brain have been altered. The portions which did not harden and therefore did not swell were the ental ones, but the cortex throughout was exposed to the action of the fluid in much the same way and does not, I believe, show any distortion that is due to irregularities in the preservation.

Insula.

I may be permitted to state here that the descriptions of the various regions were written before the following figures relating to them had been tabulated, and that in comparing the figures with the previous description I am comparing independent observations.

Defective development of the centre for articulate speech in the left hemisphere has been already described. When defective development occurs here the *insula* is often reported as sharing in the defect. The following, Table II, shows the relations for the *insula*. This table, as well as all those that follow, is corrected in the manner above mentioned.

TABLE II.

Insula. (Corrected.)

	LEFT.	RIGHT.
Greatest length,	55. mm.	66. mm.
Greatest width,	30. mm.	33. mm.
Convex surface,	1488. sq. mm.	1625.5 sq. mm.
Sunken surface,	363. sq. mm.	548. sq. mm.
Total length of sulci,	88. mm.	83. mm.
Average depth of sulci,	2.0 mm.	3.3 mm.

It appears from this that the left insula is less well developed than the right in every way except the length of the sulci, in which it is slightly superior.

Frontal Lobe.

Next in order we take the frontal lobe as above defined.

The frontal lobe is bounded by sulci, and these stand in the table as limiting sulci. One half the sunken surface which lines these sulci is designated as the limiting sunken surface; the other half of course belongs to the lobes bounding the frontal lobe. The area bounded by these limiting sulci is the included area. In this case our interest is in the included area.

TABLE III.

Frontal Lobe. (Corrected.)

	LEFT.	RIGHT.
Total exposed surface,	11320. sq. mm.	12326. sq. mm.
Limiting sunken surface,	5920.4 sq. mm.	5020.2 sq. mm.
Included sunken surface,	15818.4 sq. mm.	17994. sq. mm.
Length of limiting sulci,	449. mm.	411. mm.
Length of included sulci,	1051. mm.	1117. mm.
Average depth of limiting sulci,	13.0 mm.	12.1 mm.
Average depth of included sulci,	7.4 mm.	8. mm.

Considering the included area and the figures relating to it, we find the left lobe inferior to the right in every point; to this inferiority the suspected *gyrus frontalis inferior* is assumed to contribute largely. It would seem simpler to compare measurements of this gyrus on both sides, but the difficulty of bounding it *cephalo-ventrally* has deterred me from trying to make the comparison. The deficiency in the figures relating to the limiting portions on the right side is in part due to the less elaborate development of the *fissura subfrontalis* (Eberstaller)—the *sulcus calloso-marginalis* of Ecker.

Occipital Lobe.

In the earlier description it was brought out that the right occipital lobe and especially the right *cuneus* were poorly developed. Table IV shows the results of measurements.

Table IV.

Occipital Lobe. (Corrected.)

	Left.	Right.
Total exposed surface,	1660.5 sq. mm.	1302. sq. mm.
Exposed surface of cuneus,	608. sq. mm.	412. sq. mm.
Limiting sunken surface,	1957.2 sq. mm.	1847.7 sq. mm.
Included sunken surface,	928. sq. mm.	1356. sq. mm.
Length of limiting sulci,	133. mm.	137. mm.
Length of included sulci,	108. mm.	116. mm.
Average depth of limiting sulci,	14.6 mm.	13.4 mm.
Average depth of included sulci,	4.2 mm.	5.7 mm.

Here again the measurements support to some extent the previous observations. The total exposed surface, and the exposed surface of the *cuneus* are both less on the right side. But when we come to compare the included sunken surfaces on the two sides the right is superior, and if we sum the total exposed and sunken surface for the two sides we find it:

On Left Side.	On Right Side.
2588.5 sq. mm.	2658. sq. mm.

That is, it results to the advantage of the right side. The disturbance then which caused the peculiarities of the right lobe did not materially alter the cortical development on the two sides. This would, for one thing lead us to regard the *cuneus* where the difference between the two sides is striking with especial care. As the table shows, the exposed surface of the *cuneus* on the left side is the greater. If we add to each exposed surface the sunken surface for this special region, *i. e.*, *cuneus*, we get the following:

	Left.	Right.
Exposed surface, cuneus,	608 sq. mm.	412 sq. mm.
Sunken surface, cuneus,	376 sq. mm.	428 sq. mm.
Total surface, cuneus,	984 sq. mm.	840 sq. mm.

This indicates the total cuneal surface as smaller for the more irregular right side, which is what we might expect if the visual centre is here located. For the rest of the occipital lobe there appears to have been that compensatory growth by which the portions about the *cuneus* developed more generously as the *cuneus*, itself somewhat arrested, offered less resistance to their expansion.

Residual Portion.

What remains after the *insula*, frontal and occipital lobes have been considered, I call the "residual portion." In itself it has no special interest for us at the moment. The figures are given in Table V.

TABLE V.

Residual Portion. (Corrected.)

	LEFT.	RIGHT.
Total exposed surface,	18842. sq. mm.	19037.2 sq. mm.
Limiting sunken surface,	7877.6 sq. mm.	6867.9 sq. mm.
Included sunken surface,	35074.9 sq. mm.	31022. sq. mm.
Length of limiting sulci,	582. mm.	548. mm.
Length of included sulci,	1619. mm.	1613. mm.
Average depth of limiting sulci,	13.3 mm.	12.4 mm.
Average depth of included sulci,	10.8 mm.	10. mm.

Having thus presented the data for all portions of the hemispheres it remains to cast them in the form of tables so that, as far as possible, they may be compared with the results of others, and we may thus determine something of the relative cortical development in this case. Table VI gives the total exposed surface according to the limitations previously stated.

TABLE VI.

Total Exposed Surface.

	LEFT.	RIGHT.
Insula,	——	——
Frontal lobe,	11320. sq. mm.	12326. sq. mm.
Occipital lobe,	1660.5 sq. mm.	1302. sq. mm.
Residual portion,	18842. sq. mm.	19037.2 sq. mm.
Total,	31822.5 sq. mm.	32665.2 sq. mm.
Absolute difference,		842.7 sq. mm.
Percentage difference,		2.6 %

Table VII gives in the same way the total sunken surface.

TABLE VII.

Total Sunken Surface. (Corrected.)

	LEFT.	RIGHT.
* Insula,	1851.0 sq. mm.	2173.5 sq. mm.
Frontal lobe,	21738.8 sq. mm.	23014.2 sq. mm.
Occipital lobe,	2885.2 sq. mm.	3203.7 sq. mm.
Residual portion,	42952.5 sq. mm.	37889.9 sq. mm.
	69427.5 sq. mm.	66181.3 sq. mm.
Absolute difference,	3246.2 sq. mm.	
Percentage difference,	4.9 %	

* It will be recalled that for our purpose the *insula* is not considered to have an exposed surface.

TABLE VIII.

Total Surface, Sunken and Exposed. (Corrected.)

	LEFT.	RIGHT.
Insula,	1851.0 sq. mm.	2173.5 sq. mm.
Frontal lobe,	33058.0 sq. mm.	35340.2 sq. mm.
Occipital lobe,	4551.7 sq. mm.	4505.7 sq. mm.
Residual portion,	61794.5 sq. mm.	56927.1 sq. mm.
Total,	101256.0 sq. mm.	98946.5 sq. mm.
Absolute difference,	2309.5 sq. mm.	
Percentage difference,	2.3 %	

This Table VIII gives the total figures which I consider final for this specimen. To prevent any possible misunderstanding I may state again that Table I, which gives the original figures before they were corrected, is presented to show on what basis the corrections were to be made. And though it is possible that the two tables may be confused, I hope by this explicit statement to prevent such a complication, and make it plain that Table VIII only is the one to be used in comparison with the figures obtained by other authors.

In connection with Table VIII, I have to call attention to the figures for the total surface of the *insula* and frontal lobes of the left side which still remain smaller, whereas the occipital lobe is slightly larger on the left side. On the whole the area of the left hemisphere is greater, and I associate that with the fuller development of the caudal portions of this hemisphere. (See Fig. III.)

The length of sulci is shown in Table IX, and as will be seen the left hemisphere is a trifle inferior in this measurement. The limiting sulci are of course counted but once, so that if their length is given for the frontal and occipital lobes then the residual portion is to be credited with the included sulci only.

TABLE IX.

Total Length of Sulci.

	LEFT.	RIGHT.
Insula,	88 mm.	83 mm.
Frontal lobe, limiting sulci,	449 mm.	411 mm.
Frontal lobe, included sulci,	1051 mm.	1117 mm.
Occipital lobe, limiting sulci,	133 mm.	137 mm.
Occipital lobe, included sulci,	108 mm.	116 mm.
Residual portion, included sulci,	1619 mm.	1613 mm.
	3448 mm.	3477 mm.

Table X exhibits the average depth of the sulci for each hemisphere. The average depth of the sulci is obtained in the following manner: From the total sunken surface as previously given, the areas of the *operculum* and convex surface of the *insula* are subtracted. The areas for the *sulcus callosi* and the portion of the *gyrus frontalis inferior* which forms the dorsal wall of the *fissura Sylvii*, which have not been doubled in estimating the sunken surface, are added to this remainder. The sum is then divided by two, thus giving the area of one side of all the sulci. This divided by the total length of sulci gives the average depth. This process is carried out in Table X.

TABLE X.

Average Depth of Sulci. (Corrected.)

	LEFT.	RIGHT.
Total sunken surface,	69427.5 sq. mm.	66181.3 sq. mm.
Less sum of opercular and convex insular surfaces,	2426.0	2663.
	67001.5 sq. mm.	63518.3 sq. mm.
Plus callosal wall	1037.0 sq. mm.	1037.0 sq. mm.
Plus dorsal wall fiss. Syl.	827.0 sq. mm.	400.0 sq. mm.
One-half of this total	68865.5 sq. mm.	64955.3 sq. mm.
equals	34432.7 sq. mm.	32477.6 sq. mm.
Dividing this last figure by	3448.	3477.
Gives average depth of Sulci	9.9 mm.	9.3 mm.

The table explains itself I think without further comment, except the difference between the figures for the dorsal wall of the *fissura Sylvii* on the two sides, which is due to the fact that the method of measurement was not the same in both cases.

Before we make comparison of those figures which apply to the entire hemispheres, several other numerical relations may be noted. The surface of the frontal lobe in per cent. of the total surface is found to be:

	LEFT.	RIGHT.
Total surface,	100	100
Frontal lobe, total surface,*	32.5	35.8

We may also express the relations of the exposed and sunken surface in the two hemispheres:

*Our limits of the frontal lobe enclose a smaller region than those of the other authors who have given figures.

	Left.	Right.
If total exposed surface =	1.	1.
Then total sunken surface =	2.18	2.02

This relation of the exposed to the sunken surface is that which has been found by others, namely, the sunken surface is on the average very slightly more than twice the exposed surface.

Finally H. Wagner(44) devised a formula by which the exposed surface of the brain could be calculated from its several diameters. Applying this formula to our specimen we find by calculation a figure which is some 25% larger than that obtained by observation. Evidently the swelling of the brain and the consequent gaping of the sulci renders this formula inapplicable in our case.

It remains now to determine what peculiarities these figures obtained from our specimen show when compared with the figures from other authors, always keeping in mind that the latter figures used for comparison were obtained from shrunken specimens, whereas ours is swollen. We shall use for comparison the data furnished by H. Wagner(44), Jensen(45) and Calori(48). From the first the figures for the "woman" are used. From the second those for "Rockel," female, insane, and from the last those for brachycephalic females, three in number.

TABLE XI.

Total Surface.

Weight of Fresh Encephalon.		Left.	Right.	Sum.
1204 grm.	Laura,	101256. sq. mm.	98946.5 sq. mm.	200202.5 sq. mm.
*1304 grm.	Woman,	102742. sq. mm.	102373. sq. mm.	205115.0 sq. mm.
1065 grm.	Rockel (female, insane),	74615. sq. mm.	74523. sq. mm.	149138.0 sq. mm.
1236 grm.	Brachycephalic females.			245260. sq. mm.
1151 grm.				195684. sq. mm.
1056 grm.				194160. sq. mm.

The total figure for Laura, though her brain is swollen, is somewhat under that found by Wagner, and also under the average taken from the two brains of Calori with which it may be fairly compared, but above that of Jensen. The

* Figures for area corrected from H. Wagner's(44) table. As I understand Wagner, the fresh weight of this brain, which he gives as 1185 grm., applies to the hemispheres alone. 1304 is the estimated weight of the entire encephalon to which these hemispheres belonged.

small brain weight and the mental condition of the patient in Jensen's case must however be considered. I see here no greater variation than occurs in the full tables of these authors. We may conclude therefore that the total area of Laura's brain, if at all peculiar, was small for its weight. Comparison for total length of sulci and their average depth can be made only with the first two, as Calori does not give his figures on this point.

TABLE XII.

Total Length of Sulci and Average Depth.

Name.	LEFT.		RIGHT.		SUM.	
	Length.	Av. Depth.	Length.	Av. Depth.	Length.	Av. Depth.
Laura,	3448. mm.	9.9 mm.	3477. mm.	9.1 mm.	6625. mm.	9.5 mm.
Woman,	3349. mm.	9.88 mm.	3189. mm.	10.48 mm.	6538. mm.	10.14 mm.
Rockel,	2870. mm.	——	2834. mm.	——	5704. mm.	9.08 mm.

It appears that, whereas the length of the sulci is greater in Laura than in those with whom she is compared, the average depth in less than that of the woman and more than that of Rockel. At the same time both length and depth are well within the limits found by these authors for other brains.

The relative development of the frontal lobe is something to which a certain historical value, at least, attaches. The frontal lobe as we define it is somewhat smaller than that of Wagner and Jensen as they include that portion of the *gyrus fornicatus* which extends caudad as far as the *præcuneus*. If we include this region so as to make our results comparable with theirs we have the figures given in the next table.

TABLE XIII.

Relative Development of Frontal Lobe, given in Percentage of the Total Surface.

	LEFT.	RIGHT.	Average for Both Hemispheres.
Laura,	36.8	39.9	38.3
Woman,	40.	41.	41.
Rockel,	38.3	40.9	39.6

When the comparison is made in this way Laura is seen to be slightly inferior to the other two. An examination of the tables shows this to depend mainly on the smaller average depth of the sulci. The inferiority of the left side is manifested here again. In general then we may say that so far as these measurements are concerned, Laura's brain differs from other brains with which it may be compared to no remarkable degree, and the difference can in part at least, be explained by the failure of certain portions of the brain to develop completely. The determination of the mass of the cortex must await the measurement of its thickness, and that together with other observations is reserved for a second article.

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Explanation of Plates.

The Figures were drawn from photographs with the aid of a pantograph. Their size is approximately that of the hardened specimen. The lines indicating the sulci represent the middle of the lines marking sulci in the photograph. No indication of the gape of the sulci is given, except in the case of the *fissura Sylvii.* Where the sulcus gapes widely this method of representation makes the gyri on either side appear broad, and it is of course not possible to tell in these figures just how the space between any two sulcal lines is filled. The more constant sulci are indicated by heavy lines. The names are arranged alphabetically according to the initial letter of the abbreviation.

C. Fissura centralis.
Ca. Fissura calcarina.
ctr. Sulcus centralis transversus.
d. Sulcus diagonalis.
f 1. Sulcus frontalis superior.
f 2. Sulcus frontalis inferior.
f 3. Sulcus frontalis medius.
fm 1., *fm 3.* Sulcus fronto-marginalis.
ip. Sulcus interparietalis.
occ. ant. Sulcus occipitalis anterior.
occ. lat. Sulcus occipitalis lateralis.
pci. Sulcus præcentralis inferior.
pcs. Sulcus præcentralis superior.
po. Fissura parieto-occipitalis.
r. Sulcus radiatus.
rtc. i. Sulcus retrocentralis inferior.
rtc. s. Sulcus retrocentralis superior.
rtc. tr. Sulcus retrocentralis transversus.
S 1. Fissura Sylvii.
S 2. Ramus anterior ascendens fissuræ Sylvii.
S 3. Ramus anterior horizontalis fissuræ Sylvii.
S 1. asc. Ramus posterior ascendens fissuræ Sylvii.
sft. Fissura subfrontalis.
t 1. Sulcus temporalis primus.
t 2. Sulcus temporalis secundus.
t 3. Sulcus temporalis tertius.
t 4. Sulcus temporalis quartus.
t 1. asc. Ramus ascendens sulci temporalis primi.
t 2. asc. Ramus ascendens sulci temporalis secundi.
× Points at which the specimen was cut across.

A SKETCH OF THE HISTORY OF REFLEX ACTION.

By C. F. Hodge, Ph. D.

II.

Bell's Law.

The modern history of the nervous system may be said to begin with Charles Bell's demonstration of the law which bears his name; *viz.*, that the *posterior roots of the spinal nerves are sensory, the anterior motor.* Bell justly complained that the anatomists of his day had become disheartened by the seemingly irregular and lawless complexity of neural fibres. To those who know least of the actual anatomy of the parts, Bell says, the prevailing theories seem most ample and satisfactory; while those who study deepest only discover error and confusion. No wonder they had recourse to the authority of the ancients. Haller declared, as Galen had done, that the same nerve which conducted sensation also carried motion. But on any of the theories then extant, how the same little nerve could carry a motor impulse one way and a sensory impulse the opposite way at the same time was a confusing puzzle. Bichat (1771—1802) had distinguished the sympathetic, (or as he mistakenly called it, the ganglion system,) which presided over the functions of organic life, mediated sympathies between various parts of the body, was comparatively insensitive, and not directly under the control of the will, from the cerebro-spinal system. Curiously enough in 1809 Alexander Walker, a Scotch anatomist, claimed to have proved the converse of Bell's Law; *viz.*, that the posterior roots were motor and the anterior sensory.

Bell was accused of dissecting brains to find the seat of the soul; and this he denies in his first work upon the subject,[1]

[1] Charles Bell: Idea of a new anatomy of the brain. Submitted for the observation of his friends. Lond., 1811. The copy to which I had access is a transcription "made by H. U. D., 1813," in the possession of Dr. H. H. Donaldson.

saying that his only wish is to investigate the structure of the brain as we examine the structure of the eye or ear. Nowhere in this paper is the Law formally stated. But from it is seen that Bell is deeply imbued with the ideas which underlie, not only his Law, but the physiology of the nervous system as it is now understood. "The nerves of motion, the nerves of sensation and the vital nerves," he says, "are distinct throughout their whole course" (op. cit. p. 7). "The nerves which we trace in the body are not single nerves possessing various powers, but bundles of different nerves whose filaments are united for convenience in distribution; but which are distinct in office as they are in origin from the brain" (op. cit. p. 6). As is well known, Bell outlines the theory of specific energy of nerves. "An impression," he says (op. cit. p. 11), "made on two different nerves of sense, though with the same instrument will produce two distinct sensations, and the ideas resulting will have relation to the organs affected. Piercing the retina with a cataract needle gives a flash of light, and a blow on the head makes the ears ring and the eye flashes light, but no sound or light are present." The effect depends upon the part of the brain excited. Penetrated with these conceptions Bell sought to answer intelligently the following questions: 1, Do the nerves of the trunk and limbs derive the ability to perform their functions from a combination of peculiar forces received from the different parts of the cord indicated by their double roots? 2, Is this the reason why their course is simple or isolated as compared with the cerebral nerves? 3, Which nerves of the head and face correspond in structure with those of the trunk? Bell was acquainted with the sensory and motor effect of irritating the anterior and posterior columns respectively. On this point he says (op. cit. p. 26), "I found that injury done to the anterior portion of the spinal marrow convulsed the animal more certainly than injury done to the posterior portion." Thence he was lead to observe a corresponding difference of function for the roots. He continues (op. cit. p. 27), "On laying bare the roots of the spinal nerves, I found that I could cut across the *posterior fasciculus* of nerves, which takes its origin from the posterior portion of the spinal marrow, without convulsing the muscles of the back; but that on touching the *anterior fasciculus* with the point of the knife the muscles of the back were immediately convulsed."

In a later paper[1] Bell lays down the principle that complexity of nervous supply to an organ indicates a corresponding complexity of function. An organ with but a single nerve has but one function to perform; while the tongue, for which he observed five distinct sources of nervous supply, was employed in as many ways. For a voluntary muscle he asserted the existence of a double nervous supply, a *nervous circle*, one arc of which transmitted the excitement of the brain to the muscle, the other carried the sensation of the muscle to the brain. The proof of this he sought in the fifth nerve where besides direct fibres to the muscle there are also fibres which enter the muscle after passing the ganglion of Gasseri. The latter must be sensory nerves according to a fundamental principle which he had laid down, that no motor nerve was ever interrupted between its origin and its peripheral end by ganglia. All nerves, he admits, may be divided into these two classes, sensory and motor, but in view of the division in function and for convenience sake he prefers to make a separate class for the "respiratory nerves," *i. e.*, the nerves which co-ordinate the muscles for respiration, expression of emotion, etc. It was the investigation of this class which led Bell to his great work upon the nerves of the face and chest, and this in turn brought to light many facts in support of his Law. As has been shown, he performed experiments upon living animals to demonstrate his Law to his own satisfaction, but his aversion to vivisection and his predilection for anatomical methods no doubt delayed a full comprehension of the scope of his discovery; but an extended collection of faithful observations confirmed it beyond all doubt, and he boldly asserted its validity for each of the thirty-one pairs of nerves in man, as well as for all forms of lower vertebrates.[2]

[1] Charles Bell: On the Nerves; giving an account of some experiments on their structure and function which lead to a new arrangement of the system. Phil. Trans., 1821. pp. 398—424.

[2] See, Charles Bell: The Nervous System of the Human Body; embracing the papers delivered to the Royal Society on the Subject of the Nerves. R. S. London, 1830.

From studying the effects of cutting the facial and then the maxillary nerve in asses and monkeys Magendie (1783—1855) was led to sever anterior and posterior spinal roots, and declared that he had at last established by direct experiments the difference between sensory, or posterior, and anterior, or motor, fibres. In examining the body of a patient who had lost all power in his arms while sensation in them remained intact, he found the anterior roots considerably decayed. This law he found to be valid along the entire length of the cord, from which Legallois had already proved the motor and sensory powers of all organs without exception to be derived, one part of its surface being exquisitely sensitive and another part motor. It might thus be expected, Magendie declared, that as we pass from the surface to the centre of the cord we should reach a "secret sanctuary" where sensation perhaps passes into motion. This, however, is not the case, for, as he says, touching the centre of the cord causes neither sensation nor motion.[1]

This paper of Magendie[2] was published as an entirely independent and original observation and the claim of priority in the discovery of the law in question was at once made for him. While it seems on the whole probable that his method of demonstration was more conclusive than that of Bell, there is little doubt that the latter deserves to be called the discoverer. From other earlier papers of Bell it appears that, although not clearly recognizing the principles he finally established, he was penetrated with the idea that the difference of neural functions was grounded in anatomical differences;[3] and there is little doubt that Bell's results, which his assistant went to Paris in 1821 to demonstrate on the facial nerve, had been seen by Magendie. To him, however, belongs

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[1] Magendie: Sur quelques découvertes récentes relatives aux fonctions du systeme nerveux. Annales de chimie et de physique. Vol. 23, p. 429. Paris, 1823.

[2] Magendie: Leçons sur la Physiologie. Paris, 1839.

[3] For a good digest of Bell's earlier opinions, see *Karl Bell's Darstellung der Nerven; frei bearbeitet von Dr. H. Robbi mit einer Vorrede von I. C. Rosenmüller.* Leipzig, 1820.

the merit of introducing what was first established as an anatomical and pathological law into the fruitful field of physiology.[1]

Bell's discovery at once excited the liveliest discussion on the continent. Many doubted the validity or at least the universality of the Law. Of those who were convinced of its truth, some raised the further inquiry as to how the sensory and motor roots were distributed peripherally. The greater number of investigators, however, were led to study the functions of the various columns of the spinal cord to ascertain how far the distinction of sensory and motor could be traced in it. Bellingeri distinguished three pairs of columns in the spinal cord. The anterior pair were connected with the cerebrum, the posterior pair with the cerebellum. The lateral, restiform, and pre-eminently ganglionated columns mediated organic and instinctive functions. The anterior roots were composed of fibres from each of these columns. So too were the posterior roots. Those fibres of the anterior roots which sprung from the anterior columns mediated voluntary motions, and the fibres of the posterior columns which sprung from the posterior horns of the grey substance were exclusively sensory. All fibres, of which root soever, that took their rise from the posterior cerebellum columns innervated extension muscles, and those from the anterior columns innervated the flexors. For this latter conception he found fanciful ground in the phenomena of *episthotonus* and *emprosthotonus*.

Schoeps, in 1827, concluded that motility required more nerve-force than sensibility, and that the former was more impaired by section of the anterior root than by section of the

[1] Charles Bell. Nervous System of the Human Body. A note in explanation of this point states that "in Dec. of 1821, Mr. Shaw wrote a paper on the facial nerves in *Brandis' Journal of Science*. In this he stated, that at the request of M. Magendie he had repeated Mr. Bell's experiments on the face of a horse at Charenton, near Paris, and had at the same time presented to M. Magendie a copy of the Manual above mentioned (Manual of Anatomy; Explaining Mr. Bell's System; by John Shaw). * * * * It was after all this (in July, 1822) that M. Magendie published his paper on the nerves of the spine. On its arrival in this country, M. Magendie was informed that these experiments had been performed in Great Windmill Street, which he acknowledged in his next Journal, with the addition, that, although Mr. Bell had preceded him, his own proofs were more complete."

posterior, because the latter was feebler, smaller, and not generally able alone to move a limb. He grants that there is more mobility in the anterior columns and roots, and more sensibility in the posterior, but concludes from his experiments adversely to Bell's assertion of a complete division of function. Becker, in 1830, vindicated an absolute division of function, upon experimental and pathological grounds. Langenbeck, however, the following year, thought Bell's Law as speculative as Gall's localization of cerebral functions. As the activity of the brain may involve the functions of the entire mass, so the cord may be motor or sensory throughout. The fact that the anterior and posterior columns are so intimately connected, and the two halves of the cord are interlinked by so many commissural fibres, made a division of functions seem improbable. The fibres of both roots, moreover, are so intricately interwoven, after leaving the cord, in the plexus that the integrity of each of the two systems seems impossible. Experimental objections were urged only against Bell's assertion that the facial is exclusively a motor, and the trigeminus a sensory nerve.

Much light was thrown upon the matter in the first volume of Müller's *Physiologie*, in 1834. He may be said to have established Bell's Law in Germany. One reason why previous observers had found such difficulty and reached such conflicting results in their investigations was that most of them had used warm blooded animals, the nerves of which, especially of the posterior roots, speedily lose their power and die in consequence of the necessary operations. Another reason was that many of them had not clearly distinguished between reflex and direct stimulation, nor between the results of stimulating the peripheral or the central end of the sensory root. Müller used frogs, the large accessible and persistently vital nerves of which make them especially fitted for such studies, and he compared the effects of stimulating the severed peripheral ends of each root. Any clear distinction between anterior and posterior columns, either anatomically or functionally, Müller discountenanced; still more so the idea that the outer or white substance mediated motion and the grey central substance sensation. He was moreover inclined to regard the spinal cord as the common collective bundle of all the trunk nerves, rather than as a part of the central organ. Bell's theory, though ingenious, he thought had not been hitherto satisfactorily proved. His own method established it with a simplicity and certainty not inferior to that of the best physical *experimentum crucis.* These results were confirmed by applying galvanic irritations to both roots. Panizza and Van Deen confirmed Bell's Law by new and manifold experiments.[1] The last sought to determine which parts were innervated by the single nerves, and concluded that the seventh pair of the frog mediated the movement of flexing the thigh against the belly, the eighth, all the movements of the hip and knee, and the ninth pair of nerves the movement of the foot and toes. He inferred that in the plexus sensory and motor nerves cross and intertwine without losing or interchanging their functions. The use of the plexus according to Van Deen was to be found in the fact that different movements which traverse it at the same time are easier and more harmonious. The position, connection, and form of the muscles was determined by the position and form of the plexus. The peripheral ending of sensory nerves is in the skin, that of the motor nerves in the muscles. The two can be compared with the veins and arteries which often run side by side, but the motions mediated by each are in opposite directions and they communicate directly with each other. The nerves like the muscles of the two halves of the body are symmetrical and unconnected save in the higher nerve centres. Here the ends of sensory and motor nerves lie near together in order that the latter may observe the behests of the former. Longet, whose investigations were published in 1841, thought galvanism peculiarly adapted to demonstrate Bell's Law on higher mammals. He severed the anterior roots of one leg leaving the posterior roots intact, and even after administering small doses of strychnine observed no motion upon that side while the other was violently convulsed. The galvanic current was applied directly to the strands of the cord with

[1] For a brief sketch of the work of these and several other investigators, see J. W. Arnold: Ueber die Verrichtung der Wurzeln der Rückenmarks Nerven. Heidelberg, 1844.

many interesting results which were, however, largely vitiated from the same cause that led him to suspect the results of his predecessors, *viz.*, that the currents used were too strong. An anonymous writer, who accepted the fact that section of anterior and posterior roots destroyed motion and sensation respectively, still protested against the presupposition of Bell's Law that motion and sensation were two distinct functions, because in morbid or abnormal conditions they seemed to be more or less isolated.[1] "There are points in the nervous system," he says, "where sensation and motion pass over into each other; it is one and the same soul that feels and moves, while if Bell were right two souls, one sensory and another motor, would be conceivable. Nothing can be more casual and external than the merely spacial distinctions between anterior and posterior, and yet the re-iteration of this distinction is all Bell's school have accomplished, and this is made essential in the nature of the soul. Instead of interpenetration of functions necessary to true psychic unity, Bell offers a mechanical juxtaposition and agglomeration, which encourages speculative anatomy and is no less unscientific and disintegrating than phrenology or a supposable theory that muscles have flexor and extensor fibres." He concludes that our soul would be much poorer than it is in feeling and action, if motor nerves did not conduct centripetally and inform us of the condition of our muscles and if sensory nerves did not lead outwardly.

III.

The Physical Versus the Psychic Theory of Reflex Action.

The labors of Bell, Magendie and Johannes Müller had made known in a practical way the anatomical elements concerned in reflex action; *viz.*, a centripetal and a centrifugal nerve with their portion of the spinal cord. Anatomy out of the way, the next question was one of physiology, namely, do these parts operate upon mechanical principles or not? That the mere transmission of an impulse along a nerve is purely

[1] Roser und Wunderlich's Archiv. Jahrg. I. S. 295.

mechanical can hardly be doubted, but what of the central process by which a sensory is changed to a motor impulse, and so directed as to cause definite movements of the muscles?

The first to elaborate a mechanical theory of reflex action was Marshall Hall. Besides the cerebral system, which mediated the functions of sensation and volition, and the ganglionic, which presided over the functions of nutrition, he assumed a third, *viz.*, the true spinal system. This last he describes as follows: "The spinal cord of vertebrates consists of two parts very closely connected with each other, not easily separable anatomically, and perhaps only to be distinguished by physiological and pathological methods.[1] The first part is a bundle of nerves which subserve the purpose of sensation and volition. The central organ for these fibres is the brain, from which they proceed and to which they return. The second part, which may be designated as the true spinal cord is distinguished by the excito-motor nerves. Generally, though perhaps not invariably, it is connected with the former system." The answer to the question how far excitory nerves can be separated or distinguished from sensory and motor nerves from voluntary, he assumed must be sought in invertebrates, which lead an excito-motor life with little sensation or volition, because in them the nerves need not be clustered into bundles in passing out from the spinal cavity between two vertebræ. He regarded the opticus and acusticus as purely sensory, without excitory functions. The tonicity of muscles he considered as the result of excito-motor force, mediated by motor nerves which are enclosed in the same sheath as the volitional nerves, and observed that this power is active in sleep in all muscles except the *levator palpebrae* and perhaps the *recti*. Hence he concludes that the nerves which innervate these are purely volitional without motor power. This opinion, however, is not put forth with great confidence and still less is he disposed to insist upon the existence of purely excitory nerves. He regarded, however, the pneumogastric as the least sensory

[1] See his writings *passim*, but especially his Memoirs on the Nervous System. London 1837. Translated into German by G. Kürschner, Marburg, 1840; p. 50 of the Ger. edit.

and the most excitory of all nerves among the vertebrates. But, although the anatomical distinction between these systems may be questioned, the action of narcotics, the movements of decapitated animals, cases of paralysis and all convulsive diseases, on which he made many observations, warrant the inference, not only of an independent system, but even of two roots in every sensory-excitory and in every volitional-motor fibre, one ending in the cord, the other in the brain. The excito-motor system never sleeps, but constantly watches day and night, with great, though not absolute independence from the brain, over all the openings of the body, eyes, nostrils, mouth, larynx, and all the sexual and excretory passages. There is *nothing whatever that can be called psychic connected with any of its activities*, and Marshall Hall assured his readers with much complacency that all the complexly co-ordinate and seemingly purposive movements made by the brainless animals he so long and diligently studied, snakes, tritons, frogs, cats, dogs, rabbits and leeches, etc., are unattended by sensation or by any other *rudimentary form of consciousness even in the least degree*. If the head of an eel be first removed, the trunk may be skinned without the "abominable cruelty" of the ordinary practice, for then all its writhings are purely mechanical. Formerly, he reminds us, irritability or the *vis in sita* of muscles was thought to be sensory-volitional, and he claims for himself the merit of distinguishing it from excito-motor action. The vital functions die in the following order: first the sensory-volitional, located in the brain; then the respiratory, centered in the *medulla oblongata;* then the excito-motor or reflex; and lastly muscular irritability, of which *rigor mortis* is the "last act." Lethargy may be so deep as to affect even the lowest of these functions. The embryo in its development reverses this order, and the fœtus before birth is only irritable and reflex. Hall was well acquainted with the works of his contemporaries in France and Germany, and identified excito-motor power with Haller's "*vis nervosa*," Müller's "*motor-power*," and Flourens "*excitability*." He accepted the law of isolated conductivity of nerve fibres, but believed spinal motor-power could work in both directions and made observation that reflex contractions differed from direct in occurring more "gradually" and in being less local.

G. Kürschner, the translator of Hall's treatise into German, wrote a long and suggestive appendix, full of independent and confirmatory observations. His experiments led him to the conclusion that in the spinal cord sensory and motor nerves are distinct from each other, the former composing the posterior, the latter the anterior column. Although separated, both species of fibres are most closely connected with each other, probably through the action of the grey substance. Each group of sensory corresponds to a distinct group of motor-fibres in such a way that in different parts of the cord, one and the same sensory group is connected with several motor groups, and hence it is that every spot of the skin, *e. g.*, corresponds to certain motions of the muscles.[1] Thus he infers that perhaps all possible combinations of muscular motions may be preformed in the structure of the cord and the *medulla oblongata*, and that the sensory nerves of the external surface of the body are connected with combinations which cause single motions and change of place, while those connected with the inner mucous surface occasion so called organic reactions. When brain and cord were destroyed gradually downward, Kürschner believed that the manifoldness and complexity of the body or of any single limb were gradually lost before the sum of its mobility was sensibly affected. Müller had assumed that the striking difference observed between the action of the muscles of the "animal" system and those of the "organic," as they were then called, was due to the difference in the mode of innervations, while Kürschner argued that it was due to differences of texture and structure in the two classes of muscles, and showed that the same irritation to heart, intestines and voluntary muscles gave in each case the characteristic sort of contraction produced by normal innervation. Kürschner believed that the activity of the ganglia incited motion "as water drives a mill," while the cord, besides exciting action, at the same time prescribed its forms. Single movements, as flexions, extensions, etc., he believed

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[1] Kürschner; Uebersetzung von M. Hall, appendix, p. 216.

were reflexly combined in the cord; the "single motions, of which every part of the body is capable," are co-ordinated in the *medulla oblongata*, while the movements of the limbs are combined into co-ordinated movement within the cerebellum. Kürschner, however, agrees with Müller that Hall's hypothesis of a complete and special excito-motor system is untenable, and thinks we might as well accept Stilling's argument that there are special nerves for the sensations of heat and cold.

The theory of Marshall Hall at once excited interest, especially in Germany, where it has led to many fruitful investigations, and provoked many controversies. Rudolph Wagner declared it a mere hypothesis, while Henle asserted that all grey substance acts reflexly. Dupré rejected the hypothesis of a special excito-motor system and assumed that reflex functions are mediated by peculiar communicating fibres in the cord. Budd distinguished two species of reflexes, one centered in the brain and attended by sensation, and another in the cord, unattended by sensation. Many observations were made to determine the truth of Hall's statement that brainless animals never moved spontaneously; while the peculiar psychological turn which the discussion often took shows how far metaphysical conceptions had pervaded even the medical profession.

While the French society for the study of condemned criminals achieved very little for science, a single careful experiment by Bischoff and two of his colleagues, though attended with only negative results, deserves mention. The head and body of a freshly decapitated murderer were placed by the authorities at his disposal. Objects were thrust toward the eyes, the word "pardon" was shouted into the ear, a strong tincture of assafœtida was held before the nose, but all absolutely without result. Slight and repeated movements of the jaw and tongue followed the application of collodion to the latter. Spirits of wine produced the same effect. These movements, however, were thought to be due neither to sensation nor reflex action, but to irritation of the severed ends of nerve-fibres in the spinal cord. All these observations were made within less than one minute from the fall of the executioner's sword. The features were calm and natural as in life, only the eye-lids were partially closed and the pupil slightly dilated. There was also reason to believe that he was perfectly conscious at the moment of the fatal blow. The eye-lids, lashes, conjunctiva, mucus membrane of the nose, mouth, and throat were next touched. A needle was thrust into the central end of the severed cord, which was also touched with a caustic substance, all within the next one or two minutes, but no further movements whatever were observed, indicating that the nerves had ceased to be irritable and that consciousness was extinct. The severed carotid arteries of the body were tied up as soon as possible, and about half an hour after the blow, it was irritated in various ways and places, but, although direct application of electricity caused contraction in various muscles, there were no signs of reflex functions.[1]

Volkmann who had previously expressed the belief that the cord had sensory functions,[2] was led later to change this opinion, and to write, after recapitulating Hall's argument, as follows: "Strictly considered, however, such experiments prove only that that part of the body furnished with the brain, does not feel the irritation of that part which has been severed from its connection with the brain. But whether the isolated cord does not have sensations of its own, obscure though they be, is not manifest. In lower animals the sensitive principle is unquestionably divisable; whether anything analogous can be assumed for higher animals, can scarcely be decided. All through the history of psychic development, sensation necessarily precedes volition, so that a sensitive organism without voluntary motion is easily conceivable. Yet an observer of another organism can infer the existence of sensation only from the play of voluntary motion. Hence although the latter ceases with decapitation, sensation itself is not necessarily lost; its demonstrability becomes impossible. Impossible as it is to prove that decapitated vertebrates are insensible, still we are unable to assume for them the power of sensation. At any rate we have no occasion to conceive consciousness as divisible in the higher animals, and, as

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[1] Bischoff, Müller's Archiv, 1838, p. 489 ff.
[2] Müller's Archiv, 1838, p. 15 ff.

above explained, we can assume the power of sensation to exist only where the perceptions of nerves of sense become the possession of consciousness."[1] Volkmann does not regard the brain of the lower animals as exclusively the organ of the soul. Of animals which have the cord and *medulla oblongata* intact, Volkmann says, their movements cannot be called reflex. "Rather the entire behaviour of animals so mutilated is so characteristically psychic that we have no tenable ground to deny the co-operation of the psychic principle. It only seems doubtful to me what height of development the soul can reach with so small an amount of brain matter. I consider it probable that the condition of the soul in such cases is dream-like. Sensations are certainly perceived, only they must be more obtuse and very limited after the removal of the specific organ of sensation. Obscure conceptions (*Vorstellungen*) seem also to be present with which the first efforts of the animal are connected and from which again movements proceed. Such movements do not rise indeed to the full freedom of volition; and just as little do they sink to the mechanism of reflexes."[2]

Later Volkmann opposes Marshall Hall's assumption of a spinal excito-motor system; for upon this theory not only must the number of specific fibres be increased to an impossible extent, but the fact cannot be explained that stimulation of a single sensory fibre may excite a very few motor fibres or a vast number, or in fact, all the motor nerves in the body.[3]

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[1] Wagner's Handwörterbuch, Bd. I, 1842, p. 576.

[2] A. W. Volkmann, article, Gehirn, Wagner's Handwörterbuch der Physiologie, Vol. I, 1842, p. 582. The precise status of the debate is well shown by the experiment to which Volkmann here appeals. A frog, from which he had just removed forebrain, cerebellum and optic lobes, was placed in a shallow dish of water and lay motionless and apparently dead for half an hour. At the end of this time, it raised its head as if for breath, and after a while began of its own accord to swim, making the motions at first clumsily and afterwards with more precision. The movements here could in no sense be called reflex (Volkmann supposed), because they do not begin as stimuli at the skin which are carried to the spinal cord and thence reflected into the muscles; the action was only outward; it began spontaneously in the cord. But the entire absence of external stimuli is difficult to prove, and in this case venosity of the blood and contact with the water are wholly neglected.

[3] Volkmann, Nerven Physiologie, in Wagner's Handwörterbuch, Vol. II, p. 546-7, 1844.

Hall had made some explanation of how the sensory irritation passed through the cord in being reflected outward into motor nerves; but he does not himself attach much weight to this point.[1] Grainger thought he found in each spinal root a portion which turned upward toward the brain and another portion which buried itself immediately in the cord. Spies, carrying the fallacy a step further, assumed a direct connection of excito-motor fibres with each other in the cord. To all this Volkmann objected on the ground of too great complexity, and argues at considerable length for the hypothesis of a transmission of irritation from one nerve fibre to another.[2] This may occur for all nerves, in the cord, in plexi, in the ganglia, and in the brain; while the law of isolated conductivity holds for the peripheral nerves. Not only is reflex action thus explained, but all sympathetic movements and sensations and even *delirium traumaticum*, where a painful wound causes delirium without fever. Even indistinct vision and a defective musical ear are perhaps due to the transition of the irritation from the nerve previously affected to the others which lie near it; and we learn to distinguish fine motions and tones probably by learning to isolate the action of nerves. In fatigues which are painful the state of the motor nerves springs over to the sensory, and in this way the normal association of movement may sometimes be explained. The removal of the brain or the inhibition of its action in sleep increases the facility of such transitions in the cord; while attention sometimes causes more perfectly isolated conductivity of the fibers. Nerve activities which are naturally isolated may become combined by habit and training and may be re-isolated by disuse. The excitation of many fibres may in this way sometimes be concentrated upon one point.

The claim for priority in formulating the excito-motor

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[1] Marshall Hall, New Memoirs on the Nervous System, pp. 37-38, London 1843. After calling it the "questio maxime vexata" among writers upon reflex action, he adds with reference to separate volitional-sensory and excito-motor fibres: "nothing of the kind has ever been proved; the two distinct orders of fibres have not been divided or irritated distinctly."

[2] Wagner, op. cit. p. 528, et seq.

hypothesis was made for Johannes Müller. But he himself repudiates this and shows that his view is quite distinct from that of Marshall Hall, and in many respects it must be admitted to be the more consequent of the two.[1]

Müller maintained that it is by no means necessary that sensation should always attend reflex action. "According to my opinion," he says, "the stimulation of a sensory spinal nerve causes a centripetal action of the nerve principle, which reaches the cord. If this can pass on to the *sensorium commune*, it becomes a conscious sensation. But if, on account of section of the spinal cord, it cannot reach the sensorium, it expends its entire force as a centripetal action upon the cord. In both cases reflex movements may result, in the first instance attended by conscious sensation, in the second, not."

As many German physiologists since have done, Müller rejected Hall's hypothesis of specific excito-motor fibres.

Pflüger began his able, but somewhat violently polemic, work by declaring in his preface that consciousness is motion, and has no being. As such it is a part of the great life of the world. Consciousness exists only where central nerve substance is found. It is extended in space and by whatever name it is called, whether sensorium or soul, it is divisible in all animals with its material substratum. After a short discussion of other views, recognizing especially Whytt, Prochaska and Legallois as his predecessors, he proceeds to develop as follows his well known theory of a "spinal cord soul."

Reflex action Pflüger defines to be the operation of that neuro-physic mechanism, by means of which the peripheral sensory fibre, by whatever cause excited, alters through the mediation of the spinal cord, the ordinary state of excitation of definite motor nerves.[2]

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[1] Müller, Handbuch, Vol. I, p. 622. See also Du Bois-Reymond. Gedächtniss Rede auf Johannes Müller; in Abhandl. d. k. Akad. d. Wissensch., zu Berlin, 1859.

[2] Pflüger, Die sensorischen Functionen des Rückenmarks. Berlin, 1853, p. 62. This work also contains valuable references to the earlier literature relating to this question.

The change thus caused in motor nerves may be of such a nature as to effect the shortening of the muscles, giving us a reflex contraction or reflex cramp; or it may cause the muscle to relax, resulting in the phenomenon of reflex inhibition or paralysis. These processes, he remarks, must be widely distinguished from those of sympathetic or irradiated sensations. These latter have been explained by some as occurring in the spinal ganglia, which act as imperfect conductors and arrest weak excitations, while stronger impulses spring over and stimulate neighboring fibres and are reflected outward according to the law of isolated conduction. This, however, is not sufficient, for sympathetic sensations arise in nerves which pass no ganglia, *e. g.* nasal tingling from looking at the sun, and in those which enter the cord remote from each other.

Reflex action, Pflüger believed, could be best studied in men and so, after searching through a great number of cases of reflex neurosis from German, French and English pathological literature, he was led to his well known laws of reflex action, which he states as follows:

I. Law of Unilateral Reflexes.—*If peripheral stimulation causes contraction in only one half of the body, the contraction always occurs on the same side as the stimulus, and in general those muscles contract whose nerves arise from that segment of the cord, to which the irritated sensory nerve belongs.*

II. Law of Reflex Symmetry.—*If the effects of stimulating a sensory nerve upon one side extend to the other side, only such motor fibres are called into activity as correspond with those which are already excited on the side of the stimulation.*

III. Law of Unequal Contraction on the two sides.—*If the contraction is unequal on the two sides, the stronger reflex is always on the side of the stimulation.*

IV. Law of Reflex Irradiation.—*1. When stimulation of a cerebral nerve causes reflex contractions, the motor nerve concerned is invariably either in the same level as the sensory nerve, or it is further downward toward the medulla oblongata. 2. When stimulation of a spinal nerve causes* *reflex contractions beyond its own segment, irradiation always takes place toward the medulla oblongata.*

In the former case the nerve stimulated may be a nerve of special sense; thus for example, an irritation of the optic nerve is reflected outward along the oculo-motor.

V. THE LAW OF THE THREE LOCATIONS OF REFLEX CONTRACTIONS.—*Upon stimulation of a sensory nerve, reflexes can occur in only three parts of the body.* These are: *a.* at the level of the stimulated nerve; *b.* in parts innervated from the *medulla oblongata; c.* in the whole body.

After citing pathological cases illustrating these laws in full, Pflüger describes his own experiments. By the first law the trunks of eels, fish or salamanders (which move in but two directions), if separated from the brain and irritated on one side, *e. g.* by a candle flame, should be drawn directly towards the side irritated and thus fully into the fire. He found, however, the opposite always the case. Even a small end of the tail was reflected away from the fire. But if the animal had been put under the influence of strychnine, its tail followed the law and reacted into the flame. This difference he infers to be due to the presence of a rudimentary consciousness in the former case.[1] Exactly similar results were obtained from young kittens in which the spinal cord had been divided in the dorsal region. The whole subject, however, may best be studied in the frog. When the skin of a decapitated frog is pinched in the middle of the belly, both feet strive to push the hand or tweezers away, while if the same place be touched with acid the reaction consists in rubbing the irritated spot. If one side be irritated and the leg of the irritated side be severed, the other leg is slowly brought around to remove the irritating object.

Finally Pflüger urges[2] that if the brain were the only organ of sensation, all sensory fibres must go to it and that after section of the cord an irritation of the upper surface of the section would cause sensation which by the law of eccentric projection would seem to be located in all parts of the

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[1] Op. cit. p. 112 ff.
[2] Op. cit. p. 130 ff.

body below the section, while an irritation of its lower surface would cause contraction of all the voluntary muscles below the section. The fact is, however, that if the upper part of the cord be injured the sensation of pain is located not in the legs, but in a band around the body. While if the cord be gradually destroyed from above downward, instead of motions of all the parts at once, the muscles of the arms, breast, belly, thigh, etc., are successively stimulated. These facts go to prove that both motor and sensory nerves end in their respective levels of the spinal cord and not in the brain, which so many would make the sole organ of sensation and volition. The brain Pflüger regards as a reservoir of motor forces. By its instrumentality sensations can be compared, and expressed verbally and otherwise, while the cord can respond only by moving. Even motion, however, is probably not a certain index of the presence of the dull, undifferentiated sensations, which are assumed in the cord and which, it would seem, must rise above a certain threshold, before motion can follow. In the reflexes during sleep, Pflüger also observed that if the nostrils of a sleeping child be tickled and the hand on that side gently held, the other hand is brought to the irritated point, and he expressed the belief that none of the functions of the sensorium, extended through the cerebro-spinal system, are suspended during sleep, but that sensorial activity is reduced uniformly throughout.

The bitterness and arrogance of Pflüger's style is in strange contrast to the calm, impersonal tone of Lotze's argument and reply. Lotze, it should be premised, had previously urged that reflexes, and perhaps the lower forms of instinct, are purely mechanical.[1] Nature, he says, must lead the soul by the hand a little way into the strange land of space and matter. For each stimulus that breaks upon it from the outer world, a mechanism must be furnished ready made to its use which shall respond with an appropriate movement, or the impulse to it (p. 194.) By this means, nature shows the immaterial, unspatial soul, by purely physical connections,

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[1] Lotze. Instinct. Wagner's Handwörterbuch der Physiol., Vol. II, p. 191.

what purposive movements to make. After the soul learns these elementary motions, it weaves them in ever richer and more complicated patterns; but, these elements themselves, it can neither invent nor construct. They are like the letters of the alphabet or elementary sounds, which must be first learned, and which reason may then combine in countless ways into words and sentences, but does not alter in form or number.

The argument particularly addressed to Pflüger and those who agreed with him starts from the general assumption that the motor states of the soul, transformed in the brain alone into physical changes of matter, are propagated in this new form through the centrifugal nerves to cause contractions of the muscles. And conversely, physical changes set up in the peripheral ends of sensory nerves are conducted unaltered in character to the brain, where occur all those processes by which physical excitation is transformed into the psychic form of sensation, a feeling.[1] After repeating Pflügers experiments with the decapitated frog, which, when one foot was amputated, used the other to remove the acid, and the eel's tail which reacted from, instead of into, the flame, Lotze calls these movements not only teleological, but at the same time adapted to the special circumstances of the stimulus. And he pronounces them not due to intelligence or sensation present in the cord, but to the *after effects* of these. Acts of the conscious will, he says, leave behind "not only unconscious recollections, but also physical impressions in the organs of the central nervous system," and these latter, as well as the soul itself are sufficient to account for Pflüger's phenomena. States which can be first caused only by consciousness may actively persist as conditions of a substance after consciousness has vanished. By practice and training a secondary character, which survives decapitation, is thus imparted to subordinate centres, ennobling the already complex apparatus by the possession of new associations between sensation and motion.[2] Pflüger, he continues, might have argued a limitless series of

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[1] Lotze. Göttingen gelehrte Anzeiger. 1853, III, p. 1737 ff.

[2] This notion of Lotze's has received corroboration in the experiments of Steiner, reviewed in the last number of this JOURNAL, Vol. III, No. 2, (1890.), p. 187, middle of the page.

souls for all, even the smallest, function and part of the body; each soul stimulated to greater, though we know not what, activity by severing it from its superior centre. All this we must reject as incompatible with the unity of the individual soul. In the light of this conception Lotze attempted to explain in detail Plüger's Laws of the phenomena and found his crucial experiments too uncertain to sanction the inferences drawn from them.

But once more the argument swings to the other extreme, and this time with the weight of Auerbach's[1] authority. Auerbach repeated Pflüger's experiments, he tells us, on more than three hundred frogs and many eels, pikes, tritons, snakes, lizards and rabbits, and reaches the conclusion that psychic force may be set free in any part of the brain or spinal cord. Hence the integrity of consciousness suffers, if the central nervous system is injured. It is difficult to see, however, wherein Auerbach carried the argument beyond the point at which Pflüger left it. He nowhere even reaches the level of Lotze's view.

With Lotze we do advance in thought a step beyond the comparatively crude, simple, mechanism of Marshall Hall to a mechanism of the utmost delicacy, a mechanism susceptible of the nicest adjustments, capable of education, and of prolonged, independent and complex activity. And why is it, queries Lotze,[2] that the whole world bristles up the moment the fact of mechanism in psychology is mentioned? Men seem to think that the soul loses something of its dignity and that the highest moral interests are endangered, if we do not attach to the smallest details of life the full operation of free will. "This is the dogma of the schools." On the other hand how much of our education is directed to the very end of making the daily round of life mechanical? Habit, as people term it, is only another name for mechanism.

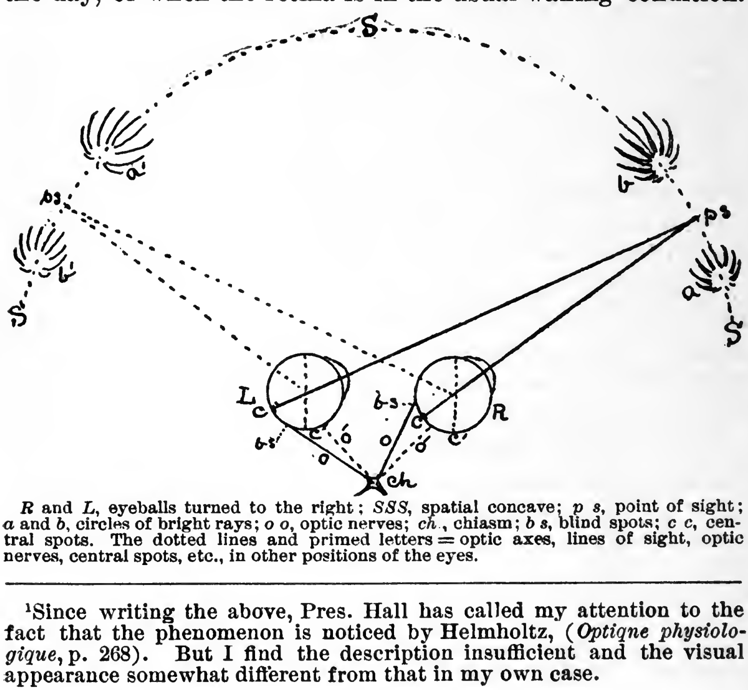
[1] Auerbach. Günsburg's Zeitschrift für klin. Med. 1855. pp. 452—96.
[2] Wagner's Handwörterbuch, Lotze, op. cit. p. 200.

MINOR CONTRIBUTIONS.

ON A CURIOUS VISUAL PHENOMENON.

By Prof. Joseph LeConte.

For some years past I have observed a visual phenomenon which is so conspicuous and even brilliant, that it seems almost incredible that it should have escaped the attention of Physiologists; and yet I do not remember to have seen it mentioned. If it has been already discussed, I should be glad to have my attention called to the fact.[1] The phenomenon of which I speak, however, cannot be observed except when the retina is exceptionally sensitive, *i. e.* after sleeping, and especially on waking up in the morning. I have tried in vain to observe the least sign of it during the ordinary course of the day, or when the retina is in the usual waking condition.



R and *L*, eyeballs turned to the right; *SSS*, spatial concave; *p s*, point of sight; *a* and *b*, circles of bright rays; *o o*, optic nerves; *ch*., chiasm; *b s*, blind spots; *c c*, central spots. The dotted lines and primed letters = optic axes, lines of sight, optic nerves, central spots, etc., in other positions of the eyes.

[1] Since writing the above, Pres. Hall has called my attention to the fact that the phenomenon is noticed by Helmholtz, (*Optiqne physiologique*, p. 268). But I find the description insufficient and the visual appearance somewhat different from that in my own case.

If on first waking up in the morning, the lids be closed, and the eyes be turned strongly to one side or the other, as if to look at a point on the extreme verge of the visual field, two brilliant circles of radiating lines, surrounding each a blank space, are momentarily seen, one on each side of the point of sight. On turning the eyes strongly in the opposite direction, they again flash out of the dark field on the other side at the moment of extreme strain of the ocular muscles.

The figure represents the eyes turned strongly to the right and directed to the point of sight, *ps*. The brilliant circles are represented by *a* and *b*. I have tried this experiment hundreds, perhaps thousands, of times, and always with the same result, but on account of the flashing momentariness of the appearance, and still more on account of its occurring at some distance from the point of sight (where only, form is accurately given), it is difficult to make an exact picture. What I have given is very nearly what it seems to me.

Such is the phenomenon—what is the explanation? Every appearance in the visual field is, of course, the representative of a corresponding change in the retina. What is the retinal correspondent in this case? I am quite sure it is the *blind spot* or point of entrance of the optic nerve into the eyeball; or, to be more accurate, the blank space from which the bright rays diverge is the representation of the blind spot, and the circle of bright rays represents the retina immediately surrounding it. The cause of the phenomena is this: when the eyeball is violently turned to one side, there is a corresponding strain or pull on the optic nerve, and, moreover, the optic nerve is strongly bent at the point of entrance into the eyeball. In the figure, the dotted lines *o′ o′* represents the position and length of the optic nerves when the optic axes are in primary position, as represented also by dotted lines. In turning the eyes to one side, the optic nerves, as may be seen, are both lengthened and strongly bent. The flash of light is produced by the irritation of the bacillary layer immediately surrounding the point of entrance of the optic nerve.

I have said that there are two bright circles, one on each side of the point of sight, one corresponding to each eye. To which eye does each belong? As is well known, the optic nerves enter the eyeballs in the inside or nasal side of the central spots (see figure). But impressions on the nasal halves of the two retinæ are seen doubled *homonymously*. Therefore, of the two bright circles, the one on the right side (*a*) belongs to the right eye, and the one to the left side (*b*) belongs to the left eye. I have found in my experiments that the left-side one (*b*) in looking right, and the right-side one (*a′*) in looking left, is the more brilliant. The reason of this is easily explained. For, except in looking at a great distance, with the optic axes parallel, it is evident that in looking right it is the left eye that is more turned and the optic nerve more pulled; and in looking left, the right eye and right optic nerve. But again, it will be observed that the rays are not equal in all directions, but stream, as it were, backward from the direction of ocular motion. In looking right, the rays stream to the left, and in looking left, they stream to the right. Now, since all retinal impressions are reversed in position in the field of view, this means that the retinal impression is greater on the right side of the blind spot, in the first case, and on the left side in the second case. In other words, in both cases the stimulation of the retinal rods is greatest on the side *toward which the optic nerve is bent* by the motion of the ball. The stimulation is probably, therefore, more by *crushing* than by *pulling*.

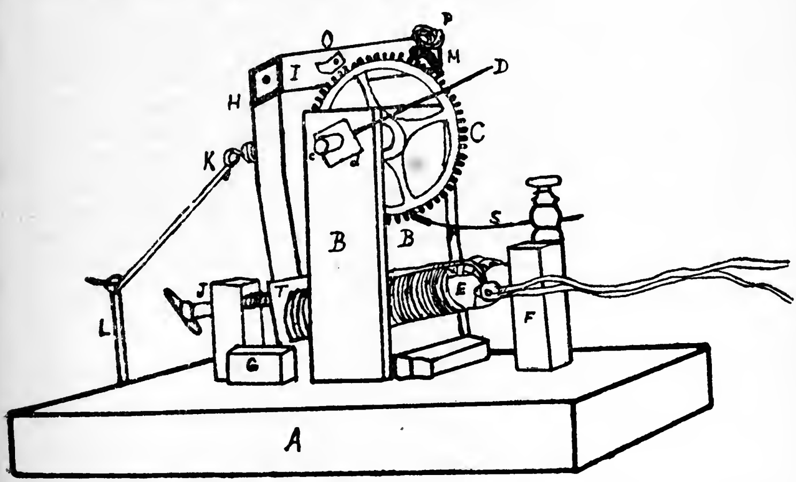
Many attempts have been made to detect some representation of the blind spot in the field of view. In most of these, the expectation seems to have been to find a black spot, or a dark, or dim, or dusky or clouded spot. But such expectation betrays a misconception of the nature of the blind spot. This spot is an *insensitive spot*, and its representative, therefore, is an *invisible spot*, *i. e.*, a spot where objects disappear from view. It cannot be a dark or dusky spot, or a spot of any kind *differentiated from the general field*, for then it would be a *visible spot*, which it is not. As it cannot be differentiated from an even field, like a white wall, or the sky, the *mind* extends the general color of the neighboring field over it. We seek in vain, therefore, to find a visible representation of the blind spot in the field of view. But in the experiment described above, the *place* of the invisible spot, or the spatial representation of the blind spot, is distinctly observed in the dark field. Not that the spot itself is differentiated from the general field, but the parts immediately surrounding the invisible spot are differentiated, both from it and from the general field. We know of no other experiment that brings out clearly the place of this spot.

A COUNTING-ATTACHMENT FOR THE PENDULUM-CHRONOSCOPE.

William Noyes, M. D.

In the April number of this Journal Dr. E. C. Sanford described a form of chronoscope in which the principle of the vernier is applied to the exact measurement of time, and the present apparatus is simply an addition to his chronoscope by which the beats of the slower pendulum are recorded mechanically and indicated on a dial. The counting-attachment is simple and inexpensive, and may easily be made without the assistance of a mechanic.

The principle of the apparatus is simply that every time the slower pendulum reaches the middle of its arc it makes an electric circuit (independent of those mentioned by Sanford), sending the current through an electro-magnet which pulls forward the arm of a lever, which in its turn shoves forward a cog of a cog-wheel, on the axis of which is attached a second-hand moving over a dial. When the pendulum swings past its centre the circuit is again broken and a spring pulls the lever back to its original position.



The construction of such an instrument is very simple, and the cost trifling, one dollar being sufficient to cover everything, even if the materials have to be bought new—fifty cents for a small electro-magnet, twenty cents for two binding posts, leaving thirty cents for a cog-wheel and necessary sheet brass and tin. The base of the instrument, *A*, consists of a piece of pine board 7 inches square, and on this are two wooden uprights, *BB*, 3¾ inches high, 1 inch wide, ⅜ of an inch thick, and 2½ inches apart. These support a cog-wheel, *C*, having sixty cogs, which was taken from an old clock. On the axis, *c*, of the wheel is a piece of small wire 2 inches long, serving as a second-hand; the wire is supported by a small wooden nut, *d*, which is made to slip off and on the axis easily, but with sufficient friction to keep it in place. The dial is not shown in the diagram, as it would prevent a view of the working parts of the instrument; it consists simply of a circle of tin 4½ inches in diameter, on which is pasted a piece of white paper divided into 60 minutes, like a clock-face. The second-hand is taken off, the dial put on the axis and tacked to the support, *B*, and the second-hand is then replaced. Care should be taken that the hole in the dial through which the axis passes is so large that there is no friction when the cog-wheel is in motion. Between the upright posts is a small electro-magnet, *E*, 3¼ by 2 inches, wired firmly to a wooden base and to a short post, *F*. In front of the poles of the magnet is an armature, *T*, made of soft hoop iron 1/16 of an inch thick and 2 by 1¼ inches in size. To the lower corners of this armature are soldered two pieces of wire running out horizontally, with their ends filed to points which play in small holes in pieces of sheet brass which are fastened to the inner sides of two small wooden supports, only one of which, *G*, is shown in the diagram. To the soft iron armature is soldered an upright piece of sheet-brass, *H*, 1 by 4 inches in size, with an arm, *I*, also of brass extending alongside the cog-wheel. The extent of the movement of the armature is regulated by the screw, *J*, passing through a small wooden post, and having on its inner end a piece of rubber against which the armature is drawn back by the spring, *K*, the tension of which is regulated by raising or lowering the pin, *L* (a 2¼ inch brad), which passes into a binding post not shown in the diagram. A piece of string connects the top of the pin with the spring.

At the end of the brass arm, *I*, is a small brass clip, *M*, hung on an axis coming out at right angles to *I*. When the current is sent through the magnet the lever arm comes forward and the clip, *M*, striking a cog turns the wheel, while the small piece of tin, *O*, is so soldered to the arm as to go down between two cogs and prevent the clip from moving the wheel forward more than one cog at a time. Above the clip is soldered at right angles to the arm, *I*, a small piece of tin around which is wound a small rubber band, *P*, which by its pressure on the clip keeps this firmly pressed down against the cogs, but at the same time does not press so tightly as to prevent the clip being pulled back over the cog behind by the spring when the circuit is broken. A check-spring, *S*, made of a piece of brass spring-wire with a small tin arm at the end presses against the lower side of the wheel and prevents this from moving backward when the spring draws the clip back over the cogs; this check-spring is held in position by a binding post, which allows it to be lengthened or shortened as may be convenient.

The instrument as now described is ready to be attached to the chronoscope. This may be done in several ways. The following has been tried with success. A second wire (the first is described by Sanford) is run down the side of the slower pendulum about as far as *S* in Sanford's diagram, where it dips in a second, independent, mercury trough. This second wire, at its upper end runs along the top of the axis of the pendulum and has its tip bent over so as to dip into a shallow trough of mercury hollowed out of the wood on which rest the brass plates supporting the knife edges. The object of having the wire end in this way is that it may not interfere at all with the swinging of the pendulum; the wire is practically part of the pendulum, the bent end that dips into the mercury offering no resistence to the free swinging of the pendulum. The counting apparatus and a battery are now brought into circuit with the slower pendulum by means of the upper and lower mercury troughs just described. Thus arranged every swing of the pendulum sends a current through the electro-magnet, pulling the armature forward and forcing the clip, *M*, down, pushing the cog forward and turning the second-hand one division of the dial. The current being broken when the platinum point swings out of the mercury in the lower trough the spring, *K*, pulls the armature back, while the check-spring, *S*, prevents the wheel from going backwards with the clip, *M*.

The proper position of the clip, *M*, and of the stop, *O*, must be determined by trial; the clip can first be fastened to the arm, *I*, and then the place for *O* can readily be found, it being so placed that it does not bind against the cog behind when the armature is pulled back. The proper position for the check spring, *S*, and the tension of the spring, *K*, must also be found by trial, and the amount of movement of the armature necessary for the proper turning of the wheel must be regulated by the screw, *J*. A break-circuit key placed in the circuit enables the operator to stop the counting apparatus the moment the click of the sounder shows that the two pendulums are in coincidence, and the number of the vibrations is then read off the dial.

The lower mercury trough in which the contact is made must be so arranged that the pendulum will swing lengthwise of the trough and not crosswise, in order to give as long a time as possible for the current to overcome the resistance of the magnet, and a strong current is necessary in order to pull the armature quickly away from the spring. The lighter the lever arm, and the more easily the clip works, the less current will be required. One objection to the instrument is that it makes considerable noise when the magnet pulls the armature forward against the poles, but this is obviated to a large extent by placing pieces of sheet rubber over the poles. This feature of the counting-attachment would in no way interfere with the use of the instrument for lecture room demonstrations, but would rather increase its serviceability for this purpose.

PSYCHOLOGICAL LITERATURE.

I.—NERVOUS SYSTEM.

Das Stirnhirn. Ein Beitrag zur Anatomie der Oberfläche des Grosshirns. Mit 9 Original-Abbildungen und 1 Tafel. Dr. OSCAR EBERSTALLER. Wien und Leipzig, 1890.

To the description of the frontal lobe the author devotes a book of about one hundred and thirty pages and cites a hundred and seventeen authorities in the course of his argument. The style is exceptionally lucid and vigorous and the descriptions concise. From this it appears that a careful and conscientious author can find a good deal that is worth saying concerning the external appearance of even one lobe of the brain. The observations were made on fresh brains from which the *pia* had been removed, and over 400 hemispheres were utilized. In describing the sulci and gyri of this region the author has paid particular attention to the variations which occur, and has attempted to show the relations between the extreme variations which are observed in normal individuals. The value of this method becomes at once apparent when we recall that the brains of all sorts of defectives, of individuals possessing remarkable or peculiar mental attainments, and of criminals are, in increasing numbers, the subjects of description, in which it is continuously sought to associate the sculpturing of the surface with the peculiarities known to have existed during life. Under these circumstances and with the possibilities of the normal variations but imperfectly recognized, it is but little remarkable that a good many appearances of the brain surface which have been designated, "peculiar," "anomalous," "atavistic," "criminal," "theriomorphic," etc., are really found to be variations that appear in the normal brain and to which, therefore, no peculiar significance can properly be attached. The material of the book is arranged under the general heads of Limiting Fissures, Principal Sulci, Secondary Sulci, Gyri, and Comparative Anatomy.

In discussing the various sulci—besides regarding the depth and constancy, the time of appearance in the fœtus and their comparative anatomy—the relations of the lips of the sulci are examined to see whether either of them overlaps the other, and most especially, sunken gyri and indications of branches from the main sulcus are sought. It is perhaps due mainly to care in the study of the last two points that Eberstaller is able to harmonize many of the variations which at first seem irreconcilable. For it appears that gyri which in some individuals are sunken become exposed in others, and where a gyrus usually prominent is not at first found it can in most cases be discovered in the sunken form by closer examination. This holds not only within the species, but in the mammalian series also, where the value of these sunken gyri for comparative topographical relations is equally great. The branches of the sulci have a similar value. They may be present as rudiments or extensive developments, and the amount of their extension can serve to greatly complicate the appearance of a region without introducing any essentially new features. The main object, then, in the study of the hemispheral surface, is to establish the constant locations for the sulci and then make these a point of departure when attempting to reduce any particular hemisphere to the type. In our opinion, Eberstaller accomplishes this task in a more satisfactory manner than any author who has preceded him. Among the structures which he discusses are the cephalic branches of the Sylvian fissure; the relations of the *sulcus præcentralis inferior* to the *sulcus frontalis inferior;* the *sulcus præcentralis medialis;* the *sulcus frontalis medius* and the 4-gyral type in the frontal lobe; the *sulcus diagonalis;* the homologies of the frontal lobe region in the monkey, and of the *sulcus cruciatus* in the carnivora. Descriptions of the sulci are followed often by epitomes of the views of other writers, thus making the book valuable for historical reference.

On the Local Paralysis of Peripheral Ganglia and on the Connection of Different Classes of Nerve Fibres with them. J. N. LANGLEY, F. R. S., and W. LEE DICKINSON, M. R. C. P. Proc. Roy. Soc., Vol. 46. Nov. 21, 1889.

Led by some experiments on the salivary gland the authors compared the results of stimulating the sympathetic nerve above and below the superior cervical ganglion in an animal which had previously received a dose of nicotin. Stimulation above the ganglion, in rabbits, caused a constriction of the blood vessels of the ear and a dilation of the pupil, while stimulation below the ganglion failed to produce these effects. It was, therefore, inferred that the impulse was interrupted in the ganglion through the action of the drug on the nerve-cells. As nerve fibres are much less susceptible to the drug than cells, the method makes it possible to distinguish between the fibres which end in a ganglion and those which pass through it without interruption. An interesting application of this method to the ganglia of the solar plexus is one of the uses thus far made of this discovery, though others are suggested, and the method promises to be of wide applicability.

La circonvolution de Broca. Étude de morphologie cérébrale. Par GEORGE HERVÉ. Avec 10 figures et 4 planches caloriées. pp. 162. Paris, 1888.

The author treats his subject, the *gyrus frontalis tertius s. inferior*, by describing it in man, according to the various schemata of the gyri; in the primates; in the human fœtus; in uneducated persons; and in those distinctly intellectual. The conclusions reached are: that the gyrus in question is extended onto the orbital surface of the brain; that the primitive type of the frontal lobes, as shown in the primates, is that of two and not three frontal gyri; that the *gyrus frontalis inferior* appears first in the anthropoid apes, and is formed by a doubling of the primitive inferior frontal gyrus; that the *gyrus frontalis inferior* forms the fourth frontal gyrus in man and the anthropoids, the *gyrus frontalis medius* of the authors being in reality two gyri; that the development of this gyrus in the human fœtus recapitulates its development in the animal series—that of the right side developing earliest; that in microcephalous persons the gyrus may be either absent, rudimentary or nearly typical; that almost always in feeble minded persons and deaf-mutes and often in representatives of lower races the gyrus is but poorly developed; that in intellectual persons the complexity of the *gyrus frontalis inferior* is in a general way correlated with the development of its function. None of these conclusions are new, and the author does not make it clear that Rüdinger in 1882 covered nearly the same ground in a concise manner. Broca's schema of the gyri (p. 22) is valuable and this reproduction of it helps to make it accessible. The author has taken some part in describing the brains of several intellectual persons, and at the end of the book the descriptions are utilized together with an account of the *gyrus frontalis inferior* in the brain of Gambetta—the original description of the entire brain having been given by Chudzinski and Mathias Duval in 1886. The plate which illustrates the gyrus in the two hemispheres is, so far as we can judge, open to the criticism that too little of this gyrus is allowed to the "convolution of Broca" on the right hemisphere, and that the sulcus designated as the *ramus anterior ascendens fissuræ Sylvii* is in both hemispheres the *sulcus diagonalis operculi* of Eberstaller and corresponding with a sulcus distinctly figured in Broca's schema as lying between the *sulcus præcentralis inferior* and the *ramus anterior ascendens fissuræ Sylvii.*

Commentary upon Fissural Diagrams. Prof. B. G. WILDER. Read before the American Neurological Association, June 6, 1890.

The two diagrams given—a lateral and mesal view of a left hemisphere—are substantially copies of those given by the same author in a previous article. They are based on 100 hemicerebrums: 65 adults and 35 fœtal or young. The majority of the lines indicating fissures are unbranched and without angular contortions. The width of these lines is taken to indicate the depth and constancy of the fissures. The diagrams differ from those of Ecker in several points, one being the introduction of some fissural names not given by Ecker. (Diagrams of the fissures may be used for several purposes, and if the purpose be that of a guide to the sculpturing of the hemispheral surface, it is a question whether much suggestiveness is not lost by extreme schematization, as in the present case. REV.)

Sehsphäre und Augenbewegungen. HERMANN MUNK. Sitzber. d. König. Preuss. Akad. d. Wissen. zu Berlin. III. Jan. 16, 1890.

This paper discusses the bearing of the observation that movements of the eyes follow electrical stimulation of the cortex in the visual area, and in this connection the author introduces the results of some experiments which he has made in collaboration with Dr. Obregia. Schäfer and others, as well as Munk, have found these movements on stimulation of the occipital cortex, and Schäfer has pointed out that their direction and character depend on the place at which the stimulus is applied. (See review in this JOURNAL, Vol. II, p. 146.) In these results Munk finds a corroboration of his views concerning the ideal projection of the retina on the occipital cortex. He objects, however, to Schäfer's idea that these movements are in response to visual perceptions and is at some pains to show that they are cortical reflexes in response to simple light sensations. It becomes further clear that the path of the motor impulses from the cortex to the primary centres lies in the bundle of radiating fibres which also conveys the fibres for the sensory impulses, and is not mediated through some other distinctively motor centre in the cortex. This is a result of considerable significance, towards which some of Schäfer's recent work also pointed. It leaves at the same time the relations of the special motor centres, from which by stimulation movements of the eyes can be obtained, quite unexplained. The prime importance of this work lies, however, in the emphasis which it gives to the two-fold function, motor and sensory, of this portion of the cortex and the suggested possibility of determining to which group of cortical elements the respective functions belong.

Ueber Augenbewegungen auf Sehsphärenreizung. Dr. ALEXANDER OBREGIA. Archiv f. Anatomie und Physiologie. Physiol. Abthl., 3 u. 4 Heft. June, 1890.

This is the full account of the research on which Munk draws for his new facts in the paper just noticed. The author gives in detail the peculiarities of the method of operating, and lays special stress on the fact that the dogs were not anæsthetized when the cortex was being stimulated, although they were anæsthetized for operation. The reactions for the various portions of the occipital cortex are given in full. The indirect nature of the reaction following the stimulus is indicated by the influence of the position of the *tapetum* within the eye. This is as a rule eccentric and lies, in the dog, in the dorso-lateral quadrant of the retina. As a consequence of its position the movements of the eye in order to fixate objects below would be less than that required to fixate those above. Indeed the author seems to have been able to predict any unusual position of the *tapetum* from the degree of the various movements observed during the experiment. It would seem a fair inference from this that the elements stimulated by the electrical current were the same as those stimulated by the impulses from the retina. Since, at the same time, stimulation of the white matter, the occipital cortex having been cut away, produces similar movements, it would appear that the co-ordinating apparatus was sub-cortical.

Zur Frage der Localization der Grosshirnfunctionen. W. WUNDT. Philos. Studien. B. VI. H. I. 1890.

When reviewing a paper by Munk on the cortical localization of vision (this JOURNAL, Vol. II, p. 627) some statement was made of the criticism there contained of Wundt's position on this subject. The above heading is that of a paper in which Wundt makes reply to Munk's strictures. It is concerned mainly with the demonstration that Munk's conception of cortical localization is unclear because he confuses the localization of elementary functions, (*e. g.* color perception, which is in accord with the new nerve-physiology) with the localization of complex intellectual activities, (*e. g.* memory pictures, which is of a piece with the old phrenology.) Wundt further goes on to show that with the doctrine of the specific energies of nerves Munk's results have little or nothing to do, and thus aims to re-establish himself in his old position. The article is referred to here mainly for what general criticism it contains of the doctrine of strict cortical localization and because it gives Wundt's present views on the subject in a somewhat connected form.

Ueber Rindenblindheit. D. FÖRSTER in Breslau. Von Græfe's Archiv f. Ophthalmologie, B. XXXVI, Abt. 1, Leipzig, 1890.

The author describes the case of a man who being 44 years of age, in 1884, suddenly, without other disturbance. developed a double hemianopsia involving completely the right halves of both visual fields. The vertical line bounding the defective region, instead of passing directly through the fixation point went 1° to 2° to the right of it. The acuteness of vision was at first decreased, but in five months returned to the normal. The patient was able to attend to his business which was that of a post-office official. Somewhat less than five years later the vision of the patient became further impaired while he was on a walking trip during his vacation. This new attack took some three days to fully develop. After it he was apparently completely blind. Six weeks subsequent to the last attack Förster saw him and found that he had a very small region in the central part of each retina which still functionated, a visual field which could be imitated by looking through a tube 81 mm. long the further end of which was closed by a diaphragm having in it an opening 1 mm. in diameter. With this he could read fine type, distinguish objects by their shape, if they were small, but could not distinguish colors. Further than this his conception of the relation of objects in space to one another and to himself was very seriously impaired and he was incapable of profiting by experience in supplying himself with new data on such points. Förster diagnosed the case as a thrombosis of the principal arteries supplying the visual area of the occipital cortex. A study of the mental defects in this case showed that while the patient had no difficulty in describing in visual terms experiences of his previous life, yet he could not draw nor describe a map of any sort, not even the arrangement of the furniture in the rooms he had been accustomed to occupy, and that with his eyes either bandaged or uncovered his ability to find his way about was far below that of the average individual blind though a peripheral lesion. Förster draws the following conclusions: Since the retina is, for a small extent at least, intact, the color blindness cannot be of peripheral origin. In the occipital cortex are located the perceptions for topographical relations. Further, he takes the case to disprove the view that the crossed and uncrossed optic fibres are mixed in the fovea, (this explaining hemianopsia with the retention of vision in the fovea,) and, if I understand him correctly, assumes a complete crossing of the optic fibres and explains the retention of vision at the fovea by considering that the anastamotic connections of the vessels supplying the cortical centre are more complete for the part of the cortex representing the fovea, and hence that a plugging of the arteries as in this case affects vision at the fovea least and last of all. The ophthalmoscope had thus far revealed no atrophy in the optic nerve.

Case of cerebellar tumor with monocular diplopia as a symptom. A. B. SHAW. Alienist and Neurologist. July 1890. Vol. XI. No. 3.

The diagnosis is given in detail, and it is simply stated that the results of the autopsy were entirely concordant with it. The lesion was on the left side, and there was homonymous hemianopsia, and diplopia of the left eye.

Zur Lehre von der Kreuzung der Nervenfasern im Chiasma Nervorum opticorum. DR. ANTON DELBRÜCK. Archiv f. Psychiatrie und Nervenkrankheiten. B. XXI. H. 3. 1890. 1 Taf.

The author first describes the optic nerves and tracts from an insane man of 70 years. As the patient never exhibited any noticeable disturbance of vision no examination of the eyes had been made, but at the autopsy the left optic nerve was found nearly completely degenerated, while the right was about half degenerated. The study of the specimen shows a connection between the optic nerves and optic tracts of the same sides, which is explained by considering that in this case it is mainly the uncrossed bundle of fibres which has been preserved. The general discussion of the course of the optic fibres contains a fundamental critique of the conclusions of Michel, whose advocacy of total decussation of the optic fibres some years since re-opened the whole question. In this connection Delbrüch shows that the ideas that the chiasma offered a resistance to the degenerative process and that degeneration was progressive, were freely used by authors reasoning on this question.

He considers that the study of the fibres in this region should be guided by the following practical rules: 1. If there are normal fibres in the optic nerves there must be corresponding normal fibres in the optic tracts. The converse also is true if the commissural fibres in the tracts are excluded. 2. If there are degenerated fibers in the nerves there must of necessity be degenerated fibres in the tracts, but these may be either plainly recognizable by their degenerated remains or may have undergone resorption to such an extent as to be no longer evident.

To these two, just given, the author adds several other suggestions:

a. In comparing a degenerated nerve which contains two groups of fibres with its mate which is normal, and drawing from this a conclusion as to the size of the degenerated portion it must always be remembered that the extent to which the degenerated portion has been resorbed will very materially influence the result. *b.* When one optic nerve is degenerated and both tracts are found almost or apparently completely normal the inference is valid, under certain conditions, that the degenerated fibres did not form a compact bundle. At the same time the residua of even a compact bundle may disappear in the cases where resorption is very active, as in young animals, for example. *c.* If a compact bundle can be traced in a tract for some distance and then disappears, the possibility that the fibres may run for a time isolated and then intermingle with the others forming the nerve, must always be admitted.

Reviewing the literature in the light of the general conclusions thus given, the author proceeds to examine the evidence for the position of the crossed and uncrossed optic fibres both in the tract and in the nerve. The evidence is not decisive. In the optic nerve the uncrossed fibres form a more or less closed bundle; but whether its usual position is laterad, as indicated by the majority of the cases, or whether it is more often variable, is uncertain. In the tract the majority of authors report a more or less isolated condition of the uncrossed bundle and a lateral position. It is to be borne in mind, however, that just these cases were most liable to be reported, since in them the results of the lesion were most clear and definite. This entire paper is an unusually valuable contribution to this subject, and it may be noted in passing, that it was offered as a dissertation for the degree of M. D. at Leipzig.

Ueber die Folgen der Durchschneidung des Hirnbalkens. ALEXANDER V. KORÁNYI. Arch. f. d. ges. Physiologie des Menschen u. der Thiere. B. XLVII. H. 2 u. 3. Feb., 1890.

The work was done in the laboratory of Prof. Goltz at Strassburg. The author concludes that section of the callosum (in dogs) causes no marked disturbance, unless the hemispheres are at the same time injured. In case of such injury there may appear disturbances of vision, of tactual sensations and of motion, and that, too, when the injury of the white matter is to a portion far removed from that to which the respective functions are attributed. The disturbances, however, are transitory. Further, after section of the callosum, convulsions of the entire body may appear. There is wanting in this account the descriptions of the lesions, and the statement as to the number of experiments and the length of time that the animals survived the operation in each case, all of which data are necessary for the proper valuation of the results.

Further note on degenerations following lesions of the cerebral cortex. C. S. SHERRINGTON. The Journ. of Physiology. Vol. XI, Nos. 4 and 5.

When the pyramidal tract degenerates as a result of injury to the cerebral cortex, degenerated fibres are found in the following portions of gray matter, 1. Ventral gray *cornua* of spinal cord. 2. Lateral gray *cornua* of spinal cord. 3. Isolated gray masses in the *pons*, lying among the deep transverse fibres of the *pons*, (*stratum complexum pontis*) and close to the fibre bundles of the *crusta*. 4. A mass of gray matter lying in the mesal third of the crustal portion of the *crus cerebri*, (a well-defined mass in the monkey). 5. The *substantia nigra*, more especially the ventral portion of it. Interest attaches to these fibres, which are always of small size, because they are considered to be in connection on the one hand with the gray matter and on the other with the pyramidal fibres. In the spinal cord a degeneration of the fibres in the column of Clark has not been found associated with pyramidal degeneration. In cases of cortical lesion confined to the "leg area" a considerable number of fibres in the *substantia nigra* are found degenerated. To what animals these results apply is not stated.

Einiges über das Gehirn der Edentata. H. RABL-RÜCKHARD. Archiv f. Mikros. Anat. B. XXXV, H. 2. Mai. 1890. 1 pl.

From the examinations of cross-sections of the brain from a fully developed fœtal armadillo, (*Xenurus gyrunurus*), the author identifies a bundle of fibres each side of the middle line, and connected with the *commissura anterior*, with the *pars frontalis commissuræ anterioris* as described by Osborn for the kangaroo, by Flower and Sander for some other marsupials, by Ganser for the mole, and by Hamilton for the human brain. A second portion of the paper deals with the conformation of that portion of the Sylvian aqueduct which may be considered the homologue of the *torus longitudinalis* in the bony fishes.

Ueber den feineren Bau des Vorderhirns der Amphibien. A. OYARZUN. Archiv f. Mikros. Anatomie. B. XXXV, H. 3. Juni, 1890.

The author worked under the direction of Edinger and studied the forebrain in some amphibia (frog, triton and salamander). It has been the current view that undoubted ganglion cells could not be demonstrated in the mantel of the forebrain in vertebrates lower than the reptiles, and hence the homologue of the cerebral cortex of the mammals was considered to be first recognizable in this group. By using a modification of Golgi's method, Oyarzun has been able to demonstrate connective tissue cells and ganglion cells also in the mantel of these amphibia and show that the direction of the axis-cylinder processes from the ganglion cells is that which might be expected. The entire arrangement of the mantel is highly embryonic even in the adult frog, and this gives additional ground for considering the mantel in this case as but slightly differentiated.

II.—EXPERIMENTAL.

Les lois de la fatigue étudiées dans les muscles de l'homme. par ARNALDO MAGGIORA. Travaux de Lab. de Physiol. de Turin, 1889, p. 213. Also, Arch. f. Anat. u. Phys. (Phys. Abth.), H. 3-4, 1890, p. 191.

This is an experimental study, on the muscles of man, of the influences which favor and hinder muscular work. The experiments were made on the flexor muscles of the middle finger. The movements of the finger were recorded by the method described by Prof. A. Mosso in a paper having the same title as this and published in *Travaux de Lab. de Physiol. de Turin*, 1889,—p. 150, also *Archiv. Ital. de Biol.* XIII. p. 123, in a paper read before the Internat. Cong. of Physiol. at Basel, Sept. 1889, and in the *Archiv f. Anat. u. Physiol.* 1890, p. 89.

In the experiments of the author the muscles were stimulated voluntarily or by an induction current applied directly to them or their nerves. The contractions were always maximal, occurred at regular intervals and raised a weight of known amount, the weight being supported during the intervals. The contractions were continued until the power to raise the weight was lost. The record gave the height to which the weight was lifted by each contraction and thus the total amount of work done was readily computed. The amount of work possible was found to vary with the weight and the intervals of rest between the succeeding contractions.

With small weights the work can be continued a very long time even when the contractions succeed each other rapidly. With larger weights, one or more kilos, there is a certain weight for each individual with which, at a given rhythm, he can do the most work before the fatigue becomes complete. The curve of fatigue may be a straight line with a certain weight and a certain rhythm. If the rest between the succeeding contractions be ten seconds no fatigue is seen. The interval is sufficient for the restoration processes to be complete. This recalls the life long work of the heart. An interval of rest sufficient to prevent fatigue by a medium weight is insufficient with a larger weight. It is not sufficient on doubling the weight to double the interval of rest. As the weight is increased the rest must be lengthened much more rapidly. This proportion would probably differ with each individual. In making a series of experiments in which the muscles were worked to fatigue, it was found that rests of 1½ to 2 hours must intervene between the successive experiments to enable the muscle to completely recover. The time required was found to vary greatly with the individual. The general condition and habit of life probably being very important factors. In experiments in which the maximal contraction was sought each time, it was found that the effort fatigued more than the work accomplished. Therefore to obtain the most work it was necessary to rest frequently. For example with two kilos, it was best to contract every two seconds for one minute and then rest one minute. To obtain the most work from a muscle during a day, the muscle should not be worked to complete fatigue, as work injures a fatigued muscle more than a greater amount of work hurts a fresh muscle. Though a muscle can recover from fatigue in two hours, it can do more work during a day if it makes only 15 contractions every half hour. Anæmia causes the muscle to fatigue rapidly even when a rate of contraction be chosen which does not normally cause fatigue. This was seen in experiments in which the anæmia was artificially produced by compression of the artery. Maggiora corroborates Mayer's statement that fatigue produced by long continued muscular work affects other muscles besides those which were engaged in the work and lessens their power. The fact that the first contractions of muscles thus weakened are good shows that their irritability is not lessened. Nevertheless these muscles rapidly weary, and this is true for electrical as well as voluntary stimuli, which shows that it is the peripheral as well as perhaps the central mechanisms engaged in the voluntary act, which are affected by the general fatigue. The effect is much the same as that seen in anæmia of the muscle. Further it was found that when the muscle was thus weakened by general fatigue it responded better to the will than to direct electrical stimuli. General muscular fatigue was caused in the case of the author, who was leading a sedentary life, by a walk of ten kilometres, while a march of 32 kilometres had little effect on two soldiers, and 64 kilometres were necessary to give a marked result in their case. After this long march the influence of the fatigue lasted one day, and on the next day they had recovered their muscular power. Loss of sleep was found to cause general fatigue of the muscles. A fast of twenty-four hours had the same effect. The power lost by fasting began to return almost immediately after food was taken and the muscle was capable of almost a normal amount of work half an hour after the meal. Experiments with electricity showed that the peripheral mechanisms were thus affected by the loss of sleep or lack of food and that the fatigue was general. Experiments with massage showed that a muscle recovers its power very rapidly if massaged during the interval of rest; fifteen minutes instead of two hours being sufficient to restore the muscle. Four times as much work can be done when the muscle is massaged during the period of rest as when it is simply allowed to remain quiet. When the intervals of rest are too short the muscle recovers less and less completely in spite of the massage. How far fatigue of the muscle is dependent on lack of nutriment and how far on the accumulation of the waste products resulting from the chemical changes occurring during work is uncertain. At the close the author states that the power of his muscles doubled in six months. This change was not due to exercise, but to an improvement in his general condition. W. P. L.

Les lois de la fatigue étudiées dans les muscles de l'homme.[1] By Prof. ANGELO MOSSO. Travaux de Lab. de Physiol. de Turin, 1889, pp. 149–212. Reale Accad. dei Lincei, Serie 4, Vol. V, 1888. Archiv f. Anat. u. Physiol. 1890, p. 89. Paper read before The Internat. Cong. of Physiol. at Basel, Sept. 1889. Archiv. Ital. de Biol. t. XIII, p. 123.

The apparatus and experiments described in this paper are of great interest. Not only do they open a large field for work, but they unite more closely than has yet been done the nerve-muscle physiology of the lower animals with that of man. In addition to this they show an intimate connection between the fatigue of the central nervous system and that of the muscles. Two new pieces of apparatus are described and many suggestive experiments recorded. The paper is illustrated by 64 plates. The work covers a wide field, viz: 1. Description of the "Ergographe" and "Ponomètre." 2. A comparison of the curves of fatigue of voluntary muscular contractions with those produced by excitation of nerves and muscles. 3. The fatigue of nerve centres. 4. The influence of psychic fatigue on muscular force. 5. Inhibition of voluntary movements by electric excitation of motor nerves. 6. Muscle contractur. 7. Effect of fatigue on muscle elasticity. 8. Influence of a support on the height of muscular contractions.

In the hope of studying on man the laws of fatigue of the muscles, Mosso constructed an apparatus, which he named the "Ergographe." With it he was able to record the mechanical work performed by the flexor muscles of the middle finger, when contracted voluntarily or in response to an induction current applied directly to the muscles or to their nerves.

If a weight were raised with each flexion of the finger, the work done and the corresponding fatigue were recorded. By means of this apparatus he was able to test on men the results which have been obtained heretofore chiefly on frogs, and the lower warm blooded animals.

Each individual gives a characteristic curve of fatigue and this varies with changes in his general condition as well as local alterations.

It was found that human muscles have an excitability and energy peculiar to themselves and that they weary independently of the excitability and energy of the nerve centers. Thus the muscles are seen to be the seat of certain phenomena of fatigue which thus far have been thought to arise in the central nervous system and to belong essentially to it.

The other new apparatus used in these experiments is the "Ponomètre." By it, the weight is released at a certain point. The further unintentional contraction, made without the weight, depends on the amount of nervous energy employed to compel the muscle to raise the weight. The height of these contractions was seen to increase as the muscle tired and Mosso concluded that this was due to the fact that more nervous energy was developed to produce the desired contraction of the fatigued muscle.

Fatigue of nerve centres. With the "Ergographe" one can study the fatigue of the nervous centres, because one can measure the work of which the muscle is capable, when it is stimulated directly or through its nerve, and compare this with the work which can be done voluntarily. It was found by such experiments that more work could be done by electrical stimulation of the nerve than by voluntary contraction of the muscles. This is true in spite of the fact that one can voluntarily

[1] This paper is supplemented by a paper by ARNALDO MAGGIORA. *Les lois de la fatigue étudiées dans les muscles de l'homme.* Reale Accad. dei Lincei, Vol. V, Séance Nov. 4, 1888. Travaux de Lab. de Physiol. de Turin, 1889, p. 213. Many of the experiments described in this paper were made with Maggiora, and Mosso often refers to his work.

lift much heavier weights, and results from the rapid fatigue of the central as compared with the peripheral mechanism. The muscle is still capable of contracting in response to an electric stimulus applied to its nerve long after the voluntary power has ceased.

Influence of psychic fatigue on muscular force. Having found that the central nervous mechanisms fatigue during muscular work, Mosso sought the effect of central fatigue on the force of voluntary muscular contractions. He found that when a man was mentally tired by a severe examination his voluntary power was lessened. Before concluding that this loss of power was due entirely to central fatigue, he tested the muscle with electricity and found that the absolute power of the muscle itself was lessened. That is to say, he found that the muscles are weakened by severe mental work. The source of this weakness was then studied. It seemed more likely that it was due to some change in the blood than to an influence exerted by the brain through the nerves. Two ways suggest themselves by which the effects of fatigue might work through the circulation, viz., 1. A material poisonous for the muscles might be developed in the brain, as a result of the chemical changes accompanying its work, and thence pass into the general circulation. Or 2. The muscles, as less important mechanisms, might cede a part of their nutriment to the nervous substance as is the case in fasting. Experiments showed that the weakness which results from fasting is rapidly recovered from on taking food, while that caused by vigils and by forced marches is recovered from only by repose of the nervous system, i. e. sleep. These facts make it probable that during severe nervous work a material is produced which on entering the circulation acts as a poison and weakens the muscles. To prove this supposition Mosso tried the effect of injecting blood from a tired dog into one that was fresh. He found that it acted as a poison and produced all the signs of fatigue, though injecting the blood of a fresh dog had no such effect. The result of this experiment was a strong argument in favor of the idea that the weakness which results from mental work is due to a poisonous material produced by chemical changes in the brain.

Inhibition of voluntary movements by electricity applied to motor nerves. Mosso corroborated the observations of Schiff and Fick that an interrupted current applied to a motor nerve prevents the voluntary contraction of the corresponding muscles. He found a weak current to have no inhibiting effect, though it produced a slight contractur of the muscles. A strong current causes a tetanus. A medium current inhibits the voluntary contraction and produces a contractur. The current must last at least 1-5 second to have an inhibitory effect. The voluntary power returns immediately on the removal of the current. This inhibition does not seem to be a reflex phenomenon.

Muscle contractur. Mosso studied on men with the "Ergographe" the phenomenon of contractur, with reference to the results of Tiegel, von Frey, Rossbach, Richet, von Kries and Kronecher, gained from experiments on frogs, etc. He irritated the muscles of a man with a tetanizing current of medium strength every two seconds, and saw a series of contractions the record of the first five of which, on account of the contractur, formed steps, each contraction reaching a higher level than the preceding. At the summit there was a contraction lower than the rest, and then the contractur began to diminish and continued to lessen until the record again started from the abscissa. At its height the contractur was so strong that it supported the weight of 500 grms., at a higher level than the first contraction had lifted it. When the contractur began to lessen, the fatigue seemed to begin. The contractions, which were then greater than at the beginning, fell off rapidly. In voluntary contractions the amount of the contractur varies with the person and the way the weight is applied. It may be strong enough to lift 3 kilos.

Though diminishing as the fatigue comes on, it may in certain persons persist to a certain amount even after the fatigued muscle ceases to respond to stimuli. A very short rest is sufficient to restore the contractur. The intensity of the contractur is in relation to the intensity of the electric excitation up to a certain maximum. It is less marked with voluntary contractions than with those produced by electric excitation. It is only well marked with light weights. The adding of a heavy weight for a time, may be followed on return to a light weight by the contractur. Contractur is entirely a muscular phenomenon in spite of the fact that it is seen more marked in persons in an irritable condition. Indeed in experiments on animals it may be observed on curarized muscles. This observation is important as showing that many phenomena accompanying exaggerated excitability are of peripheral origin and independent of the central nervous system. The contractur seems never to occur in certain muscles as of the eyes, and in other muscles only to accompany excessive effort. It seems to be almost an abnormal condition, a symptom characteristic of an alteration of the muscle produced by too great excitation, and hence as a form of fatigue manifested in the muscle as it passes from a state of rest to that of work. It is probable that the first contractions of a fresh muscle differ from those of a fatigued muscle. Maggiora shows that a fatigued muscle is injured more by work than a fresh muscle. The shape of the muscle curve is influenced, not only by the contractur, but by the elasticity of the muscle and many other factors, so that its interpretation is most difficult. Mosso promises another paper on this subject. In spite of apparent contradictions he looks upon the contractur as a phenomenon of fatigue. It is certain that the nervous excitation produces in the muscle other effects than contraction. One recalls Bowditch's "Treppe." Mosso regards the "Treppe" as due to fatigue. It can be prevented by massage, and he thinks it ceases because the muscle by its contractions massages itself. The relation of these questions to the theory of tetanus is most important and it is to be hoped that Prof. Mosso will continue his work in this direction.

Effect of fatigue on elasticity of muscles. In some experiments the elasticity seems diminished by fatigue, in others the results are masked by the continuance of the contractur. The confusion of terminology—contractur, tonicity, elasticity, makes a clear understanding and statement of results a matter of great difficulty.

The influence of a support on the height of the contraction. The curve of fatigue is uninfluenced by having the weight supported at various heights during the work when the muscle is fresh, but if it be weary the partial removal of the weight increases the height of the contraction, i. e., when fresh, the muscle gives a maximal contraction regardless of the weight, but when weary it is aided if the weight be supported at a certain height. W. P. L.

Ueber die kleinsten wahrnehmbaren Gesichtswinkel in den verschiedenen Teilen des Spektrums. W. UHTHOFF. Zeitsch. f. Psychol. Bd. I, H. 3. 1890.

In connection with his studies on the acuteness of vision, Uhthoff has re-determined the smallest angular distance by which two objects must be separated in order to be seen separately, when illuminated with light of different colors. The importance of his determination rests on his having used spectral lights. The visual object was a fine wire net specially made for the purpose in which the intervals between the wires were just equal to the diameter of the wires, i. e., 0.0463 mm. This was seen against the face of a large prism so fixed that its whole surface was presented to the observer illuminated with one monochromatic light. The wire-net was moved backward and forward between the eye and the prism till its wires reached the limit of separate visibility. The intensity of the light was made so great that no increase of intensity caused an increase in the visibility of the wires. Wave lengths 670, 605, 575, 535, 505, 470, 430 $\mu\mu$, corresponding to the seven spectral colors were used. The experiments show that the *color* of the light has scarcely any influence provided that the *intensity* is sufficient. The limit was reached for one observer when a wire subtended an angle of about 32.″8, for the other 27.″6, corresponding respectively to retinal images of 0.00234 mm., and 0.002 mm. The value generally assigned for this angle is 1′ and these experiments, when the measurement is made in the same way, i. e. from the middle of one wire to the middle of the next, give substantially the same result, namely: for one observer 65.″6, for the other 55.″2.

Ueber die Muskuläre Reaction und die Aufmerksamkeit. GÖTZ MARTIUS. Philos. Stud. Bd. VI, H. 2.

The question here discussed is the significance of the important distinction between "sensory" and "motor" forms of reaction as introduced by Lange. The distinction itself Martius fully corroborates, finding it somewhat small in practiced reactors (about 20σ), but marked in two novices (about 100σ.) He, however, agrees with Wundt that the distinction is confined to simple reactions, and questions the validity of Münsterberg's extension of this distinction to more complicated reactions. He has repeated Münsterberg's experiments of reacting with the five and with the ten fingers to the first five and first ten numbers, the reaction to five vocal sounds, to five different declensional forms, to five categories such as a "river," "a city," etc., and finds in all these cases where Münsterberg found a large and increasing difference between the "sensory" and "motor" reactions, only a slight difference; and while Münsterberg finds the "sensory" longer than the "motor," Martius has a flatly contradictory result. While unable to explain Münsterberg's results, he feels confident that no true distinction between motor and sensory was there involved, and that it is impossible to apply this distinction beyond the simple reaction. The second portion of the study describes simple reactions in which the subject, after each reaction, gave a judgment as to its comparative worth, and also described his attitude of mind at the moment of reacting. This very commendable method is not carried forth with sufficient system to allow of easy formulatable conclusions, but they leave in Martius's mind an increased confidence in the value of his results. A third point discussed at length is the mechanism by which the shortening process of the motor reaction takes place. In opposition to the view that it is a return to a reflex mode of action—a view which he treats too literally—he holds that the motor reaction anticipates and takes for granted the precise nature of the stimulus and therefore reacts to it at an earlier stage of its development.

The most essential and puzzling contribution of this paper is the opposition to Münsterberg's results; only careful and abundant research can explain this important point. J. J.

Untersuchungen zur Mechanik der activen Aufmerksamkeit. GEORG DWELSHAUVERS. Philos. Stud. Bd. VI, H. 2.

The author has determined anew the effect of a signal preceding the stimulus in reactions, with due reference to the distinction between "sensory" and "motor" reactions. He finds that reactions to the fall of a hammer preceded by a signal at an internal of $1\frac{1}{2}$ seconds, were executed in 257σ sensory and 130σ motor; if the interval was 3 seconds, the times were 280σ and 133σ; if 6 seconds, 300σ and 149σ, (average of 5 subjects). On the other hand, when no signal preceded, the "sensory" time was 305σ and the "motor" 188σ. In all these results the attention was closely focused upon the reaction. If the attention were purposely diverted from the reactions and no signal preceded, the time was 353σ. The chief result is thus a corroboration of the distinction between "motor" and "sensory" as well as of the effect of a preceding signal, with accurate determination of the effect of the interval between signal and stimulus upon the reaction-time; it is also shown that the advantage of the signal is greater with "sensory" than with "motor" reactions. The second portion of the research is devoted to the same problem with which Martius (see above) has occupied himself, *i. e.*, the correlation of the subject's own version of the value of his reaction and the state of his attention at the time of reaction. He finds that a complete attention takes place in 85 per cent. of all cases, and that total inattention is rare, and ventures the generalization that as the accuracy of the attention increases the time decreases. The subjective testimony would also indicate that the distinction between "sensory" and "motor" is only a relative one, transitional forms and times appearing everywhere. One's own opinion as to the quickness of the reaction, Dwelshauvers does not value as highly as Martius, but regards it as very liable to effects of contrast and other illusions of judgment. J. J.

Mental Tests and Measurements. J. McK. CATTELL. Mind, XV, 373; July, 1890.

Prof. Cattell here presents in detail the plan for psychic tests mentioned in his note upon Psychology at the University of Pennsylvania in the last number of this JOURNAL. These are: 1, Dynamometer pressure; 2, Rate of movement; 3, Sensation-areas; 4, Pressure causing pain; 5, Least noticeable difference in weight; 6, Reaction-time for sound; 7, Time for naming colours; 8, Bi-section of a 50 cm. line; 9, Judgment of 10 seconds time; 10, Number of letters remembered on once hearing. Numbers 2 and 4 have not so far been much tried, but are promising; new instruments have been devised for making them. These ten tests are now taken at Prof. Cattell's laboratory upon all that are willing, and his students are submitted to a much longer series, a list of which is also here given. Discussion and co-operation is invited (and some notes by Galton are appended to this article) to the end of securing the best methods and uniformity in using them. This move is in the right direction; some standard series of mental measurements is a thing very much to be desired, and uniformity is no less important. Prof. Cattell has upon the stocks a laboratory manual of psychology, a book much needed at this stage of the teaching of experimental psychology.

Ueber die Wahrnehmung und Lokalisation von Schwebungen und Differenztönen. KARL L. SCHAEFER. Zeitschrift für Psychologie und Physiologie der Sinnesorgane. Bd. I, H. 2. 1890.

That the ear has a certain power of judging the direction and distance of sounds, no one will deny, but how will it locate those that actually have not a single source, that arise from the combination of two other sounds? The most readily audible of such sounds, "beats" (due to interference) and difference-tones, (due to the mechanism of the ear) have been examined in this particular by Schaefer. His experiments were made with tuning forks and lead to the following results. Beats: When the beating tones are of unequal intensity the stronger of the two fixes the apparent place of the beats; when they are of equal intensity the beats are referred to the intermediate space—thus, as a special case, when one tone reaches one ear only and the other tone the other ear only, the location of the beats is in the median plane or even in the middle of the head. Difference-tones: When the generating tones are produced in the median plane of the body or symmetrically on either side of it (and at the same time are equally intense) the difference-tone seems to be in the median plane within the head, sometimes mid-way between the ears. When both generating tones are on one side of the head the difference-tone is heard in or near the ear on that side and is not referred to the generating tones. When the generating tones are not equally intense, one being produced before one ear the other before the other, the difference-tone is heard on the side of the fainter generating tone—a result due apparently to the more favorable relation of intensities existing on that side. Dove, Stumpf and Thompson failed to hear the difference-tone with the generating tones in this position, but probably because of imperfect conditions. The 32 forms of experiment contributing these results, as well as notice of the effect of different positions of the generating tones upon the intensity of the "beats" and difference-tones, are set forth in the original. [These results are in harmony with the general principle that a sound is located upon the side on which it is most intensely heard; or if equally intense on both sides, in the median plane. REV.]

Die Association successiver Vorstellungen. H. MÜNSTERBERG. Zeitsch. f. Psychol. Bd. I, H. 2. 1890.

The theory of association here advocated by Münsterberg is that the connection of any two members of a memory series depends either on their more or less complete simultaneousness in consciousness (or the simultaneousness of their nervous correlates), or, if successive, on their connection with the members of a parallel motor series (made up of the reflex movements or tendencies to movement which attend sensory processes). Thus sensory image *a* is connected, because simultaneous, with motor impulse *A*, the latter with motor impulse *B*, and that in turn with sensory image *b*. Image *a* can thus call up image *b* indirectly though wholly lacking direct connection. In addition to a statement of the difficulty of conceiving the connection of neurological processes wholly successive, the author presents experiments going to show a connection by way of these motor accompaniments. The experiments fall into two groups. In the first written letters are exhibited in such a way that each letter was seen by itself for one second till from four to ten had been shown. The subject, Münsterberg himself, was required to fix the series in mind and at the end repeat the letters in order. He found that he was able to repeat seven letters without error, but reached the limit of his ability with a series of 10. The errors which he made, and this is the important point, were mostly the substitution of wrong letters, *almost never errors in order;* taking reproductions of series of all lengths only about 1 per cent. were affected by errors of this kind. In the second group the setting of the experiment was the same as in the first; but the subject, instead of being able to concentrate his mind on holding one letter till the next came or even to say them in his head, was deprived of such aids by being required to work problems in mental arithmetic aloud (such as adding continuously), while the letters were shown. The result was a fall of the limit of possibility from 10 to 7-letter series, and of that of perfect reproduction from 7 to 4 or 5. More important, however, is the fact that *the order of letters, even when the right ones were given, was very frequently wrong.* Of 100 4-letter series only 6 contained wrong letters, but 52 were wrong in order; of 100 5-letter series, 10 contained wrong letters and 64 a wrong order; and the 6-letter series were very much worse. The effect of simple distraction of attention shows itself in the fall of the limits of possible and perfect reproduction, but the errors in order must have another explanation. This is to be found in the fact that the mind was not at liberty to hold one letter till the next came (hence association by simultaneousness was excluded) nor able to connect them serially by means of their natural reflex motor accompaniments, because the speech apparatus was fully occupied with the loud reckoning. There was therefore no means of serial connection left, though the letters were impressed on the memory singly. With this explanation the subejctive observation of Münsterberg during the experiments agrees.

The author holds that the serial connection in the motor series is quite another matter from that in the memory series. The point is an important one, for unless this is so he still has to account for one link in his chain, and to the reviewer's mind it should have had a much fuller and better demonstration. The experiments, however, are valuable and the paper, unlike those in the author's Beiträge, is brief and to the point.

E. C. S.

Ueber negative Empfindungswerthe. Briefe von G. TH. FECHNER, herausgegeben von W. Preyer; (Schluss). Zeitsch. f. Psychol. Bd. I, H. 2.

The five letters given in this section continue the discussion of "negative sensations" upon the lines followed in the former section (Zeitsch. f. Psychol. Bd. I, H. 1; review, *Amer. Jour. Psychol.* III, p. 288), and bring the correspondence to a close, evidently without the surrender of either party. New analogies are introduced and Fechner makes clear his strict limitation of his formula and its deductions to *psycho-physic* phenomena, refusing to have it carried over to purely psychic matters and withholding assertion as to its applicability in purely physical ones. In the course of the letters reference is several times made to the views of Hartmann on the physiology of consciousness.

III.—CRIMINOLOGICAL.

BY ARTHUR MACDONALD, PH. D.

Tipi di criminali nati, GUIDO ROSSI e S. OTTOLENGHI, Archivio di Psichiatria, Scienze Penale ed Antropologia Criminale, Vol. XI, Fasc. 1, Torino, 1890.

As an example of the way in which criminals are studied by the Italian specialists, we give the details of a single case.

The writers investigated two cases of typical born-criminals. The first case (by Rossi) is as follows: S. C., 38 years of age, born in Turin, a type-founder by trade, condemned twice; the first time, ten-year sentence for cruelty to father. While in prison he attempted suicide twice. Being unable to work, he wrote his history upon a vessel. Always suffered sensations of heat in the head; was subject to vertigo; had an alcoholic attack and epileptic prison insanity, *follia carceraria epilettica*, during which he broke the glass in the window, for having been punished excessively; did not think in such moments of the possibility of being punished again; had a true morbid epileptical hypochondria. His physical examination gave: pallid skin, thin chestnut hair, abundant beard, thin moustache, blue iris; nose long and crooked; teeth: median incisors hypertrophied, the lateral decayed; slightly projecting ears, squint in left eye, paralysis of the eyebrows. Craniometry: anterior-posterior diameter, 182 mm.; transverse, 151 mm.; anterior-posterior curve, 340; transverse, 317; total circumference, 540; cephalic index, 83; cranial capacity, 1530; a depression at the union of the frontal and parietal, not evident whether it is due to a wound or not; lacks the ethnic type; a scar on right hand arising out of a dispute after gambling. Sensibility: with Faradaic current, the right hand feels at 32, the left hand at 35; touch gives 3 mm. for left and 2 mm. for the right. Meteorological sensibility is moderate; two or three days before bad weather he is restless. He is credulous; was made to see a bottle of black wine under a white paper. At nine years of age was given to masturbation. The dynamometer gave 46 for the left hand, 53 for right. Motility: gait awkward; speech stammering; writing good; knee-jerk exaggerated; had a simian agility since infancy. He walks often without consciousness of where he goes; this is one form of propulsive epilepsy; at certain moments there comes to him a desire to destroy everything, and often he does it. He does not believe in any religion. He sleeps uneasily; commenced to like wine at ten; was forgetful; smoked; liked gambling; is fond of striking; knows the criminal slang. His father was 44 at the birth of S. C.; his mother 50; his father drank much, but supported the wine, and was never in jail. The mother played much at lottery; his sister was mother of thirteen sons, all healthy, except one who died, disease unknown. He was studious in his four elementary classes; said he never had difficulty in learning. He reads the *Cronaca dei Tribunali*. He does not like the present system of government; would like the republican form. In infancy he suffered with *ematurie* and neuralgia.

Le crime politique et le misonéisme. CESARE LOMBROSO. Nouvelle Revue, 15 Fév. et 1er Mars, 1890.

This article, by one of the founders of Criminal Anthropology, shows some of the broader social aspects of the science of crime. While a certain freshness of experience brings enjoyment, suspicion and hatred of the new (misoneism) is deep-seated and characteristic in society and the individual, most so in the feeble and primative. Innovators, reformers, geniuses are opposed, and, since even they do not escape this law, oppose each other. The same law pervades religion and pedagogy. Disregard of the misoneistic feeling in sudden and violent attempts at progress is anti-social and a crime. Revolutions are distinguished from revolts and seditions in being normal steps of advance; they do not excite conservative reaction; they have high aims and moral causes; they appeal to people of all classes; they reach success in spite of loss of leaders; they are rare and characteristic of advanced nations. Revolts and rebellions are the reverse of all these; society is not prepared for them, they are abortions. In doubtful cases society itself decides, by accepting or rejecting the attempted advance, whether the attempt is a revolution or a rebellion.

Mittheilungen der internationalen kriminalistischen Vereinigung; Heft 1, Februar, und Heft 2, Juli, Berlin, 1890.

The International Penal Law Association was founded in 1889; principally through the efforts of Prof. Franz von Liszt of the University of Halle. It will be seen from the principles advocated by the association (given below) that it takes the most advanced views in practical criminology.

The International Penal Law Association holds that crime and punishment should be considered from the sociological as well as from the juristic standpoint. Its fundamental propositions are: (1) The purpose of punishment is to oppose crime as a social phenomenon. (2) The results of anthropological and sociological investigations are therefore to be considered. (3) Punishment is one of the most effective means of opposing crime, but not the only one, and therefore should not be separated from other remedies, especially that of prevention. (4) The distinction between occasional criminals and habitual criminals is of fundamental theoretical, as well as practical, importance, and therefore serves as a basis for the determining of penal legislation. (5) Since the administration of penal justice and its execution have the same purpose, they should not be separated, for in addition the judicial sentence gains its content and meaning from the execution of the punishment. (6) As the restriction of freedom rightly takes first place in our penal system, the Association devotes itself to efforts for the improvement of prisons and related institutions. (7) Yet the Association holds that the substitution of short restraints of liberty for other penalties of equal efficacy is possible and desirable. (8) In long restraints upon liberty, the duration of punishment is to depend not only upon the results of penal procedure, but on that of penal execution. (9) Penal legislation, even in cases of frequent repetition of small offenses, is to place incorrigible habitual criminals beyond the possibility of doing harm for as long a time as possible.

There are 487 members in the Association, representing almost all countries of the world. The American members are: Mr. Z. R. Brockway, Rev. F. H. Wines, R. P. Falkner, Clark Bell and A. MacDonald.

We give below a short résumé of the reports of the Association for July, 1890:

Question II, c. Is it necessary and suitable to make the treatment of young criminals depend upon the distinction, whether they have acted with sufficient knowledge of their guilt? John Foinitzki, Professor of Penal Law in St. Petersburg, answers in the negative, and comes to the following conclusions: (1) This criterion is indeterminate, and leaves no sure ground for the distinction of the act, and leads to mistaken results. (2) The opinion as to the inadequacy of the criterion is more and more acknowledged; it has lost its former importance, and the work of the judge in applying it is useless. (3) Another criterion must be used which should include the general estimate of the personality of the youth; it must give ground for deciding whether the youth should come under public guardianship, and what measures are to be employed as suitable to his condition. It should be assumed that: (a) measures of punishment in the ordinary sense should not be applied; (b) it would be desirable that the passage from the procedure, determined by one court, to another, be made easy, and that this passage be looked upon as necessary, and that it correspond to the change in the individual physical condition of the young criminal.

Question II.—Is forced-labor without imprisonment adapted to take the place, in certain cases, of temporary punishment ? V. J. Baumgarten, Docent in the University of Budapest, answers that forced labor without imprisonment is not a substitute for restraint upon freedom, but a substitute for a fine. With the working out of the fine, a social injustice is at the same time taken out of the world, which exposes to the economical and moral injuries from the short restraint upon freedom just that class in society which possesses the least power of resistance against injuries.

Question III.—Can and should legislation be occupied more than ever before with the element of civil reparation for the infraction of the rights of the injured party? Prof. Bernardino Alimena of the University of Naples, in answer says: At present the compensation to victims of crime is almost illusory, and without doubt the first purpose of legislation is to destroy the evil effects of crime; and if it cannot revive the victim, who has been killed, it should make the evil felt as little as possible by his sons. (a) Damages for voluntary crimes. For grave crimes, where the restrictive penalty is necessary, damages should always follow the penalty, and never be substituted for it, nor diminish it. If the criminal is solvent, he may pay with his property, and this credit will be privileged in preference to all other credits. In lesser crimes, in which imprisonment would be inutile, one can study and experiment with care. An example is given in the code of Germany which permits the penal judge to pronounce a fine in favor of the offended, to the amount of 6000 marks ($1500). (b) Damages for involuntary crimes and for cases of civil responsibility: In involuntary misdemeanors it would be necessary almost always to apply the penalty in favor of the injured party. This penalty should not interfere with the civil damages in cases where the money paid by this penalty is not sufficient for the reparation of the damages. For the cases of non-culpability followed by civil responsibility, one cannot speak of a penalty transformable into imprisonment. The damages should be obtained in the ordinary way. A treasury for penalties should be instituted. The treasurer should pay in cases where the guilty, for a sufficient reason, *e. g.*, his death, his flight, etc., does not pay; or he should anticipate alimony in all cases where the victim is very poor and the payment will not be made soon. For this, money earned in prison should be divided into four parts: 1. For the victim until payment of the debt determined by the magistrate. 2. For the State. 3. For the coffer of penalties. 4. For the benefit of the condemned.

Question IV.—How is the incorrigibility of an habitual criminal to be determined; and what measures against these criminals are to be recommended? Prof. von Lilienthal of Marburg answers in brief: Those who have repeated relapses, from which crime appears as an outcome, are to be considered as incorrigible. Two kinds are distinguished, one resting upon hereditary taint or acquired degeneration; the other upon a criminal manner of life industrially. In answer to the second part of the question there should be: (1) Institutions for the high degrees of degeneration; (2) Institutions for the dangerous incorrigible, whether degenerated or not; these might form a special division of the present penitentiaries; (3) Work-houses for those who are not dangerous,—like the present work-houses. Perhaps they could in part be combined with them.

Internationale kriminalistische Vereinigung; Erste Landesversammlung der Gruppe deutsches Reich. Halle a. S., den 26 und 27 März, 1890.

The German division of the International Penal Association met in March, and discussed the following questions: 1. Under what presuppositions, is the introduction of the conditional sentence into German legislation expedient? 2. How is the fact of recidivation to be determined legally; and what means of punishment are to be recommended for the incorrigible? After many varied modifications, the Association finally voted on the following questions: 1. Is recidivation to be assumed if the new and former criminal act lie in the same penal grade, as designated by legislation? 2. Should recidivistic superannuation be admitted? 3. Should repeated recidivation form a necessary ground for sharpening the punishment? 4. Is a relatively increased restraint upon freedom to be recommended as a means of punishment for repeated recidivation, with the permission of imprisonment in the workhouse as a consequence? 5. Should the law touch upon regulations which ensure the permanent separation of evil-doers (considered by the penal magistrate as incorrigible), into special divisions: of prison, work-house or insane asylum? 6. Should a conditional release, after five years' detention,be granted to those considered incorrigible? The Association affirmed unanimously questions 1, 2, 3 and 6; and by a large majority questions 4 and 5. Another question was: Is it expedient to prepare jurists practically and theoretically [*i. e.*, by training in psychiatry, criminology, etc.] for the penal executive? (*a*) before; (*b*) after the States' examination. The main question was almost unanimously affirmed. After the laying aside of the subordinate question *a*, subordinate question *b* received a large majority of the votes.

Compte général de l'administration de la justice criminelle, 1887. Revue Scientifique. 8 Mars, 1890.

The official report of criminal justice in France for 1887, published in 1889, gives a good idea of French criminality. On looking at the maps it would seem at first sight that the high degree of criminality in the large cities was due to population, but a more thorough examination shows, that it depends on ethnographical conditions. All the north and northeast of France (Normandy, Isle of France, Champagne, Picardy, Flanders) show a high criminality; below (Sarthe, Orne, Eure-et-Loir, Loiret, Yonne) a medium degree; and in the center, west and south of France criminality is feeble, with the exception of the border provinces (Basses-Pyrénées, Haute-Savoie, Savoie, Doubs, Vosges), which give a more elevated degree of criminality than the west and center of France, in which the mortality is greater than in the other provinces. The map of suicides corresponds exactly with that of criminality, except in Corsica, where there are very few. The constant progression of suicide (not special to France) deserves attention:

Year.	Absolute number.	Number per 100,000 of population.
1872	5275	15
1873	5525	15
1874	5617	16
1878	6434	17
1879	6496	18
1882	7213	19
1884	7572	20
1885	7902	21
1887	8202	21

Comparing the number of crimes from 1871 to 1887, the statistics are as follows:

	1871—75	1876—80	1881—85	1886	1887
Parricides,	10	10	14	13	23
Poisoning,	17	14	10	8	8
Assassination,	201	197	216	234	234
Infanticide,	206	194	176	166	160
Murder,	163	143	186	174	186
Unchastity,	851	899	783	712	654

Since the population from 1871 to 1887 has increased, the table shows a tendency for crime to lessen, although it is feeble. While foreigners furnish 10 per cent. of the crime, they constitute only 3 per cent. of the population. The percentage of recidivists has continually increased:

1871—75	1876—80	1886	1887
47	48	56	54

Alchoholism has diminished greatly:

1873—75	1876—80	1881—85	1886	1887
81416	75026	67155	61346	59098

In looking at the above results we are struck with the large proportion of crimes against chastity. The fact that suicide is so low in Corsica, while other crimes are numerous, suggests the law of antagonism between suicide and crimes of blood. According to these figures France (looked upon by some as a wicked country) is about the only place where crime is decreasing.

Le dêlit et le suicide á Brest, par le Dr. A. CORRE. Archives de l'anthropologie criminelle, 1890.

In the study of criminology, one is impressed with the continued repetition of the same offences in places widely separated; so that a thorough investigation of one locality will give much that is common to all. The author gives the results of such an investigation in a city of about 60,000 inhabitants. He is also careful to point out the local peculiarities. We give some of his conclusions: The Breton is traditional but not atavistic; he retains many of the characteristics of his ancestors; he is a good Frenchman without ceasing to be himself. Misdemeanors have become more frequent and crimes less numerous. Measures of correction explain this in part. The return to violence in attacks on the person is explained by the recrudescence of alchoholic habits. Intemperance is a factor of a slow degeneration, which pushes to cowardly and cunning misdemeanors; is a provoker of quarrels which end in murder; it may run in the train of reviving ancient instincts of brutality. Pauperism is almost a profession; it has its saints in popular veneration. The beggar is still "*l' hôte de Dieu*"; this renders him respectable. Much whisky is consumed, and enormous quantities of absinthe, the more pernicious because very often adulterated, making it cheap, which is a principal aid in its sale. In the hospital alcoholism dominates in the etiology and in the form of the majority of the diseases. Divorces and separations are few because of distractions and mutual accommodations. You often read in the paper; "Mr. X. informs the public that he will not pay the debts of his wife." As to recidivation, drunkenness accounts for the largest part of it. Suicide, according to one school, is only a different form of the same impulsive abnormity of which crime is another form; this impulsiveness is very much allied to insanity; and as a matter of fact the three increase together from year to year. As to the influence of the seasons, one is impressed with the existence of a maximum of offences in winter, and a minimum in summer. Sometimes the cold gives the least impulsiveness to crime in January, and the heat shows its influence by increase of offences in August. Assault and battery show their maximum in February and March, and their minimum in August. Vagabondage and mendicity are parallel, having their maximum in summer, with a momentary rise in spring. Drunkenness is prevalent at all seasons, and reaches its maximum on the different holidays.

La Questione della pena di morte, per EMANUELE CARNEVALE. Torino, 1888. pp. 97.

The author treats critically in the first chapter the objections to the death penalty, and in the two following considers the matter more positively. The special question of the death penalty raises the question of penal jurisprudence in general. Individualism and its inviolability are at the basis of the theories opposed to the death penalty. But the idea of the organic unity of the individual and of society is the one to correct the errors of individualism, and emphasize rather the inviolability of the life of humanity. This is one of the principal missions of the new Italian school in criminology. Although the argument of fear from the death penalty may be over-estimated, yet it has force with the ignorant and with those who are timid among the educated classes. A second argument as stated by En. Ferri is from natural selection. The universal laws of evolution show that the progress of every living species should be in a continual selection; that in humanity, this selection, natural among the animals, should be made artificially in obedience to all the laws of life. Thus the death-penalty, like nature eliminates the individuals who do not assimilate. According to Colajanni, the voluntary element in the social organism acquires daily greater influence in comparison with the physical element, and such influence becomes always more contracting (*contrattuale*). The final argument (by Garofalo) is based on the idea of eliminative reaction; penalty is but a reaction against crime; the death-penalty is a unique and sure way of absolute elimination, hence indispensible to a full and perfect exercise of social defense. In thus eliminating those individuals, who are unadapted to society, the race is purified and an example is set. These are in brief some of the arguments mentioned by the author.

La Recidiva nei reati, studio sperimentale. GIUSEPPE ORANO. Roma, 1883, pp. 298.

The author considers recidivity theoretically in the first part of his book, and experimentally in the second part. After taking up the general notion and legislation of recidivity, and the dissention between criminologists as to the legitimacy of the threatened repression of the recidivists, he passes in the second part to the question of the aggravation of punishment in respect to age and physical conditions, and to the relations of recidivity to insanity, and comes to the following conclusions: Such ideas, as the relative insufficiency of objective physical force of punishment on account of the insensibility which the criminal opposes to it, the contempt which the guilty one manifests, the social danger which comes with the relapse, the consequent necessity of hindering this by the menace of a greater castigation, are abstract considerations, apriori criteria, bereft of the aid of positive enquiry, and consequently more hypotheses and conjectures than reasons. Thirty per cent. of the criminals in Italy are recidivists. In France, it was 43 per cent. for men and 31 per cent. for women in 1867; in Belgium at that time it was 45 per cent. and in Austria 59 per cent. for men and 51 per cent. for women, in Switzerland 45 per cent. The average shows that 45 per cent. of criminals are recidivists. The second and successive punishments are in general expiated in that period of time in which the human organism commences to lose its natural vigor; there is thus a certain aspect of injustice and inutility in punishing the recidivist. There is also a greater bitterness in a second or successive punishment between the ages of 25 and 30, the period in which recidivity is most conspicuous. As to the relation of recidivity to the carcerial system, some of the most illustrious and competent men say that about six sevenths of the men are allured into relapse. Beranger says it is the prison which makes the recidivist. The influence of surroundings can be greater or less, but it does not affect substantially the great damage done by increasing the punishment of recidivists.

Socialismo e Criminalità. ENRICO FERRI. Roma, 1883, pp. 224.

The author says in his preface to the reader, that it is imposed upon contemporary science to embrace daily reality, and not platonic researches for archeological sweepings; and that this is not the love of science for its own sake, but for the sake of life. He calls attention to two new current ideas; one is the result of the experimental method in the study of criminal phenomena, the other is the effect of positivism in the study of economical facts. His conclusions are as follows: Crime, like all other manifestations of social pathology, is the offspring of the present social system; but socialism will change radically the state of society. In the new order of things, prophesied and desired, crime will disappear (in a manner more or less absolute), and with it the relatively unproductive institutions, prisons, soldiers and judges. The social surroundings will be the best, and crime, like misery, ignorance, prostitution and immorality in general will finish their sad tyranny. The following are two general socialistic affirmations, which have immediate relation to the problem of the criminality of the future. The iron laws of the struggle for existence, which have dominated the animal world and humanity, will be eliminated from the economical order of socialism, which is the suppression of vital competition. Egoism, which in humanity, past and present, stands as a bar to all moral and social life, will disappear before altruism, disinterestedness, and love of neighbor, which will reign sovereign in the economical order of socialism.

Les Récidivistes, par JOSEPH REINACH. Paris, 1882. pp. 388.

This work is valuable, in that it gives a definite idea of the French penal system. The author describes in a forcible way the recidivistic character. The recidivists are criminals by profession. Just because they have lost the use of understanding, they are like all the insane, a great peril to society; and it is necessary to keep them also from doing evil. Psychiatrical science and penal science are branches of the same tree, and accidental criminality bears the same relation to professional criminality that a burning fever, which is curable, does to melancholia, which is not. Yet we let loose upon society recidivists charged with ten or more condemnations. Moreover, while the insane are isolated, the criminals by profession are generally in groups, more dangerous and more menacing. In fact, that which distinguishes the recidivists from the mass of criminals, is that they are a compact army, an association opposed to society and law, incorporated to make an attempt upon the safety and property of the public. Rebels and revolters *par excellence* are the more to be feared, since they have not entered with gaiety of heart into the infernal circle, where it is necessary to renounce all hope, but have been precipitated there by misery, and almost all of them, alas, are right in accusing society, which could save them after their first false steps, but which has let them slide into the abyss without reaching a helping hand. Then it matters little that you have only to do with a feeble heart, and a soul functionally perverse. In the half-grim liberty, which the penal law has made for the recidivist, the two dangerous signs in man, habit and a taste to do evil, have become a second nature. In the degree that it would be easy to redeem him after his first fault, in the same degree it would be chimerical to attempt it now that he is in his place in the army of crime; he will not flinch; for one who deserts, ninety-nine will die impenitent on the field of battle. They are a world apart not only from honest men, but from all other criminals. The unfortunate whom misery or passion has led astray during an hour, trembles before justice, the recidivist defies it. One has not ceased to belong to society; the other has; he lacks no kind of vice; he recruits himself everywhere; with his great ally, prostitution, he is the product and the mixture of all the impure elements of society, a veritable social ulcer. The misery is terrible, no less the physical than the intellectual; his vice and debauch are monstrous, and cynical beyond conception; he has called the bench for the accused in court, "the bread-board." The main incentives to his crimes are women, wine and gambling. He is moth-eaten by the itch, which comes directly from dirtiness and privations of every nature; he is undermined by epilepsy which comes from alchoholism; he is the victim of a social order without pity; but in his turn he is the most infamous oppressor. Whatever be the cause of his hardened criminality, whatever be his own vices, misery and the logical consequences of a defective penal law are dangers to be denounced. The recidivists are dangerous because their antecedents push them to new crimes, and half of all crimes come from them. Crime produces crime, the recidivist never says *adieu* to the courts, but always *au revoir*, and on every return his crime is wiser and graver. In times of civil discord, he takes advantage of the confusion. Misery and ignorance have always been the two great causes of criminality; the number of crimes against property rises and falls with the price of wheat; the want of instruction is proportionate to the number of crimes committed. Misery and ignorance are the two aged perveyors of the courts, houses of debauch and morgues. If scarcity of bread and ignorance are the cause of the first crime, the penal code is often the cause of the second. The result of the penitentiary system is an increase of recidivists. Permanent transportation in a penitentiary colony is the only means of security against the recidivist. Patronage is the only solution of the problem of how to keep the wanderer of to-day from becoming the hardened malefactor of to-morrow, how to save the unfortunate whom abandonment leads straight to misery, and misery in its turn fatally to crime. If the prison regime has been what it ought to be, the prisoner on his release has a desire to make a man of himself. It is just at this moment of moral convalescence, that he should be cared for and should be given employment; and if private enterprise does not do it, the state should. If after this, he refuses this aid, the social conscience is clear. When a hungry woman sells herself to have bread, society is guilty; but when a woman, who has bread, sells herself to have cake, society can follow the example of Pontius Pilate.

Criminals, by CHARLES D. SAWIN, Physician at Mass. State Prison. April, 1890. pp. 30.

This brochure is interesting as coming from the practical experience of a physician, who has been for some five years almost daily in contact with State prisoners. That all criminals are about the same and never to be trusted, whether in or out of prison, is a false conclusion. The degree of moral sense and of intellectuality should be as carefully measured by those familiar with criminals as men are measured physically by the Bertillon system, and then the criminal should be placed with those in the same approximate grade. Murderers, burglars and thieves should not be huddled together, thereby obtaining new points for their criminal career. Separating criminals into groups of the same degree of moral responsibility is preferable to the Belgian system. The hope of rendering a prison self-supporting must be given up, in order to produce the best results, *i. e.*, the stamping out of the trained criminal. Crime may be defined as the commission, by a rational being, of a certain offence or action, of which the government disapproves. It is relative; thus an inebriate instead of being put into a penal institution, may be put into a hospital. Perhaps the dealer in intoxicants will be classed as the criminal in the future. Criminals may be classified into: (1) Those having a congenital malformation or disease, either through accident or birth, or disease or vices of antecedents. (2) Criminals by circumstance, having good physical development, but insufficient will-power to withstand a propensity. And (3) criminals having a good physical development, but a constant bad environment during their lives. Although there is a greater percentage of weak-mindedness in prisons than outside, yet the tendency in major crimes, and especially where the individual is prominent, to detect evidences of mental aberration, is to be deprecated. Many prisoners become insane after entering prison; in a few instances, through remorse, or on account of the sudden change of the conditions of life, from one of pleasure to one of monotony. A little over eight tenths of one per cent. of the prison population have been transferred annually to the lunatic hospitals for treatment, for the past five years. Many more, who were harmless and quiet, could have been transferred. From a recent cursory examination, thirteen and eighteen hundredths per cent. of the prisoners in Massachusetts State Prison exhibited strong mental peculiarities; and although the major portion are very tractable during confinement under stringent rules, when permitted to mingle with the general public upon the expiration of their sentences, they fail to comprehend the social body, and break forth into some new and atrocious crime. Solitary confinement has a wonderful effect, reducing an excitable prisoner to a spirit of subjection. A certain one of this kind, when allowed the freedom of the yard was like a wild animal. He said himself that he could not bear his liberty and wanted to fight. The writer gives some interesting facts as regards Jesse Pomeroy; and closes his brochure with citations from letters written by criminals in answer to the question: "Is crime a form of insanity?" The criminals cited are decidedly of the opinion that crime is not a form of insanity; that is, five out of the six are of this opinion.

The Restoration of the Criminal, a sermon by FREDERICK H. WINES. Springfield, Illinois, 1888. pp. 22.

This sermon has more than usual value, not only for the ideas it contains, but for the facts and the confidence that may be put in them, inasmuch as the writer is the one who gathered the criminal statistics for our census of 1880. The majority of people take an optimistic or pessimistic view of crime according to their temperament, and either think that nothing can be done to stay the rising tide of crime; or else everything is done that can or ought to be. In either case they suppose that it is a matter for the government to deal with, and that private citizens have no call to waste any of their time in considering it. Many do not know how many prisons there are in our country, nor the cost of them to the community. At the time of our last census, in 1880, in all our prisons there were nearly 60,000 prisoners, and in addition 11,000 inmates of juvenile reformatories, who are virtually prisoners. Nearly ten thousand were sentenced for life, or for terms exceeding five years; they are a small fraction, and aptly compared to prisoners of war. The cost of maintaining our prisons, which is estimated at fifteen millions a year, is but a small portion of the cost of defending property and life. To this must be added another fifteen millions annually for keeping up our police departments. Then we have to maintain the ponderous and expensive system of courts. What proportion of this expense is criminal is difficult to say; but what those courts, with all their officers and employes cost us is beyond computation. Nor can the cost of the successful depredations of criminals be reckoned. We know that many individuals live by crime. Crime has its capitalists, its officers, and even legal advisers. The worst of all is, that crime is increasing in this country out of proportion to the growth of population. An examination of the reports from State prisons shows that at the present time there are over one third more convictions for high crimes in proportion to the population than there were twenty years ago.

What is the real end sought in establishing a prison? Some say: to punish crime; some, to protect society; some, to deter others from committing crime; some, to reform the criminal. There is an element of truth in each of those answers. There is a weak sentiment in society, that punishment has no place in the criminal code. We must not oppose administering justice in the spirit of retaliation in such a way as to impress others that we do not recognize the essential evil-desert of wrong-doing. At the same time, it must be admitted that the impossibility of measuring guilt in specific criminal acts, and the failure of all attempts to overcome evil with evil, have gradually changed the current of human thought, so that retaliation is not any longer the basis of an enlightened criminal code. As to protection, society has the same right as any individual in it. Fear has its legitimate use as a motive to human action. He who cannot be made to fear the consequences of evil-doing, is wrongly constituted, possibly insane, certainly void of conscience. Yet the deterrent influence of punishment upon those who experience it is greatly exaggerated. There is in human nature a propensity to self-destruction, or reckless disregard of consequences that impels men to run terrible risks to gratify passions, particularly those which are unlawful and injurious. No degree of severity will ever put an end to crime. The prison protects as long as the criminal is there; in a sense, it is a substitute for death and for banishment; but here the only sure protection is imprisonment for life; but no government will ever authorize its indiscriminate application to all grades of offenders, no matter how incorrigible they may be. There are many, even among the officers of prisons, who oppose imprisonment for life of any man, however heinous his crime, on the ground that it deprives him of hope and reduces him to a condition resembling a living death. Further, we have no right to commit any one to a prison in which the discipline is not essentially reformatory. The worst man in liberty may fall under good influences and be changed; but to put him where influences are wholly bad, cannot be justified, especially where the sentence is for life. In any reformatory system the co-operation of the prisoner must be had. The strongest sentiment in his breast is the hope of release, and the indeterminate sentence makes the best use of this sentiment. The prisoner should be told that the date of his liberation depends upon himself, and the experienced prison officer is the one to decide this. The difficulties here are no greater than in the care of the insane. The utterly incorrigible should be put where they can do no harm as violators of law, or as teachers or examples to the young. Methods for the repression and prevention of crime should be Christian and scientific.

The Criminal, by HAVELOCK ELLIS. New York, 1890. pp. 337.

The author modestly says, that he believes there is nothing original in his book; that it simply represents a very large body of intelligent opinion in many countries. He has, however, in the introduction and conclusion well stated his own belief, resultant from a study of many and different sources. This book treats of those questions which have to do with the criminal as he is, and with society in relation to him, taking up also the practical social bearings of such studies. There are six divisions of criminals: the political criminal, criminal by passion, insane criminal, the instinctive, the habitual, and the professional criminal. The political criminal is the victim of an attempt, by a more or less despotic government, to preserve its own stability. The aims of such a criminal may be anti-social; he may try to overthrow a certain political order, which may itself be anti-social. Lombroso calls him "the true precursor of the progressive movement of humanity." From the scientific point of view, the use of the word crime to express a difference of national feeling or political opinion is an abuse of language. The criminal by passion is generally a man of wholesome birth and honest life, who under the stress of some great unmerited wrong has wrought justice for himself. For instance, if his wife be grossly insulted, he makes an attempt on the life of the offender. This species of criminal never becomes a recidivist; his crime is a solitary event in his life; he is not, therefore, dangerous to society; but he is not of advantage to society when in a moment of passion he commits his crime, and he must not complain if he produces a social reaction. The insane criminal is one, who, already in a condition of mental alienation, commits some serious anti-social act. Instinctive propensity to crime is called "moral insanity," but "instinctive criminal" is a better term; such an one is a moral monster; he does not possess guiding or inhibiting social instincts as an antidote to his strong sensual and self-seeking impulses. There is the occasional criminal, of whom weakness in resisting temptation is the chief characteristic. The occasional criminal, aided by neglect on the one hand and by the prison on the other, can develop into a habitual criminal; and by gradual steps the habitual criminal can become the professional criminal. Thus in the thefts in the Parisian shops, the Louvre and the Bon-Marché, the experience of the police shows how it begins: A woman, rich or well-to-do, buys a number of things and pays for them; but without asking permission, she takes some little, almost insignificant object, a little ribbon to fasten a parcel, a more commodious paper bag. No one will say that she is stealing. But she is observed, for one expects to see her again, some time after, taking as she walks along a flower, worth five cents say. A little later she will appropriate something of greater value, and thereafter she will take for the pleasure of taking.

The friends of a man are startled by his great crime; but this is linked to a chain of slight occasional sporadic vices and offences. Those links can sometimes be traced out. Lebiez, in company with another French criminal, murdered an old woman in order to rob her, cutting the body up to dispose of it. The crime was prepared deliberately and carefully; a few days after it Lebiez delivered an able lecture on Darwinism and the Church. Here are the stages: (1) His violent language to his mother is remembered; (2) though with small means, he lives with a mistress and procures obscene photographs; (3) he is sent away from an institution where he gave lessons on account of irregularities; (4) he speculates on the stock exchange, which, being poor, he could only do by accepting profit and refusing to meet loss; (5) he steals books from his friends and sells them; (6) he leaves his lodgings several times clandestinely, without paying the rent; (7) he participates in stealing a watch; (8) he shows the profits of the second theft; (9) he with another decides on the murder of the old woman, whose earnings by the sale of milk were considerable. The habitual criminal is usually not intelligent, while the professional is. Lacenaire, a celebrated criminal at the beginning of this century, has been regarded as a typical professional criminal. He was born at Lyons; received a good average education; was very intelligent, though not distinguishing himself at college; he was ambitious, but incapable of sustained work; studied law in Paris, but his resources were inadequate, so became a clerk, frequently changing his situation; growing tired of work, he engaged as a soldier. So far no offence is recorded. When he returned to France, his father had become bankrupt, and fled. Friends gave Lacenaire $100 to help him. He hastened to Paris and spent it for pleasure; then he wrote verses and political articles, fighting a duel and killing his opponent. He said later that the sight of his victim's agony caused him no emotion. He might have obtained money had he cared to work steadily, but he got it by theft and swindling. Condemned to prison, he formed connections with professional criminals, adopted false names, multiplied forgeries and disguises, and preyed actively on society. After an orgy of this kind he committed murder, and attempted to murder a man who had won a large sum from him in gambling. The crime and the attempt both remained unpunished. He continued his career of crime until he met the guillotine. He was a professional, habitual, and something of an instinctive criminal.

The causes of crime can be cosmic; this includes the influences of inorganic nature, of weather; thus the increase of crimes of violence in hot weather, and the periodicity of other kinds of crime; the influence of climate and of diet. They can be biological, which head includes the personal, anatomical, physiological and psychological characteristics of the individual. There is the social factor, as treated of in criminal sociology; and with it belong the relations between crimes against the person and the price of alcohol; and crimes against property and the price of wheat. Society prepares crimes, as Quetelet said; the criminal is the instrument that executes them. "Every society has the criminals it deserves." The general conclusion of the author is, that crime is a natural phenomenon, and to be studied by natural methods, by which alone its elimination can have any chance of success.

But the public look at a criminal as a hero. In Lacenaire's case his portraits were displayed on the streets; meats and delicate wines were sent to his cell, while those driven to crime by hunger outside are but a step from him. Men of letters visited him, noted all he said, whether composed in drunkenness or given for effect; but the ladies, young, beautiful and finely attired outdid them all, desiring the honor to be presented to him; and in despair if not permitted. Lacenaire himself mocked at the infatuation he excited. They come to me, he said, "as they would ask a ticket from M. Geoffrey Saint-Hilaire to see the elephant's den." But the criminal is simply a feeble or distorted person, who has chanced, most often from lack of human help, to fall out of the social ranks. It is unreasonable and inhuman for a whole nation to become excited over him. Only education and a rational knowledge of criminality can change this sort of craze. As is well known, crime has been on the increase during the whole of the present century. In France, says Ellis, it has risen several hundred per cent.; so also for several kinds of serious crime in many parts of Germany; in Spain the number of imprisonments for life nearly doubled between 1870 and 1883; in the United States the criminal population has increased since the war relatively to the population, one third. Although certain factors may enter in to modify this real increase somewhat, yet there is a general agreement as to the fact of increase. Great Britain alone appears to be an exception; but there is a real increase in proportion to the population, in the more serious kinds of crime. Crimes of passion are rarer in the Anglo-Saxon race in England, Scotland and America than anywhere else. The decrease is in minor offences, and is due in large measure, no doubt, to reasons connected with the police.

Criminality, like insanity, waits upon civilization. Among primitive races insanity is rare; true criminality is also. Conservatism and the rigid cult of custom are as much a barrier to crime as they are to progressional civilization. When there is stress and change in social surroundings, ill-balanced natures become more frequent, and the anti-social instincts are called out more than in stagnant society. Irish criminality is far greater in England than at home. While the Americans are more criminal than the English, the criminality of the English-born in the United States is more than double that of native American whites. Thus criminality, like insanity, flourishes among immigrants, and our civilization is bringing us into the position of immigrants. But there is no reason for discouragement, for social facts, of which criminality is one, are most under our control. The problem is not isolated. It is a waste of time to talk about methods of improving criminals so long as life outside of prison makes life inside of prison a welcome shelter. So long as we foster the growth of the reckless classes we foster the growth of criminality. Thus it is that crime is *par excellence*, a sociological question.

B.—Charitological.

The relation between crime, alcoholism and pauperism is so intimate —indeed an unmixed case of any one of them is the exception—that the consideration of one involves all.

De l'Assistance, compte rendu officiel (in extenso) du congrès international tenu à Paris en 1889. 2 vols, pp. 560 and 774.

The international congress of public relief, of which this is the report, was held under the patronage of the French government at Paris from July 28 to August 4, 1889. The congress favored the guaranteeing of public relief by law to the temporarily indigent; the provision of medical attendance so far as practicable by the lowest governmental division to which the patient belongs, commune, parish, etc.; the equalization of such burdens among the governmental divisions, so that the richer communes, etc., shall help the poorer, under the general supervision of the state. Destitute children should be placed in suitable families, and the pay of those having charge of them should not be too small. The aid of disinterested women living near where the children are placed should be engaged in looking after them. Legal guardianship of children morally abandoned is to be secured, and in their subsequent treatment some regard is to be had to the circumstances in which they are found. Places are to be provided for the care and instruction of poor children during the working hours of their parents, and special schools for those unsuited for the ordinary schools. Children that cannot be rescued by the family method should be placed in institutions where they may receive special training.

The second volume contains the reports of the four sub-sections of the congress: 1, On public relief in general; 2, On charities for children; 3, On hospitals and home relief; 4, On the insane, the poor house, etc. In Section 1 it was contended that obligatory public assistance must be justified, efficacious, preventive, and neutral in religion. In Section 2 the benefits of dispensaries to children and the public were shown, and an administrative plan for the supervision of guardianship was developed. Section 3 resolved in favor of professionally trained nurses in hospitals and better treatment of them with a view to improving the *personnel* of this branch, also schools for their training. In Section 4 Dr. Bourneville supported the establishment, by the larger governmental divisions, of institutions for defective children. Dr. Kéraval advocated provisional release of certain of the insane, under asylum supervision, for the mutual benefit of themselves and the asylums. At the suggestion of Dr. Magnan the following resolutions were voted: That the asylum should be considered as an instrument of cure and treatment; that aside from the asylum, family care and agricultural colonies should be developed as much as possible, to avoid the embarrassment of the asylums. (3). That the attending physician should indicate the classes of patients, who are in a state to receive family care, and that he should have the oversight of the agricultural colonies. At the end of the second volume is a very complete and methodical bibliography of over 300 pages on public and private assistance in France and other countries.

Die ländliche Armenpflege und ihre Reform. Verhandlungen des deutschen Vereins für Armenpflege und Wohlthätigkeit, von F. Frhr. von Reitzenstein. Freiburg, i. B., 1887. pp. 405.

The German Society for Poor Relief and Charity, has developed in detail a plan for rural poor relief. Seyffardt-Crefeld in a report on the organization of such poor relief makes the following points: 1, Legal establishment of adequate charity societies; 2, Application in the country of the principles of relief approved by experience in the city; 3, A good system of poor relief is one, which, instead of paying as cheaply as possible for temporary or continued need, strives to educate the poor to self-help, and to prevent their continued need of help; 4, The best system is the individual one, which with the co-operation of the state, guarantees a thorough treatment of every case. The conclusions of the congress as a whole have to do with matters of administration, the general aim of which seems to be to turn over to the larger communal associations those functions which call for large expenditure and technical information and to reserve for those associations which stand closer to the people needing help those functions which are individual and variable in their nature, together with sufficient financial interest to secure hearty co-operation. The larger governmental divisions can also best care for the sick and defective that are treated in institutions, and for work-houses.

Prosperity or Pauperism, edited by the EARL of MEATH, LORD BRABAZON. London, 1888. pp. 342.

Although one of the titles of this book is pauperism, a reader will find little about this subject, but a great deal concerning those reforms in education, which would be most powerful antidotes to poverty. It is painfully obvious at present that education prepares us little for actual life. The agricultural school does not make farmers, the average college course produces a sort of non-descript or intellectual tramp. This condition of things has its influence on crime as well as pauperism. College graduates, physicians, lawyers, (and sometimes theologians even) are found in almost every prison. Poor training makes the struggle for existence more severe, and temptations to certain forms of crime more difficult to resist. The educated classes are also more sensitive to deprivations. The outcome of many of these struggles, if not suicide, is crime. This book is a republication in a cheap and popular form of recent papers on educational reforms especial prominence being given to technical education. The editor believes in physical, technical and industrial training in the common schools. The young are entitled to start in life with healthy bodies, with a knowledge of things as well as of books, with the power of using their hands as well as their heads, and of making the most of all their resources. With such reforms the future generation would find itself in a much superior position to that of the present, which being nourished mainly on intellectual food, finds its body starved and its hands paralyzed.

We may add, that, strange as it may seem, such reforms as the editor mentions, are being tested best in some penal reformatory institutions, and perhaps one of the benefits of such institutions to the state, their benefactor, is to serve as a sort of laboratory, where educational and sociological experiments can be performed and tested, as a preliminary precaution to their introduction into society in general. For if they succeed with weak men that are criminals, they ought to succeed with weak men that are not criminals.

The Tribe of Ishmael, a study in social degradation, by Rev. OSCAR C. MCCULLOCH. Reprint from the proceedings of the 15th National Conference of Charities, July 1888.

This study is an investigation, after the manner of Dugdale's "Jukes," of some of the pathological phases of pauperism. It extends over two hundred and fifty known families, thirty of which have been taken out as typical cases. The name, "The Tribe of Ishmael," is taken from the name of the central, the oldest, and the most widely ramified family. This family first appears in Indianapolis about 1840. The original family stem, of which we have scant records as far back as 1790, was then in Kentucky, having come from Maryland through Pennsylvania. Ben Ishmael had five sons and three daughters; some of the descendants are now living in Kentucky and are well-regarded citizens. One son John married a half-breed woman, and came into Indiana about 1840; he was diseased; he had seven children, of whom two were left in Kentucky; the remaining three sons married three sisters from a pauper family named Smith. These had children, of whom thirteen reared families, having sixty children, of whom thirty are now living in the fifth generation. This family has had a pauper record since 1840; having been in the Almshouse, House of Refuge, Woman's Reformatory, the penitentiaries, and has received continuous aid from the township. They are intermarried with the other members of this group, and with over two hundred other families. In the history of this family are murders, and many illegitimate children and prostitutes; they are generally diseased; the children die young. They live by stealing, begging, ash-gathering, and "gypsying" in summer; they have been known to live in hollow trees, on river bottoms and in empty houses; yet they are not intemperate to excess. A second typical case is that of the Owens family; there were originally four children of whom two have been traced, William and Brook. William had three children who reared pauper families, in which there is much prostitution, though little intemperance. Brook had a son John, who was a Presbyterian minister. He [Brook?] reared a family of fourteen illegitimate children, ten of whom came to Indiana; their pauper record begins about 1850. Of the ten, three reared illegitimate families in the fourth generation; and of these, two daughters and a son have illegitimate children in the fifth generation. These are two typical cases; any other one of the thirty could have been taken. We start at some unknown date with thirty families. Out of 62 of the first generation, we know certainly of only three; in the second generation we have the history of 84; in the third generation, of 283; in the fourth generation (1840–60), of 644; in the fifth generation, (1860–80) of 679; in the sixth generation, (1880–90) of 57. Here is a total of 1750 persons; of these we know of 121 prostitutes and many criminals, including a number of murderers. The author shows by statistics the expense which such persons as these are to society, their physical unsoundness, their fostering by unwise charity, and points out as the things to be done: 1, Close up official out-door relief; 2, Check private and indiscriminate benevolence, or false charity; 3, Get hold of the children.

First Annual Report of the New York State Commission in Lunacy for 1889; BY C. F. MACDONALD, G. BROWN, H. A. REEVES and T. E. MCGARR, Commissioners.

A practical view of insanity, and the method of treatment from the point of view of the State, together with the difficulties involved in the combination of insanity and pauperism, is brought out in this report. The insane should be separated from other objects of the State's charities. It is improper to class the major part of the insane cared for at public expense as "pauper insane." Seventy-five per cent. of those so classed are not paupers in any true sense of the word. Insanity being a long disease, confinement being necessary, and the friends of the patient being very often not more than able to support themselves, difficulties are quite evident. The real pauper, who is insane, is not free to leave his surroundings, if they are unsatisfactory. It is evident that such cases should be treated in a specially organized hospital, that is both custodial and curative.

The reasons for the large numerical increase of insanity are: (1) a steady growth of population, and large annual influx of foreign immigration with its undue proportion of mentally defective persons; (2) a wider knowledge of insanity, which brings to light a numerous class of mild cases that formerly were not regarded as proper subjects for care; (3) realization of the fact that insanity is a disease and needs treatment; (4) the duration of insane life is greater under modern methods; (5) the reported number of admissions to asylums misleads, because some are re-admissions and others patients transferred from other institutions, (It is probable also that the baneful practice of committing recent cases to county alms-houses, where they are detained without proper treatment, either permanently or until chances of recovery have greatly lessened, increases the number); and finally, (6) much greater care is used in enumerating the insane than formerly.

Some of the recommendations of the committee are as follows: That the discharge of patients from custody be vested solely in the medical officers. That laws that divide the insane into "acute" and "chronic" be repealed; and that all insane be treated solely with reference to their curability. That the insane State paupers bear a different method of treatment from that given to the sane State paupers. That an asylum be provided for the helpless and unteachable idiots.

Notes on the Statistical Determination of the Causes of Poverty. A. G. WARNER. American Statistical Association. March, 1889.

The following are some of the conclusions of the writer: The method of case-counting is likely to exaggerate subjective influences as compared with objective; thus the immediate cause of poverty may be deterioration of character, the primary cause environment. Confusion arises also from the fact that under exactly similar conditions, some families are destitute and some not. From Mr. Booth's statistical tables of East London, we find that casual laborers comprise but 4.8 per cent. of the whole population, but more than 41 per cent. of "the very poor"; that families having female heads include 3.7 per cent. of the whole population, but furnish more than 11 per cent. of "the very poor," and more than 6 per cent. of "the poor." Mr. Booth says, that intemperance is a contributing cause in many cases where it cannot be reckoned the principal one; that the poverty of the poor is mainly the result of the competition of the very poor. The entire removal of this class out of the daily struggle for existence is the only solution of the problem of poverty. Turning to our own country, Mr. Kellogg, from figures gleaned from the reports of about forty charity organization societies in our leading cities, finds in New York and Boston, that the percentage of those needing work, rather than relief, has been 53.4, and of the unworthy, 15.8. One third of the cases actually treated were in need of material assistance, for which friendly counsel or restraint could not compensate. A logical application to the whole country is that two thirds of its real or simulated destitution could be stopped by a more perfect adjustment of the supply and demand for labor, and a more vigorous and enlightened police administration. Dugdale concludes from his study of the Jukes that environment is the primary cause, and heredity is an organized result of invariable environment.

In an article entitled "Scientific Charity," in the *Popular Science Monthly* for August, 1889, Dr. Warner illustrates the importance of the empirical method, as applied to charity. Scientific charity, as opposed to pure emotional philanthropy, regards poverty as an evil to be assailed in its causes; it does not merely pity poverty, but studies it. Thirty-four charity organization societies, representing cities containing one-eighth of our population, and probably one-sixth of its pauperism reported at the National Conference in 1887. From careful estimates, it is supposed that these cities contained about 456,000 paupers. Over 62 per cent. of this number actually came under the charge of these societies, that is, they had 57,000 families, containing about 285,000 persons, to deal with. Twenty-five of these societies agreed in classifying under four heads. By careful analysis of nearly 28,000 cases, including over 100,000 persons, the results were as follows:

Those needing continuous relief,	10.3 per cent.
" " temporary "	26.6 " "
" " work rather than relief,	40.4 " "
Unworthy of relief,	22.7 " "

As an example of the value of more elaborated figures, the results of the Buffalo society are given, on a basis of 1407 families, including 5388 persons. The chief cause of destitution was lack of employment in 263 cases; sickness in 326; no male support in 373; intemperance in 124; physical defects in 113; insufficient earnings in 87; accidents in 45; imprisonment of bread-winner in 35; shiftlessness in 26; and insanity in 15. Out of these 1407 destitute families, the respective heads of 1019 of them could both read and write; 49 others could read, but not write; and 339, or 24 per cent. were wholly illiterate. It is interesting to recognize that by this method, the philanthropist, with the principle of enlightened self-sacrifice finds himself in accord with the economist, with his enlightened self-interest.

Endowed Charities. COURTNEY KENNY. London, 1880. pp. 280.

One of the objects of the author is to make his book useful as well to politicians, who may take part in charitable reforms, as to charity trustees or benevolent persons, who in planning charitable gifts, may desire to enhance their liberality by a wise prescience. The materials are taken chiefly from the Blue-books of the last sixty years. The conclusions of the author are: That endowed charities have done more good than harm, and should be encouraged. Foundations in themselves are usually good, but left to themselves, usually become bad; there must be constant supervision and periodical revision. The one will restrain the principle of caducity, the other will counteract the principle of obsolescence. A considerable minority of foundations either spring from a bad origin or tend to a bad result. Lest this minority should be increased, the law must impose certain restrictions on the establishment of new foundations.

The Tramp at Home, by LEE MERIWETHER. New York, 1889.

The author has spent some time in the old world as well as in the new, in gathering labor statistics. The results of investigations in this country are given in this book. But the dry figures are clothed with incidents, amusing and otherwise, that befell the author in his intercourse with the working classes. Although the book is popular in its style, yet it is not without interest to a more serious study of sociological questions. The author seems to consider present society as in an abnormal state; and, however one may regard this point of view, he is still made conscious of how all questions of social pathology (crime, pauperism, etc.) are inseparably linked together. The sociologists and statisticians show the crowded condition of the poor in cities, low wages, high cost of living, and sewing and saleswomen working fourteen and sixteen hours a day for pittances scarcely sufficient to support life. The working men are generally told, in order to be happy and prosperous that they should organize, co-operate, be educated, practice temperance, economy and industry. To these admonitions in themselves there are no objections. But they are all makeshifts; they only remedy evils already created, but do not go to the heart of the matter and seek to prevent the evil. When women that are sober, intelligent and economical, work from early morning till late at night, and still actually hunger for bread, the plea that education, temperance and economy are the preventives, falls to the ground. Why will sewing-women, cloak-makers, and others, work for three dollars a week? Is it not because of the over-supply of labor? Because our cities are teeming with unemployed labor? The problem primarily resolves itself into that of counteracting and preventing abnormal concentration of population in cities. In 1780 less than a thirtieth of our population lived in cities of eight thousand and over. In 1880, nearly one-fourth of the population lived in cities of eight thousand and over. The Federal Government has said to the farmer, for a great part of our national existence, manufacturing is not profitable; farming pays well; we will take part of your profits to make up the manufacturer's deficit. This puts a premium on manufacturing (going to cities) and a penalty on farming, which has become unprofitable; so the farmers move into the city and increase the competition. The first preventive then is to cease governmental premiums to cities and penalties to farmers. The second preventive is a graduated land-tax, with its expected train of benefits. The day will come, says the author, when every citizen will be able to retain and enjoy the wealth he himself has created. In that day both the billionaire and the tramp will go.

Scientific Charity, by MRS. GLENDOWER EVENS, Conference of Charities and Correction, 1889.

This paper gives many practical suggestions as to the meaning and methods of scientific charity and the working of Charity Organization Societies. When the wise methods here described shall have become the common property of the people, as they are now of specialists in charitology, charity will at last be both sane and kind.

Social Problems. DANIEL CLARK, M. D. Address read before the Association of Executive Health Officers of Ontario, Aug. 17, 1888.

We have here a doctor's views on very practical questions plainly stated. He speaks of tramps, divorce, the selection of proper partners in wedlock, prostitution and diseases which attend it, and lastly inebriety. The unanimity with which the need of some remedy would be acknowledged would probably equal the diversity of opinion on some of the remedies suggested, though none of them are unheard of. The doctor does not hide his belief that the short-livedness of drunkards and criminals is a beneficent elimination of the unfit, and, since in a degree they attain the pleasure at which they aim, not so very hard upon them either.

C.—ALCOHOLOGICAL.

Inebriism, a pathological and psychological study. T. L. WRIGHT, M. D. Columbus, O., W. G. Hubbard, 1885. pp. 222.

To the credit of American physicians and the discredit of American citizens, the study of "Inebriism" is here no novelty. Among those who have been active in bringing about a rational conception of Inebriety as a disease, and of special hospital treatment as a cure, Dr. Wright holds a prominent place. In this book he sets forth in fashion to be understood by the non-professional reader, the information which the neurologist and alienist has to contribute to the effect of alcohol on the nervous system and the mind. The book is not hortatory, but expository, and therefore the more effective; the author is at more pains to show the limited responsibility of the drunkard than to fix the responsibility for his condition. In the inebriate, as in the sufferer from cerebral disease, nature is making experiments in physiological psychology for all to see, and the psychologist will find matter of interest in Dr. Wright's analyses and in the cases which he cites in illustration.

L' ivress au congrès pénitentiaire de Saint-Pétersbourg. Revue de l'hypnotisme, 1er juillet, 1890.

The following resolutions, coming from an International Congress, may indicate, to some extent, the general consensus of opinion in Europe, as to drunkenness. The fourth International Penological Congress, which assembled in July, 1890, considered the question of inebriety and penal legislation. After a long discussion of six sittings, the first section of the congress presented the following resolutions, which had been adopted by the Congress in its general meeting, the 19th of June: 1. Drunkenness considered in itself would not constitute an offense; it gives cause for repression only when manifested publicly, in dangerous conditions to security, or by acts of a scandalous nature, or likely to disturb the peace. 2. Legislative action is useful in the care of drinkers who become a charge on public benevolence, dangerous to themselves or others. 3. Licensed dealers should be made penally responsible for the sale of strong liquors to persons manifestly drunk. 4. In case of offenses committed in drink: (*a*) The state of drunkenness does not complete, nor in any case exclude responsibility; this state cannot be defined by the legislator as an attenuating or aggravating circumstance, but its influence depends on each particular case. (*b*) The state of drunkenness does involve responsibility, at least before the law, in the following cases: (a) when drunkenness constitutes by itself a penal offense; and (b) cases of *actiones liberas in causa*, when a person becomes drunk knowing that in the state of inebriety he will or can commit a crime; in the first case, he renders himself responsible for an offense committed with premeditation; in the second case, for an offense committed by negligence.

De la dipsomanie et son traitement par la suggestion, par le Dr. EDG. BÉRILLON, Revue de l'hypnotisme, août, 1890.

The treatment and cure (temporary at least) of one who has been a hard drinker for fifteen years, is a case in hypnotic therapeutics worthy of consideration. We extract points from the writer's lecture. Patient 35 years old, robust, muscular, intelligent, successful in business; parents sober and healthy. Learned to drink in the army, drinking wine and whiskey, sometimes in considerable quantity, but without drunkenness. On leaving the army he exchanged whiskey for absinthe; his business, which involved travelling, encouraged his drinking, but he had little inclination to drink when at home. At last, signs of physical trouble appeared, together with nightmare, hallucination, delusion of persecution, and idea of suicide. These returned every month or two with irresistable craving for drink, which scattered his good resolutions. He was also an inveterate smoker. On May 3, 1888, he was hypnotized, and dreamless sleep and total abstinence from liquors and tobacco were suggested. The suggestion was successful. He was under treatment from May 3 to May 15, the hypnotization and suggestion being repeated daily at first. By degrees physical troubles were helped and his desire to drink and smoke removed. He found himself able to resist under circumstances in which before he would have inevitably yielded. On May 15 he was pronounced cured and discharged. After thirteen days of treatment, without isolation, continuing to walk the streets of Paris, he saw all his physical and mental troubles successively disappear, and his inveterate habit of drinking and smoking cease.

Hérédité et alcoolisme. Dr. LEGRAIN. Revue de l'hypnotisme 1er Mars, 1890.

There are three main characteristics in alcoholism: the mental state, the impulsions and the tendency to delirium at the slightest cause. The degenerate are more susceptible than those who are of well-balanced mind. Alcoholic delirium differs in its symptoms from that of drinkers with no defects. In hereditary cases drunkenness comes in a short time; once started it assumes forms which recall its nature and predisposition. Alcoholic delirium of the predisposed does not resemble that of the stereotyped delirium. The rigors of intoxication and the rigors of hereditary predisposition have a certain independence. The slowness of evolution, frequence of relapsing, feebleness of mental faculties, polymorphism of delirium characterize the alcoholism of the degenerate. Inveterate abuse of drinking in non-hereditarily disposed persons creates a degeneracy like the hereditary. Organic physical resistance diminishes as excess increases. Alcohol causes its special delirium; little by little it simply plays the roll of an *appoint*. In a large number of cases the man is not free not to drink.

La responsabilité des alcooliques. M. MOTET. Revue de l'hypnotisme, 1er août, 1889.

There is no fixed jurisprudence in France as to responsibility in alcoholism. In civil matters alone, when drunkenness of the contracting party has been established at the time of the contract, the contract is annulled. Drunkenness has in these conditions been made like to a state of dementia. One class comprehends simple drunkenness, accidental or provoked, and in some cases premeditated. To this class belong drinkers by habit, who without showing the troubles characteristic of drunkenness, are always under the influence of alcohol. A second class concerns all forms of pathological drunkenness, partially acute or acute mental troubles, or chronic troubles due to intoxication. In this class are the insane, imbecile, epileptic, whom alcoholic excess can lead to the most dangerous acts, by awakening impulsive tendencies which otherwise would not be awakened. Drunkenness is punishable as well as crimes committed under its influence, when the delinquent has the power to avoid it; when the alcoholic excitation has been sought in order to give one enough determination to commit a crime. Drunkenness is punishable in an attenuated degree in cases of feeble intelligence, in which intolerance for liquor is shown by an inferior cerebral organization; they are not excusable when they know they cannot drink without danger; such cases are more numerous than is generally supposed. Crimes cannot be punished if committed during an acute or sub-acute period of delirium in an alcoholic paroxysm. It is also the same in chronic alcoholism, when cerebral lesions have affected the integrity of the organ. The individual should be put under treatment.

The Public and the Doctor in Relation to the Dipsomaniac, by Dr. DANIEL CLARK. Toronto, 1888. pp. 20.

The writer brings out clearly the sociological side of alcoholism, showing how the State is responsible for many of its drunkards. He mentions a practical and suggestive prophylaxis. There are four classes of drunkards: 1. Those who drink from a habit of tippling; 2. Those who drink to relieve nervous prostration, or to drown sorrow or wrong; 3. Those who drink from hereditary tendency; 4. Traumatic drunkards. The tipplers are usually of three kinds: a, The weak-willed; b, The genial; c, The mean-souled man, who delights to "sponge" on others. Those who become drunkards by nightly potations to relieve mental trouble are more numerous than supposed. This drunkenness has no excited stage, and the habit may go on without being noticed for years. The nocturnal drunkard will take a small dose in the morning to throw off the stupidity of the nightly debauch and to appear as usual before the public. But this has its limits, and paralysis, apoplexy or insanity may result. This class usually belongs to our active members of society. Such nightly stupefactions are more fatal to mental integrity than any other form of drinking. In heredity it is the nervous bias which is transmitted, which can be aroused suddenly or may lie latent for years. The paroxysms come intermittently, like the periodic insanities. The hereditary foe may be overcome by daily battles, but not by isolated ones. Persons of this class have an unusually nervous condition, irregular circulation, low nutrition, morbid fears, irritable temper, lack of resolution (foreign to the individual in health); even misconceptions and delusions may supervene when the attack is coming on. During these bouts of drinking mania the man is uncontrollable. We may eliminate from the large number of defectives in society those who could reform if they would only try, but yet a large number remain, on whom no influence, social or religious, has any effect. There is no help for those but enforced restraint in special asylums, where they can have work, air, amusement and homelike treatment. These should be as unprisonlike as possible, and the State should provide them. The author, apparently is not averse to prohibition, and failing that would have the revenue from licenses devoted to the care of the inebriates produced.

IV.—PSYCHIATRY.

The Insanity of Jean Jacques Rousseau.

William Noyes, M. D.

J. J. Rousseau's Krankheitsgeschichte. P. J. Möbius. Leipzig, F. C. W. Vogel, 1889.

Rousseau. John Morley. London, Macmillan & Co., 1886.

The Confessions of J. J. Rousseau. Hédouin Edition.

The part played by mental disease in religion in the past has been a tremendous one, and is coming to be recognized more year by year, but the part that insanity has taken in political movements, although it has been considerable, has not been so well understood. In Rousseau the two rôles of reformer in religion and in politics were united as perhaps they have been in no other one individual, for we are still in ignorance of what will be the end of that battle for human freedom which began under his leadership over a century ago. That Rousseau was insane is generally, if not universally admitted, but the period of disease is usually limited to the latter years of his life when the disorder became patent to every one from his accusations against Hume. That Rousseau was insane all his life might be thought a thesis impossible to maintain; but as a matter of fact, his life as set forth in the Confessions and Reveries, with the side lights thrown on these by other writers and commentators, forms as perfect a clinical picture of a well recognized form of mental disease as there is in literature. The literature of psychiatry in itself contains nothing that approaches this in accurate description of symptoms, analysis of character, and the persecutions suffered by a chronic lunatic.

During the past few years there has been a great and rapid increase of Rousseau literature, as more and more attention has been paid to the remote causes of movements that are now going on among us.

Dr. Möbius has written the history of Rousseau's disease more fully than it has ever been written before, and has given the story of the evolution of his malady from its very beginnings. His book is of special interest to the alienist, as he discusses many points of a purely medical interest. Mr. Morley has also written a history of Rousseau's disease, which is all the more valuable because of the author's ignorance that the details he gives and the criticisms he makes tell with such deadly force against his subject. Morley protests that he does not wish to turn poor Rousseau over to the pathologists too soon, but in fact he turns him over to them from the moment of his birth. It is but fair that before we make Morley turn pathologist we should give him a chance as historian to state the case for Rousseau, and he does this so vigorously and so brilliantly that all must acknowledge the debt that humanity is under to the poor sufferer.

"The Revolution is now the accepted name for a set of changes which began faintly to take a definite practical shape, first in America and then in France, towards the end of the eighteenth century; they had first been directly prepared by a small number of energetic thinkers, whose speculations represented, as always, the prolongation of some old lines of thought in obedience to the impulse of new social and intellectual conditions. . . . . Rousseau was the most directly revolutionary of all the speculative precursors, and he was the first to apply his mind boldly to those of the social conditions which the revolution is concerned by one solution or another to modify. How far his direct influence was disastrous in consequence of a mischievous method we shall have to examine. It was so various that no single answer can comprehend an exhaustive judgment. His writings produced that glow of enthusiastic feeling in France, which led to the all-important assistance rendered by that country to the American colonists in a struggle so momentous for mankind. It was from his writings that the Americans took the ideas and the phrases of their great charter, thus uniting the native principles of their own direct protestantism with principles that were strictly derivative from the protestantism of Geneva. Again, it was his work more than that of any other one man, that France arose from the deadly decay that had laid hold of her whole system, and found that irresistable energy that warded off division from within and partition from without. We shall see, further, that besides being the first immediately revolutionary thinker in politics, he was the most stirring of reactionists in religion. His influence formed not only Robespierre and Paine, but Chateaubriand, not only Jacobinism, but the Catholicism of the Restoration. Thus he did more than any one else at once to give direction to the first episodes of revolution, and force to the first episode of reaction. . . . . The personality of Rousseau has most equivocal and repulsive ideas. It has deservedly fared ill in the esteem of the saner and more rational of those who have judged him, and there is none in the history of the famous men and our spiritual fathers who begat us, who makes more constant demands on the patience or pity of those who study his life. Yet in no other instance is the common eagerness to condense all predication about a character into a single unqualified proposition so fatally inadequate. . . . . We may forget much in our story that is grievous or hateful, in reflecting that if any man now deems a day basely spent in which he has given no thought to the hard life of garret and hovel, to the forlorn children and trampled women of wide squalid wildernesses in cities, it was Rousseau who first in our modern time sounded a new trumpet note for one more of the great battles of humanity. It was in Rousseau that polite Europe first harkened to strange voices and faint reverberations from out of the vague and cavernous shadow in which the common people move. Science has to feel the way towards light and solution, to prepare, to organize; but the race owes something to one who helped to state the problem, writing up in letters of flame at the brutal feast of kings and the rich that civilization is as yet only a mockery, and did furthermore inspire a generation of men and women with the stern resolve that they would rather perish than live in a world where such things can be."

Humanity is indeed under a great debt to the man of whom all these things are true, and it will help us to a more charitable view of him to study the conditions under which he did his work, and how handicapped he was from his birth. Morley tells Rousseau's life-history so vividly, and analyzes and sums up his character so justly, that we shall allow him to tell the story in large part, with comments from time to time on what the signification is to the mental pathologist.

Jean Jacques Rousseau was born in Geneva in 1712. His mother was the daughter of a Geneva minister; she was possessed of much sensibility, was fond of drawing and music, was well read and made verses. "I cost my mother her life," wrote Rousseau, "and my birth was the first of my woes." The child was born dying, and was saved only by the affectionate care of a paternal aunt, but his constitution remained infirm and disordered. There was no known tendency to mental disease on his mother's side; but on the father's side there was an hereditary taint. Rousseau was born with a congenital malformation of the bladder, but Möbius does not think that this can with certainty be looked on as a sign of degeneration. There is no evidence of any other signs of physical degeneration. "The father of Rousseau," says Morley, "was unfortunately cast in the same mould as his mother, and the child's own morbid sensibility was stimulated and deepened by the excessive sensibility of his first companion. . . . . Isaac Rousseau's restlessness, his eager emotion, his quick and punctilious sense of personal dignity, his heedlessness of ordered affairs, were not common in Geneva, fortunately for the stability of her society and the prosperity of her citizens. This disorder of spirit descended in modified form to the son; it was inevitable that he should be indirectly affected by it. Before he was seven years old he had learnt from his father to indulge a passion for the reading of romances. The child and the man passed whole nights in a fictitious world, reading to one another in turn, absorbed by vivid interest in imaginary situations until the morning song of the birds recalled them to a sense of the conditions of more actual life, and made the elder cry out in confusion that he was the more childish of the two."

"I had no idea of real things," Rousseau wrote, "though all the sentiments were already familiar to me. Nothing had come to me by conception, everything by sensation. These confused emotions striking me one after another, did not warp a reason that I did not yet possess, but they gradually shaped in me a reason of another cast, and gave me bizarre and romantic ideas of human life, of which neither reflection nor experience has ever been able wholly to cure me."

After the romances they read Plutarch, Tacitus and Ovid, and Rousseau, at the age of ten, actually conceived himself to be the Greek or Roman hero of whom he read. That his after life was ever clouded by the evil knowledge he acquired at school, and by the abnormally early birth of the passions, must be freely admitted. But his school life is also memorable in an agreeable manner, for it is possible to trace back to that period his resistance to injustice and wrongful suffering. He was placed under suspicion of having broken the teeth of a comb that did not belong to him. Severe punishment followed, but without bringing out an untrue confession of guilt. "The first sentiment of violence and injustice has remained so deeply engraved on my soul that all the ideas relating to it bring my first emotion back to me; this sentiment, though only relative to myself in its origin, has taken such consistency and become so disengaged from all personal interest, that my heart is inflamed at the sight or story of any wrongful action, just as much as if the effect fell on my own person. When I read of the cruelty of some ferocious tyrant, or the subtle atrocities of some villain of a priest, I would fain start on the instant to poinard such wretches, though I were to perish a hundred times for the deed. . . . . This movement may be natural to me, and I believe it is so; but the profound recollection of the first injustice suffered was too long and too fast bound up with it, not to have strengthened it enormously. . . . . Here was the term of the serenity of my childish days. From this moment I ceased to enjoy a pure happiness, and I feel even at this day that the reminiscence of the delights of my infancy comes to an end. . . . . Even the country lost in our eyes that charm of sweetness and simplicity which goes to the heart; it seemed sombre and deserted, and was as if covered by a veil, hiding its beauties from our sight. We no longer tended our little gardens, our plants, our flowers. We went no more lightly to scratch the earth, shouting for joy as we discovered the germ of the seed we had sown."

"Whatever may be the degree of literal truth in the confessions," says Morley, "the whole course of Rousseau's life forbids us to pass this description by as overcharged or exaggerated. We are conscious in it of a constitutional infirmity. We perceive an absence of healthy power of resistance against moral shock. Such shocks are experienced in many unavoidable forms by all save the dullest natures, when they first come into contact with the sharp tooth of outer circumstance. . . A vehement objective temperament like Voltaire's is instantly roused by one of these penetrative stimuli into angry and tenacious resistance. . . . . A sensitive or depressed spirit like Rousseau's or Cowper's finds itself without any of these reacting kinds of force, and the first stage of cruelty or oppression is the going out of a divine light."

It would be hard to find, outside a treatise on insanity, a better description of the neuropathic temperament that foredooms its possessor to a life of unstable equilibrium and almost inevitable mental disease.

After leaving school he spent three years with an uncle in Geneva, losing his time for the most part, but learning something of drawing and something of Euclid.

At the age of eleven he was placed in a notary's office, but was dismissed by his master for dullness and inaptitude; being pronounced stupid and incompetent past hope by his fellow clerks. He was next apprenticed to an engraver. The roughness and coarseness of this man completely demoralized Rousseau, and he sank into a moral slough, telling lies, pilfering things to eat, using his master's best tools by stealth. His master was very cruel, and punishments for these offences produced an overmastering physical horror. In his sixteenth year he ran away.

Making his way to Savoy, he was kindly received by a Catholic priest who was an active proselyter. Rousseau agreed to receive instruction in the matters of the Catholic religion, and was sent by the priest to a Madame de Warens, who in her turn sent him to a monastery in Turin, where, exactly nine days after his admission, he "abjured the errors of the sect." The interest of the priests ended with his conversion, and he was set adrift with twenty francs. His wanderings do not concern us, but one incident throws a lurid gleam on his moral condition at this time. He had been a footboy in the household of a widow, and on her death a piece of ribbon was missing; Rousseau had stolen it, and it was found in his possession, but he accused a young maid of giving it to him, and repeated the story in her presence before the whole household. The dread of suffering was doubtless the cause of this baseness, but it shows the extent of the degeneration that was going on within him. He afterwards lamented greatly his unjust accusation, and as usual probably overestimated the evil that befell the maid in consequence of his accusation. A period of six weeks' wandering followed, when he obtained another position as lackey, but was dismissed for reckless neglect of duty. Once more he becomes a vagrant, and in the company of a companion starts homeward. Morley quotes Rousseau as saying, in words which shed more light on darker parts of his history than fits of vagrancy,—"To understand my delirium at this moment it is necessary to know to what a degree my heart is subject to get aflame with the smallest things, and with what force it plunges into the imagination of the object that attracts it, vain as this object may be. The most grotesque, the most childish, the maddest schemes come to caress my favorite idea, and to show me the reasonableness of surrendering to it."

Rousseau's youth properly ends here. His wanderings ended by his being received again by Madame de Warens, and the history of his connection with her belongs to his biography and not especially to the history of his disease, except that all that followed while he was with her was made possible by his temperament and by the vacillating weakness, emotionality and sensibility shown in his growth from boyhood to youth.

We shall let Morley characterize him at this period, just before he comes under the influence of Madame de Warens: "A vagrant sensuous temperament, strangely compounded with Genevese austerity; an ardent and fantastic imagination, incongruously shot with threads of firm reason; too little conscience and too much; a monstrous and diseased love of self, intertwined with a sincere compassion and keen interest for the great fellowship of his brothers; a wild dreaming of dreams that were made to look like sanity by the close and specious connection between conclusions and premises, though the premises happened to have the fault of being profoundly unreal: this was the type of character that lay unfolded in the youth who towards the autumn of 1729 reached Annecy, penniless and ragged, throwing himself once more on the charity of the patroness who had given him shelter eighteen months before. Few figures in the world at that time were less likely to conciliate the favor or excite the interest of an observer who had not studied the hidden convulsions of human character deeply enough to know that a boy of eighteen may be sly, sensual, restless, dreamy, and yet have it in him to say things one day which may help to plunge a world into conflagration."

The years with Madame de Warens were the formative ones of his life. Here he acquired his knowledge of books, of the lives of the poor, and of the world's way with them. "Above all his ideal was revolutionized, and the recent dreams of Plutarchian heroism, of grandeur, of princesses, and of a new career full in the world's eye were replaced by a new conception of blessedness of life which never afterwards faded from his vision, and which has held a front place in the imagination of literary Europe ever since."

Rousseau was with Madame de Warens, including various intervals, until April, 1740. His mental condition during this time offers nothing especially noteworthy. The connection with Madame de Warens was broken off permanently when Rousseau was 28. Möbius places the first real outbreak of insanity in 1766, when Rousseau was 54, and last twelve years until his death in 1778. The twenty-six years between 1740 and 1766 we may pass over with but one or two references to his mental condition. The first thing to note is the ease with which he placed his five children by Theresa le Vasseur in the foundling asylum, one after another. Möbius refrains from passing any judgment on these acts or their motives. In late years Rousseau tried to remedy this defect, but it was too late.

The circumstances under which he wrote many of his works are especially worthy of note in a study of his mental condition. First came the essay which gained the prize from the Academy of Dijon, *Has the restoration of the sciences contributed to purify or corrupt morals?* Walking in the road one day he saw in a newspaper the announcement of the theme propounded by the Dijon academy. "If ever anything resembled a sudden inspiration, it was the movement that began in me as I read this. All at once I felt myself dazzled by a thousand sparkling lights; crowds of vivid ideas thronged through my mind with a force and confusion that threw me into unspeakable agitation. I felt my head whirling in a giddiness like that of intoxication. A violent palpitation oppressed me; unable to walk for difficulty of breathing, I sank under one of the trees of the avenue, and passed half an hour there in such a condition of excitement that when I arose I saw that the front of my waistcoat was all wet with tears, though I was wholly unconscious of shedding them. Ah! if I could ever have written the quarter of what I saw and felt under that tree, with what clearness should I have brought out all the contradictions of our social system; with what simplicity I should have demonstrated that man is good naturally, and that by institutions only is he made bad."

This was years before the outbreak of insanity that was noticeable to all the world; but we here see another well marked sign of the neuropathic constitution. Rousseau's literary activity began with this ecstatic vision at the foot of the oak. Morley, who devotes more space to the incident than Möbius, admits that "such a transport does not come to us of cool and rational western temperament, but more often to the oriental after lonely sojourning in the wilderness, or in violent reactions on the road to Damascus and elsewhere. Jean Jacques detected oriental quality in his own nature, and so far as the union of ardor with mysticism, of intense passion with vague dream is to be defined as oriental, he assuredly deserves the name. The ideas stirred in his mind by the Dijon problem suddenly 'opened his eyes (it is Rousseau himself who is speaking), brought order into the chaos of his head, revealed to him another universe. From the active effervescence which this began in his soul came sparks of genius which people saw glittering in his writings through the ten years of fever and delirium, but of which no trace had been seen in him previously, and which would probably have ceased to shine henceforth if he should have chanced to wish to shine after the access was over. Inflamed by the contemplation of these lofty objects he had them incessantly present in his mind. His heart, made hot within him by the idea of future happiness of the human race, and by the honor of contributing to it . . . . dictated to him a language worthy of so high an enterprise . . . . and for a moment he astonished Europe by productions in which vulgar souls saw only eloquence and brightness of understanding, but in which those who dwell in the ethereal regions recognized with joy one of their own.'"

Rousseau counted this moment as the ruin of his life, and that all his misfortune flowed from this, and it may be that there were saner moments in which he recognized that here was the beginning of the trouble that afterwards completely shadowed his life.

For the next thirteen years he was completely mastered by his visions, and almost all his works were written under the influence of such ecstasies as he has described.

From 1744 to 1756 he was in Paris, and during this period his mental disease seems to have advanced but little. He had a position as a cashier in the receiver-general's department. Having an illness which his physicians thought would end fatally in six months, he threw up a position which would in time have made him rich, and undertook to gain his living by copying music. During this period he was reconverted to protestantism.

A new period of his life is marked by his residence at the Hermitage (1756), which was fitted up for him by Madame d'Epinay. Rousseau was never at home in the city,—"having (in Paris) been fifteen years out of my element,"—and his return to the country filled him with transports of delight. His arrival brought on what he truly called a "rural delirium," lasting some days, in which he was not able to do any work. "My very first care was to surrender myself to the impression of the rustic objects around me. Instead of beginning by arranging things inside my quarters I first set about planning my walks, and there was not a path, nor a copse nor a grove round my cottage which I had not found out before the next day." On attempting to work, he found this impossible; he was in such a state of exaltation due to his change to the country. "This exaltation was in a different direction from that which had seized him half a dozen years before, when he had discarded the usage and costume of polite society, and had begun to conceive an angry contempt for the manners, maxims and prejudices of his time. Restoration to a more purely sensuous atmosphere softened this austerity. No longer having the vices of a great city before his eyes, he no longer cherished the wrath which they had inspired in him. 'When I did not see men I did not despise them, and when I had not the bad before my eyes I ceased to hate them. My heart. little made as it was for hate, now did no more than despise their wretchedness and their badness. This state, so much more mild if less sublime, soon dulled the glowing enthusiasm that had long transported me.' That is to say, his nature remained for a moment not exalted but fairly balanced. And in studying the movements of impulse and reflection in him at this time of his life, we are hurried rapidly from phase to phase. Once more we are watching a man who lived without either intellectual or spiritual direction, swayed by a reminiscence, a passing mood, a personality accidentally encountered, by anything except permanent aim and fixed objects, and who would at any time have surrendered the most deliberately pondered scheme of persistent effort to the fascination of a cottage slumbering in a bounteous landscape. Hence there could be no normally composed state for him; the first soothing effect of the rich life of the forest and garden on a nature exasperated by the life of the town passed away, and became transformed into an exaltation that swept the stoic into space, leaving sensuousness to sovereign and uncontrolled triumph, until the delight turned to its inevitable ashes and bitterness."

These ecstacies usually took place in the woods, where, accompanied by his dog, he used to go "in search of some wild and desert spot in the forest, where there was nothing to show the hand of man or to speak of servitude and domination; some refuge where I could fancy myself its discoverer, and where no inopportune third person came to interfere between nature and me. My imagination did not leave the earth thus superbly arrayed without inhabitants. I formed a charming society of which I did not feel myself unworthy; I made a golden age to please my own fancy, and filling up these fair days with all the scenes of my life that had left sweet memories behind, or all that my heart could yet desire or hope in scenes to come, I waxed tender even to shedding tears over the true pleasures of humanity, pleasures so delicious, so pure, and henceforth so far from the reach of man. Ah, if in such moments any ideas of Paris, of the age, of my little aureole as author, came to trouble my dreams, with what disdain did I drive them out, to deliver myself without distraction to the exquisite sentiments of which I was so full. Yet in the midst of it all, the nothingness of my chimeras sometimes broke sadly upon my mind. Even if every dream had suddenly been transformed into reality it would not have been enough; I should have dreamed, imagined, yearned still."

He conceived several literary schemes after the first fermentation which followed his arrival was over, but gave them up one after another, and although the effort was partly successful, it was followed by a severe and prolonged crisis. "The impossibility of reaching to real beings plunged me into the land of chimera, and seeing nothing actual that rose to the height of my delirium, I nourished it in an ideal world, which my creative imagination had soon peopled with beings after my heart's desire. In my continual ecstasies, I made myself drunk with torrents of the most delicious sentiments that ever entered the heart of man. Forgetting absolutely the whole human race, I invented for myself societies of perfect creatures, as heavenly for their virtues as their beauties; sure, tender, faithful friends, such as I never found in our nether world. I had such a passion for haunting this empyrean with all its charming objects, that I passed hours and days in it without counting them as they went by; and losing recollection of everything else, I had hardly swallowed a morsel in hot haste, before I began to burn to run off in search of my beloved groves. If, when I was ready to start for the enchanted world I saw unhappy mortals coming to detain me on the dull earth, I could neither moderate nor hide my spleen, and, no longer master over myself, I used to give them greeting so rough that it might well be called brutal."

An attack of physical disease happily brought these raptures to a close for the time. "The moment he could get out of doors again into the forest," says Morley, "the transport returned, but this time accompanied with an active effort in the creative faculties of his mind to bring the natural relief to these over-wrought paroxysms of sensual imagination. He soothed his emotions by associating them with the life of personages whom he invented, and by introducing into them that play and movement and changing relation which prevented them from bringing his days to an end in malodorous fever. His thought became associated with two female figures, one dark and the other fair, one sage and the other yielding, one gentle and the other quick, analogous in character but different, not handsome but animated by cheerfulness and feeling. To one of these he gave a lover, to whom the other was a tender friend. This vicarious or reflected egoism, accompanied as it was by a certain amount of productive energy, seemed to work a return to a sort of moral convalescence. He walked about the groves with pencil and tablets, assigning this or that thought or expression to one or other of the three companions of his fancy." When the winter came on he was confined to the house by the bad weather, and he attempted to resume his music copying and the compilation of his Musical Dictionary, but he found this impossible, as he could see nothing but the three figures and the objects about them made beautiful by his imagination. He could not dismiss them and resistance was vain, so he began arranging his thoughts "so as to produce a kind of romance." He could not write his romance on anything but the finest paper with gilt edges; the powder with which he dried the ink was of azure and sparkling silver, and he tied up the quires with delicate blue ribbon. Morley admits that the distance of all this from a state of nature is very great indeed. Rousseau appeared fully to recognize his inconsistency in writing a love romance; "after the severe principles I had just been laying down with so much bustle, after the austere maxims I had preached so energetically, after so many biting invectives against the effeminate books that breathed love, could anything be imagined more shocking, more unlooked for, than to see me inscribe myself with my own hand among the very authors on whose books I had heaped this harsh censure? I felt this inconsequence in all its force, I taxed myself with it, I blushed over it, but nothing could restore me to reason." Rousseau added that perhaps on the whole the composition of the New Heloïsa was turning his madness to the best account.

The ecstacies and transports of delirium that we have just witnessed were the conditions under which the New Heloïsa was begun, in the year 1757; it was finished in the winter of 1759–60. Rousseau was to suffer still further torments during the composition of this romance, but this time the visions were not mere impalpable shadows. The episode of his relations with Madame d'Houdetot was the cause of what Morley truly calls an outbreak of erotic mania. She visited his retreat disguised in male attire with results most disastrous to Rousseau's peace of mind. "A sort of palsy struck him. He lay weeping in his bed at night, and on days when he did not see the sorceress he wept in the woods. He talked to himself for hours, and was of a black humour to his housemates. When approaching the subject of this deadly fascination, his whole organization seemed to be dissolved. He walked in a dream that filled him with a sense of sickly torture, commixed with sicklier delight." Madame d'Houdetot remained faithful to her lover, Saint Lambert, but Rousseau's duplicity is well shown by a letter to Saint Lambert, after the affair had been noised abroad. "Is it possible that you can have suspected me of wronging you with her, and of turning perfidious in consequence of an unseasonably rigorous virtue? A passage in one of your letters shows a glimpse of some such suspicion. No, no, Saint Lambert, the breast of J. J. Rousseau never held the heart of a traitor, and I should despise myself more than you suppose, if I had even tried to rob you of her heart."

Both Saint Lambert and Madame d'Houdetot were exceedingly kind to Rousseau throughout the whole affair, which shows Rousseau in a very bad light. It should not be forgotten, however, in drawing a balance between the good and evil in his character at this time that he was suffering tortures from a painful physical disorder. His brooding and egoistic character made it impossible for him to master his pain and rise superior to it. Rousseau had always been unsocial, but now he became bitter, irritable and suspicious. We are approaching the period of his quarrels with Grimm, Madame d'Epinay and Diderot, and it is but right that he should give his own account of his temperament at this time: "In my quality of solitary I am more sensitive than another; if I am wrong with a friend who lives in the world, he thinks of it for a moment, and then a thousand distractions make him forget it for the rest of the day; but there is nothing to distract me as to his wrong toward me; deprived of my sleep, I busy myself with him all night long; solitary in my walks, I busy myself with him from sunrise until sunset; my heart has not an instant's relief, and the harshness of a friend gives me in one day years of anguish. In my quality of invalid, I have a title to the considerateness that humanity owes to a man in agony. Who is the friend, who is the good man that ought not to dread to add affliction to an unfortunate wretch tormented with a painful and incurable agony?" Into the details of these quarrels it is not possible to enter here, nor to attempt to settle just how much Rousseau himself was to blame for the troubles that ensued. Grimm had disapproved of Madame d'Epinay's installing Rousseau in the Hermitage, and had warned her that solitude would darken his imagination,—"He is a poor devil who torments himself, and does not dare to confess the true subject of all his sufferings, which is in his cursed head and his pride; he raises up imaginary matters, so as to have the pleasure of complaining of the whole human race." He assures her several times that Rousseau would end by going mad, it being impossible that so hot and ill-organized a head should endure solitude.

The misunderstandings and quarrels reached such a pitch at last that Rousseau left the Hermitage on Dec. 15, 1757, and moved to a cottage at Montmorency. Ten days before this Diderot went to visit him. Rousseau cried out on seeing him, "What have you come here for?" "I want to know whether you are mad or malicious." "You have known me for fifteen years; you are well aware how little malicious I am, and I will prove to you that I am not mad: follow me." He then tried to clear himself, by means of letters, of the charge of trying to make a breach between Saint Lambert and Madame d'Houdetot, but the letters in fact convicted Rousseau of trying to persuade Madame d'Houdetot of the criminality of her relations with her lover, and at the same time to accept himself in the very same relation. Diderot remonstrated, but to no avail, and that night he wrote to Grimm, "I throw myself into your arms like one who has had a shock of fright; that man [Rousseau] intrudes into my work; he fills me with trouble, and I am as if I had a damned soul at my side. May I never see him again; he would make me believe in devils and hell."

Here closes another chapter of Rousseau's pathetic life, and we may let Morley sum up the story,—"And thus the unhappy man who had begun this episode of his life with confident ecstacy in the glories and clear music of spring, ended it looking out from a narrow chamber upon the sullen crimson of the wintry twilight and over fields silent in snow, with the haggard desperate gaze of a lost spirit."

The period that opened at Montmorency was the most productive one of his life. Within three years from the time of the moral maladies we have been witnessing, Rousseau "had completed not only the New Heloïsa, the monument of his fall, but the Social Contract, which was the most influential, and Emilius, which was perhaps the most elevated and spiritual, of all the productions of the prolific genius of France in the eighteenth century." Rousseau completed the New Heloïsa in 1759, and published it in 1761; he published the Social Contract in the spring of 1762, and Emilius a few weeks later. For the last time in his life he was at peace with most of his fellows throughout this period. His new friends at Montmorency were the Duke and Duchess of Luxembourg, among the highest people in France, socially and politically.

We have seen the state of mental storm under which the New Heloïsa was begun, and now it was to be finished in this period of quiet and serenity. We might expect to find a great difference between the two halves of the romance, knowing how all important his surroundings were on all that Rousseau produced, and such in fact is the case. Morley thinks it curious that "while the first half of the romance is a scene of disorderly passion, the second is the glorification of the family," but it is hard to see what else was to be expected. The New Heloïsa "helped to give a new spirit to an epoch. . . . . The women between 1760 and the Revolution were intoxicated to such a pitch that they would pay any price for a glass out of which Rousseau had drank; they would kiss a scrap of paper that contained a scrap of his handwriting, and vow that no woman of true sensibility could hesitate to consecrate her life to him if she were only certain to be rewarded by his attachment. The booksellers were unable to meet the demand. The book was let out at the rate of twelve sous a volume, and could not be detained beyond an hour. All classes shared the excitement, courtiers. soldiers, lawyers and bourgeois. . . . . In Germany the effect was just as astonishing. Kant only once in his life failed to take his afternoon walk, and this unexampled omission was due to the witchery of the New Heloïsa." In numberless indirect ways it brought the manners of the great into contempt, by presenting the happiness of a simple and worthy life, simple, self-sufficing, and homely; but "his book and its chief personage awoke emotion to self-consciousness, gave it a dialect, communicated an impulse in favor of social order, and then very calamitously divorced it from the fundamental conditions of progress, by divorcing it from disciplined intelligence and scientific reason."

Although the New Heloïsa contained so much that was revolutionary, it did not involve the author in trouble with the authorities, but this was soon to follow. Emilius was completed, and the preparations were made for publishing it. These had to be carried on with much secrecy owing to the severe repressive measures to which the book trade was then subject. One day the printing came to a standstill, and Rousseau was unable to get any reason for this. "Being unable to discover either the cause or manner of it, I remained in the most cruel state of suspense. I wrote letter after letter to Guy, to M. de Malesherbes, and to Madam de Luxembourg, and not receiving answers, at least when I expected them, my head became so affected that I was not far from a delirium. I unfortunately heard that Father Griffet, a Jesuit, had spoken of Emilius, and repeated from it some passages. My imagination instantly unveiled to me the mystery of iniquity. I saw the whole progress of it as clearly as if it had been revealed to me. I figured to myself that the Jesuits, furious on account of the contemptuous manner in which I had spoken of colleges, were in possession of my work; that it was they who had delayed the publication; that, informed by Guerin of my situation, and foreseeing my approaching dissolution, of which I myself had no manner of doubt, they wished to delay the appearance of the work until after that event, with an intention to curtail and mutilate it, and in favor of their own views, to attribute to me sentiments not my own. The number of facts and circumstances which occurred to my mind, in confirmation of this silly proposition, and gave it an appearance of truth supported by evidence and demonstration, is astonishing. I knew Guerin to be entirely in the interest of the Jesuits.

I attributed to them all the friendly advances he had made me; I was persuaded he had, by their entreaties, pressed me to engage with Néaul, who had given them the first sheets of my work; that they had afterwards found means to stop the printing of it by Duchesne, and perhaps to get possession of the manuscript to make such alterations in it as they should think proper, that after my death they might publish it disguised in their own manner. . . . . After having been afraid of the Jesuits, I began to fear the Jansenists and philosophers. An enemy to party, faction and cabal, I never heard the least good of persons concerned in them. The gossips had quitted their old abode and taken up their residence by the side of me, so that in their chamber everything said in mine and upon the terrace, was distinctly heard, and from their garden it would have been easy to scale the low wall by which it was separated from my alcove. This had become my study; my table was covered with proof sheets of Emilius and the Social Contract, and stitching these sheets as they were sent to me, I had all my volumes a long time before they were published. My negligence and the confidence I had in M. Mathas, in whose garden I was shut up, frequently made me forget to lock the door at night, and in the morning I several times found it wide open; this, however, would not have given me the least inquietude had I not thought my papers seemed to be disarranged. After having several times made the same remark, I became more careful and locked the door. The lock was a bad one, and the key turned in it no more than half round. As I became more attentive, I found my papers in a much greater confusion than they were when I left everything open. At length I missed one of my volumes without knowing what was become of it until the morning of the third day."

There are those who date the first real outbreak of insanity from this time, and hold that Rousseau's suspicions of the Jesuits, then of the Jansenists and finally of the philosophers mark the foundation stones of the delusional system that he soon began to build. Möbius does not hold this opinion, but thinks that it is sufficient to say that Rousseau was physically sick, morbid, lonesome and irritable, and that indeed there were good grounds for his suspicions. However this may be, Rousseau's complaints at this time came perilously near the border line of systematized delusions, a border line that he was soon to cross. All this time he was suffering incessant pain, and passing his nights in sleeplessness and fever.

Emilius appeared at last, and with its appearance Rousseau became a persecuted wanderer, nevermore to enjoy peace or quiet. "On the 11th of June, 1762, the parliament of Paris ordered the book to be burnt by the public executioner, and the writer to be arrested. . . . The grounds of the proceedings were alleged irreligious tendencies to be found in the book." It was for the interest of Madame de Luxembourg and Malescherbes that Rousseau should escape arrest by flight, and he readily agreed to their plans. "After a tearful farewell with Theresa who had hardly been out of his sight for seventeen years, and many embraces from the greater ladies of the castle, he was thrust into a chaise, and despatched on the first stage of eight melancholy years of wandering and despair, to be driven from place to place," writes Morley, "first by the fatuous tyranny of magistrates and religious doctors, and then by the yet more cruel spectres of his own diseased imagination, until at length his whole soul became the home of weariness and torment."

Nothing could better illustrate Rousseau's introspective temperament and show how little hold the actual world had on him than that no sooner was he in the post-chaise than he again fell to musing over the tragic tale of the Levite of Ephraim, where his thoughts had been broken off by the circumstances that brought about his flight. Before the journey was ended he had composed a long and impassioned version of the Bible story. He has himself characterized his own temperament in this respect: "It is amazing with what ease I forget past ill, however fresh it may be. In proportion as the anticipation of it alarms me and confuses me when I see it coming, so the memory of it returns feebly to my mind and dies out the moment after it has arrived. My cruel imagination, which torments itself incessantly in anticipating woes that are still unborn, makes a diversion for my memory, and hinders me from recalling those that have gone. I exhaust disaster beforehand. The more I have suffered in foreseeing it, the more easily do I forget it, while on the contrary, being incessantly busy with my past happiness, I recall it and brood and ruminate over it, so as to enjoy it over again when I wish."

Rousseau reached the territory of the canton of Berne, where he had remained but a few days before he received word that the Council at Geneva had ordered Emilius and the Social Contract to be publicly burnt. This blow was soon followed by another, for within a fortnight he received notice that he must quit the canton of Berne within fifteen days. He fled into territory that was under the King of Prussia, who gave him permission to remain.

Rousseau lived very plainly and simply, and spent much of the time in botanizing, and on all these excursions he always went bareheaded, even in dog-days, declaring that the action of the sun did him good. He spent three years in this quiet valley, and during this time he adopted the Armenian costume, the vest, furred bonnet, the caftan and the girdle. This adoption of an odd costume is often put in evidence for the unsettling of Rousseau's mind, but too much importance might easily be attached to this circumstance, and we must remember that his physical disorder made such a dress peculiarly appropriate for him. The Duke of Luxembourg and his wife did not think that vanity and a desire to attract attention had anything to do with the adoption of the costume.

He was not allowed to enjoy his retreat in peace, but was attacked by the clergy, beginning with the Archbishop of Paris, and then by the minister of Motiers, who had at first felt highly honored when Rousseau came to his communion. How great a part Rousseau played in the politics of the time is seen from the fact that his condemnation in 1762 by the Council of Geneva had divided the city into two parties, the point at issue being political rather than religious; for "to take Rousseau's side was to protest against the oligarchic authority which had condemned him, and the quarrel about Emilius was only an episode in the long war between the popular and aristocratic parties." Rousseau answered his persecutors in the Letters from the Mountain (1764), and an examination of these letters shows how unjust and illegal was the treatment Rousseau received from the authorities of his native city.

These letters involved him in fresh troubles, for the parliament of Paris ordered the Letters from the Mountain to be burned. But this was not the end. In 1765 a terrible libel on Rousseau appeared, full of the coarsest calumnies. He wrongly attributed it to a Genevese pastor, and refused to believe the pastor's disavowal. The clergy then attacked Rousseau, and he was warned not to present himself at the next communion. Rousseau would have been excommunicated but for the intervention of the King's officials; but the pastor stirred up his flock against him, and the people were told that Anti-Christ was among them. The Armenian apparel added to the plausibility of this notion. His botanizing was thought to be for noxious herbs, and he was accused of poisoning a man who had died. A block of stone was placed so as to kill him if he opened the door, and at length an attempt was made one night to stone him in his house. This was too much for his fortitude and he fled from the valley on Sept. 10, 1765, having been there three years.

He sought the Isle of St. Peter, in the Lake of Bienne, but unfortunately this was under the jurisdiction of the canton of Berne, and after he had been there but a short time he was ordered to quit the territory within fifteen days. In this dire extremity he made the following extraordinary request. He wrote to the representative of the authorities: "In this extremity I see only one resource for me, and however frightful it may appear, I will adopt it, not only without repugnance, but with eagerness, if their excellencies will be good enough to give their consent. It is that it should please them for me to pass the rest of my days in prison in one of their castles, or such other place in their States as they may think fit to select. I will there live at my own expense, and will give security never to put them to any cost. I submit to be without paper or pen, or any communication from without, except so far as may be absolutely necessary, and through the channel of those who shall have charge of me. Only let me have left, with the use of a few books, the liberty to walk occasionally in a garden, and I am content. Do not suppose that an expedient so violent in appearance is the fruit of despair. My mind is perfectly calm at this moment; I have taken time to think about it, and it is only after profound consideration that I have brought myself to this decision. Mark, I pray you, that if this seems an extraordinary resolution, my situation is still more so. The distracted life that I have been made to lead for several years without intermission would be terrible for a man in full health; judge what it must be for a miserable invalid worn down with weariness and misfortune, and who has no wish save only to die in a little peace."

He was not allowed even this poor privilege, and after considering in turn Vienna, Normandy, Lorraine, Potsdam, Holland, Corsica and Berlin, it was finally determined by his friends that he should go to England, and on Dec. 17, 1765, he found himself in Paris on his way to London.

Rousseau was accompanied to England by David Hume, to whom Lord Marischal had told the story of his persecutions four years previous, and Hume had offered to find a refuge for him in England. On January 13, 1766, they reached London, and Hume's charge excited much interest and had much attention shown him in London. Rousseau was anxious to leave the capital, and after several changes he was finally settled at Wootton, in Derbyshire, in a house belonging to a Mr. Davenport.

He was entirely ignorant of the language, and was without companionship except that of Theresa, in whose conduct, even while they were at Motiers, Rousseau had thought he perceived a growing coolness. After two months of solitude at Wootton, a fierce quarrel sprang up between Hume and Rousseau, one of the most famous of the quarrels of distinguished men. We have seen how the ground was gradually being prepared for an outbreak of mental disease, and this was now to come.

Hume was accused of being a member of an accursed triumvirate, of which Voltaire and D'Alembert were the other members. Their object was to blacken Rousseau's character and render his life miserable. Two letters that had appeared gave Rousseau great pain; one was the letter to Dr. Pansophe, and the other the letter of the King of Prussia to J. J. Rousseau. In the first, Rousseau is characterized as an idle hypocrite; in it Voltaire's pen was recognized by everyone. The letter from the King of Prussia appeared while Hume and Rousseau were in Paris. It is as follows: "My dear Jean Jacques: You have renounced Geneva, your native place. You have caused your expulsion from Switzerland, a country so extolled in your writings; France has issued a warrant against you, so do you come to me. I admire your talents; I am amused by your dreamings, though let me tell you they absorb you too much and far too long. You must at length be sober and happy; you have caused enough talk about yourself by oddities which in truth are hardly becoming a really great man. Prove to your enemies that you can now and then have common sense. That will annoy them and do you no harm. My states offer you a peaceful retreat. I wish you well, and will treat you well if you will let me. But if you persist in refusing my help, do not reckon on my telling any one that you did so. If you are bent on tormenting your spirit to find new misfortunes, choose whatever you like best. I am a king and can procure them for you at your pleasure; and what will certainly never happen to you in respect of your enemies, I will cease to persecute you as soon as you cease to take pride in being persecuted. Your good friend, Frederick."

Rousseau at first suspected Voltaire of writing the letter, then D'Alembert; it was in reality written by Horace Walpole, to whom Rousseau had been introduced by Hume for the sake of entrusting some papers to Walpole to carry to England. Hume never told the world that the piece was a forgery, and he did not break with Walpole. It was horrible for Rousseau to think he had been deceived in Hume. He struggled against this view for a long time, but suspicion after suspicion developed, and finally the whole web became clear. He saw that he was the victim of a devilish plot. Repeated suggestions brought no answer from Hume, and Rousseau resolved to become explicit. On the 23d of June he wrote, "I know you, sir, and you know me. . . . Moved by your generosity I threw myself into your arms. You conducted me to England, apparently to furnish me with a refuge, but in reality in order to dishonor me. You devote yourself to this noble work with a zeal worthy of your noble heart, and a dexterity worthy of your powers."

At this attack Hume demanded explanations, and on July 10, 1766 Rousseau gave them in a long letter, the contents of which are somewhat as follows.

Rousseau realizes that he cannot furnish a judicial proof, his view depends entirely on his own conviction. He will openly and honorably relate the whole acquaintance, and call Hume's conscience to judgment, always speaking of Hume in the third person. He describes the beginning of their relations, their meeting together, their arrival in England, the brilliant reception in London, Hume's endeavors to procure him friends, and his other good acts. Hume had persuaded Rousseau to have his portrait painted, and taken pains to procure him a royal pension. Rousseau had declared that he would thankfully accept this pension, if Lord Keith would give his permission. Then followed the search for a residence and the settling at Wootton. "Then I thought that all my suffering had come to an end, but no, here it began to be more cruel than I had ever perceived." Rousseau narrates how since his arrival the tone of London has changed, how the journals follow him with scorn and sneers. "Since I am so accustomed to the fickleness of the public I do not wonder greatly at this abrupt change or over this singular unanimity, since not one of those who while absent made me so many promises has come forward and remembered me now that I am here. I found it odd that directly after the return of Mr. Hume, who enjoyed so great a reputation in London, who had so much influence with the authors and publishers, and who had such numerous associations, his presence should have had such entirely different consequences from what one would have expected from it, that not one of his friends should have showed himself to be one of mine. That those who spoke were not his enemies was clear since they praised his character." It had still further astonished him that in their personal intercourse his tone had become different. Hume's friends should have continually endeavored to show him attention, but the nature of their behaviour had changed.

Hume had made himself suspected through exaggerated flatteries, and had spoken insipid praises instead of the words of true friendship. In their intercourse Hume had given the impression that he did not wish so much to secure good will for Rousseau as assistance. Although Hume knew that Rousseau's pocket was not empty, yet more or less injurious offers were continually being made, as if Rousseau wished to live at the public cost. Yet let it be granted that this charity was offered with good intentions.

"Let us go still further. It is known that a false letter of the King of Prussia has appeared in Paris which is directed against me, and is full of the cruelest malice. I hear that this was written by a Mr. Walpole, a friend of yours. I ask if this is true, but instead of any answer Mr. Hume asks me from whom I know it. . . . . I understand that the son of that fool Tronchin, my deadliest enemy, is not only the friend and favorite of Mr. Hume, but even lives with him. Mr. Hume replies that this is true, but remarks that the son is not like the father. . . . . The letters that I write do not arrive; those that I receive have all been opened, and all pass through Mr. Hume's hands. If one escapes him he cannot conceal the burning desire to see it." Rousseau then cites an instance of Hume's desire to look over his letters. "After supper, as we were seated around the fire, I noticed that he looked at me fixedly, as was often the case with him, and in a way that is hard to describe. This time his dry, hot, mocking look made me more than restless. I tried to look at him in return, but as my eyes encountered his I felt an unaccountable shiver, and I soon had to cast mine down. The expression and the voice of the good David are those of a good man, but from where, good God, does this good man get the eyes with which he fixes his friends? The impression of that look remains and convulses me. My unrest increases to the point of consternation. . . . . Soon after I had some qualms of conscience, and in a moment of transport I threw my arms about his neck and closely embraced him, and called out with broken voice, 'No, no, David Hume is no traitor; were he not the best of men he would be the blackest of villains.' David returned my embrace heartily, and while he repeatedly patted my back, he kept saying, 'What, my dear sir! Oh! my dear sir! What is the trouble, my dear sir?' but said nothing beyond this. I felt as though my heart was cramped. Then we went to sleep, and on the morn I left for the provinces." He found no rest at Wootton. "Surrounded by the cruelest uncertainty, not knowing what I had to think of a man whom I loved so much, I tried to free myself from my horrible doubt, and to regain my trust in my benefactor. Why did he have externally so much zeal for my welfare while at heart he was planning my dishonor? Each individual fact was without such great importance, and it was only when taken together that they were so astonishing. Perhaps Mr. Hume could have given a satisfactory explanation. The great mystery was that he did not of himself offer the explanation which his honor and his friendship demanded."

At last Rousseau wrote a letter to Hume in which, on the one hand, he showed his gratitude, and, on the other, he could not conceal his disquiet. Hume in his answer had shown himself not at all disturbed; had written with cordiality of various things. "I was disturbed by this silence even more than I had been by his coolness in our last conversation. I was wrong; this silence after the other was very natural and I should have expected it, since if one dares to say to a man's face, 'I am tempted to consider you a villain,' and this man has not the curiosity to know why, then we must assume that he will not have such a curiosity during his whole life, and if the proofs do not in the least trouble him, then this man stands condemned." Rousseau now decides to break off his intercourse with Hume, and in this conclusion he became confirmed when he learned from Theresa that Hume had inquired about his circumstances. This curiosity of Hume's in wishing to know Rousseau's every source of income had disturbed him before, and so this questioning behind his back was doubly against him. A new thrust was given by acquaintance with the letter of the King of Prussia, and this was now printed in French and English in the journals. "Instantly a light came to me as to the secret source of the astonishing and speedy revolution in public feeling, and I beheld in Paris the seat of the plot that came to a head in London." He thought D'Alembert to be the author of the letter, and remembered that Hume had been much prepossessed with D'Alembert. "The reading of this letter disturbed me greatly, since I knew that I had been made the object of a plot, the execution of which had just begun, and the limits of which were unknown to me. After I had been decoyed to England I felt the danger without knowing where it lay or how I could guard myself. Then occurred to me the four terrible words of Mr. Hume, of which I will soon speak." The letter, to his mind, was designed to take away people's interest in him, and even to excite anger against him. "But my sorrow, the deepest and bitterest grief that I suffered was not from the danger by which I was surrounded. I had endured too much of this to be particularly moved by it. The treachery of a false friend, whose booty I was, filled my all too sensitive heart with dejection and deadly sorrow. In the violence of my first agitation, which I could not control, and which my skillful enemies wished to bring on, I wrote a letter full of incoherence, in which I did not conceal either my uneasiness or my rebellion." Rousseau then calls attention to the fact that certain letters written in his favor, the printing of which Hume wished to oversee, had not appeared, as the letter of Dupeyron on the occurrences at Motiers. "When the false letter of the King of Prussia and its translation appeared, I understood why the other writings had been concealed." He allowed an explanation to be printed in the journals, in which he energetically characterized that false letter as a coarse fraud and gave expression to his bitter feelings. "Up to this time Mr. Hume appears to have proceeded in the dark. From now on you shall see him go forward in the light and without covering. When that false letter of the King of Prussia was published in London, Mr. Hume, who without doubt knew that it was forged, since I had told him so, neither said nor wrote anything. He kept silence and did not once think to give an explanation of the true state of the case for the benefit of his absent friend. . . . . Since Mr. Hume had brought me to England he was in a certain sense my protector. If it was natural that he should defend me, so it was not less natural that I should turn to him first for a published protest. I turned to some one else. The first blow on the cheek of my patron." In his explanation Rousseau had said that no matter who the author was, he had accomplices in England, and that this circumstance had broken his heart.

Still another libel appeared. Rousseau did not take much notice of it, and the public too had become tired of these things. Hume came back to the matter of the royal pension, obtained this for Rousseau, and informed him of the honor of the King. Rousseau was thrown into the greatest embarrassment; if he accepted it, he would thus be receiving a favor from an enemy, whom he looked on as his betrayer; if he declined it, he would hurt the feelings of the King and appear to be a fickle, imperious and thankless man. He chose the expedient of writing to Gen. Conway, and in a somewhat involved manner expressed his thankfulness as well as his inability to accept. "Mr. Hume has mediated in the affair, and has conducted it alone. I did not answer him at all, and in my letter I said no word of him. The third blow on the cheek of my patron; . . . . he felt nothing of it." This was the time of the appearance of Voltaire's letter. While other acquaintances of Rousseau were mentioned in this, Hume's name was not mentioned at all. This surprised Rousseau and made him suspect that Hume had a share in the publication. Hume's friends were Rousseau's enemies, Tronchin, D'Alembert, Voltaire, and in London he had no other enemies except Hume's friends. "One discovers the web that has been spun in London since my arrival, and we shall see if it is not in Hume's hand that the threads are collected together. When finally the moment had come to strike the great blow, some one has prepared it by a new satirical composition." This piece convinced Rousseau fully and completely of Hume's faithlessness, since it showed designs that could only spring from him. It was said in it that Rousseau opened his doors to the great and shut them to the small; that Hume had guided Rousseau's entire course. Rousseau was cold towards his relatives; he had in Hume's presence coldly received a cousin. Rousseau was not only convinced that Hume had furnished the material for this composition, but also thought that Hume had done it with a view of letting Rousseau recognize his authorship, and thereby irritate him to anger. Hume struck the "great blow" by writing to Gen. Conway that the source of Rousseau's delay was the wish of the King that nothing be said about the pension, and as the General answered favorably, he sent a very friendly letter to Rousseau that he would receive the pension without that condition. "That was the deciding moment, the goal, the subject of all his endeavors. He wanted an answer. He wished it. Since I could not exempt myself from it he sent to Mr. Davenport an abstract of his letter, and not content with this precautionary measure, he wrote to me in another letter that he could no longer remain at my service in London. I almost fainted as I read this note." He now had the longed-for answer, and can triumphantly designate Rousseau as a monster of thanklessness. He had more, as he received from Rousseau an accusatory letter. "This stroke proves all and without contradiction." Rousseau once more goes through all the particulars cited by him, and comes to the conclusion that only a fool, and not such a sharp witted man as Hume could have deceived himself up to this time over Rousseau's apprehensions; that Hume, while he appeared unprejudiced and friendly, in spite of all his trustful signs in reality acted a part, since, while he continued showing kindness to Rousseau, he still pursued a hostile purpose. Hume must know that Rousseau did not esteem him, and that on this account he could receive no more favors from him. In spite of this he exerted himself in Rousseau's interest while pursuing a wicked plan. Hume said to himself: Now is the time for action, for, since I urge Rousseau to accept the pension, he must either accept it or send it back. If he accepts it, then I completely dishonor him with the proofs I have at hand. If he refuses it after he has formerly declared his willingness, and that pretext is withdrawn from him, then he must say why. That is what I wait for. If he accuses me he is lost. Only under the supposition of such a process of thought as this is Hume's course explicable to Rousseau. "The critical condition into which he had brought me reminds me of the four words I have mentioned before, and which I heard him speak and repeat at the time when I did not understand their significance at all. It was the first night of our journey from Paris. We were sleeping in the same room, and several times during the night I heard him call out in French with great vehemence, 'I have Jean Jacques Rousseau. I do not know whether he is awake or asleep.'" In spite of the fact that Rousseau interpreted the words at that time in a good sense, he was frightened at the tone in which they were spoken. "It was a tone of which I can give no idea and completely corresponded to the look which I mentioned earlier. Every time he spoke these words I felt a shudder that I could not master." He had forgotten the occurrence and it came to his mind again for the first time in Wootton. "These words, whose tones resounded in my heart as if they had just been spoken, the long and terrible looks which he directed at me so often, the striking of the back with the words · 'My dear sir,' as an answer to the suspicion that he was a traitor, all frightened me in view of the other things, to such a degree that these remembrances will banish forever all trust from my heart. There was not a night in which the words, I have Jean Jacques Rousseau, did not sound in my ears as if I heard them anew. Yes, Mr. Hume, you have me, I know it. All the prejudices are in your favor. . . . . It costs you nothing to let me appear as a monster, in the way you have already begun, and I already hear the barbaric rejoicings of my enemies," The public also is for Hume, since he can point to the services he has rendered Rousseau, and all will praise the one who has rendered the services, since they themselves would like to receive such. Intelligent people will indeed judge otherwise, but in this it matters little, and they are not of those who make a noise. Rousseau can only reckon on the consolation of his conscience. He will have the scorn of men, and to the end, in misfortune as well as in fortune, he will do that which he thinks honorable and right. "My body is weakened, but never was my soul stronger." He wonders that he has found the strength for this letter. "If one could die from grief I should have died at every line of this." Finally, he still leaves room for doubt. He sees a gulf on both sides. He is the unluckiest of men if Hume is guilty; he is the most contemptible if he is innocent. Still he will prefer the latter case. "If you are guilty, do not write me. . . . . If you are innocent, think it worth while to vindicate yourself. I recognize my duty. I love you and will continue to love you, hard as it may be. Once more, consider it worth while to justify yourself; if you are guilty, adieu forever."

The preceding extract quoted by Möbius from this long letter is necessary to give an idea of Rousseau's mental condition at this time, for here, beyond any doubt are the first marked signs of paranoia, the first indubitable evidence of insanity. It is not possible here to enter into a discussion of these charges against Hume. Without doubt Rousseau had some reason to be dissatisfied with Hume's coldness and failure to appreciate his feelings, but throughout the acquaintance Hume had shown himself to be a true friend to Rousseau and never to have had in mind anything but his good.

As not infrequently happens in delusions of persecution, there was a basis of fact for Rousseau's accusations, for Hume might have set matters right to some extent by publishing his knowledge of the falsity of the letter of the King of Prussia, yet the manner in which all the circumstances are twisted and perverted by Rousseau, and Hume's most innocent acts misinterpreted, and the complete web of a delusional system of persecution formed, all show the formal systematization of the delusions of a paranoiac. It was not in his condemnation of Hume that his morbidness lay, but in the fact that he saw in Hume's behavior and in almost everything that befel him in England the results of a deep laid plan, and recognized everywhere the conspiracy to injure him. Many of the circumstances are so easy to explain that Rousseau could not have misunderstood them without a morbid blindness. It is scarcely possible that even in Paris Rousseau should not have known how closely allied Hume was to all the literary celebrities, and also to his own enemies, Voltaire, D'Alembert, and others. Instead of wondering at the attacks which he suffered in London, Rousseau, to whom the methods of thought and influence of Voltaire were well known, should have recognized in the forged letter the natural reaction against his brilliant reception in London. It is not to be doubted at all that

Voltaire's envy and hatred were excited by the honor that had been shown Rousseau.

Möbius, from whom we have just been quoting, thinks it could scarcely have escaped Rousseau that his relations to his housekeeper gave offense to English society, and that on this account many people showed a different aspect after Theresa's arrival.

Möbius rightly assumes that the insane character of Rousseau's letter will be evident even to the laity, as well as the delusional character of the inferences and deductions with regard to the pension; of especial importance is the scene by the fireside, and Hume's calling out at night. To attach such secret importance to the looks and voice of suspected persons that these call forth an unaccountable shudder is the very essence of paranoia.

We shall see from now on, says Möbius, how in Rousseau's life there soon comes an ebb and flow of excitement, alternating with quiet. The strong excitement in Hume's case is the first wave. The storm lulled again, but what had arisen in him remained ever afterward the chief fact of his existence; the idea of a plot, as great as it was secret, of which he was the victim, was never absent from his mind. He remained convinced, also, that his judgment and treatment of Hume were completely right.

In commenting on Rousseau's condition at this time Möbius remarks that hallucinations appear never to have been present, and that his insanity consisted throughout in a false interpretation of actual occurences. On the other hand Rousseau's undoubted veracity is made evident by innumerable proofs, and there is no reason to doubt his actual statements. Indeed it is often hard to say where observation ceases and conclusions from the observation begin.

The quarrel with Hume was a great blow to Rousseau. Hume's "concise rejoinder" appeared, and Rousseau's "boundless pride," "unthankfulness," and "hypocrisy," became matters of common report. The French edition of the rejoinder appeared with a preface glorifying Hume, and it afterwards appeared that D 'Alembert had assisted in this. The great mathematician wrote later, "Jean Jacques is a wild beast that one dares to touch only behind iron bars, and with a stick."

In newspapers, pamphlets and letters, the hostility raged against Rousseau. He allowed the storm to roar away, sighed and kept silence. More and more he saw the number of his friends diminish. If the two ladies, Boufflers and Verdelin, had before this been objects of suspicion to him, since thy had brought about his connection with Hume, he now completely lost trust in them as they wrote him reproachful letters. And now, also, the one man whom he had cherished in the highest degree, and whom he had never before doubted, Lord Keith, appeared to turn away from him. One reads with painful emotion Rousseau's letter, in which with expressions of tender regard he implored his friend to give him some sign, but in vain; the marshal remained mute, and Rousseau had to give him up.

Deeply as these experiences wounded Rousseau, feeling as he did that he was destined to be "henceforth disgraced in the eyes of men, and to stand forth degraded," yet his elastic nature quickly recovered itself as the excitement died out. All his thoughts turned toward quiet; he wished to be forgotten by the world, and so far as he could, to forget it. Botany, which had before served him in time of trouble, again became his diversion. He would read only botanical books, and would speak only of plants with his friends.

In fair weather Rousseau was scarcely ever in the house, but in poor weather, and in the cold season of the year he busied himself, in addition to reading botanical books, in writing the memoirs of his youth. The plan of writing his life had been conceived at Montmorency, and with this object in mind he had examined and arranged his letters in Motiers, and as the papers were fortunately in England he began to write down his "Confessions." It cannot be doubted that from the beginning Rousseau had the idea of doing this in the way he actually did it. The attacks that had been made on his personal character, especially the abuse of the "*Sentiment des Citoyens*," had given him the idea of answering his enemies in this way, by showing himself in complete truth to nature, unveiled in evil as well as in good, so that if any one accused him of other badness he would be able to call such statements untruths.

As his introduction to the "Confessions" throws much light on his mind at this time, it may properly find a place here.

"I have entered on a performance that is without example, whose accomplishment will have no imitator. I mean to present my fellow-mortals with a man in all the integrity of nature; and this man shall be myself.

"I know my heart and have studied mankind; I am not made like any one I have been acquainted with, perhaps like no one in existence; if not better, I at least claim originality, and whether nature did wisely in breaking the mould with which she formed me, can only be determined after having read this work.

"Whenever the last trumpet shall sound, I will present myself before the Sovereign Judge with this book in my hand and loudly proclaim, thus have I acted; these were my thoughts; such was I. With equal freedom and veracity have I related what was laudable or wicked, I have concealed no crimes, added no virtues; and if I have sometimes introduced superfluous ornament, it was merely to occupy a void occasioned by defect of memory: I may have supposed that certain, which I only knew to be probable, but have never asserted as truth a conscious falsehood. Such as I was, I have declared myself; sometimes vile and despicable, at others virtuous, generous and sublime; even as Thou hast read my immortal soul, Power Eternal! Assemble round Thy throne an innumerable throng of my fellow-mortals, let them listen to my confessions, let them blush at my depravity, let them tremble at my sufferings, let each in his turn expose with equal sincerity the failings, the wanderings of his heart, and, if he dare, aver, *I was better than that man.*"

Of this introduction Morley says: "The exaltation of the opening page of the Confessions is shocking. No monk nor saint ever wrote anything more revolting in its blasphemous self-feeling. But the exaltation almost instantly became calm, when the course of the story necessarily drew the writer into objective facts, even muffled as they were by memory and imagination. The brooding over old reminiscence soothed him, the labor of composition occupied him, and he forgot, as the modern reader would never know from internal evidence, that he was preparing a vindication of his life and character against the infamies with which Hume and others were supposed to be industriously blackening them."

The condition of quiet which Rousseau enjoyed in his botany and in writing his "Confessions" continued until the spring of 1767. During the winter a misunderstanding had arisen between him and his host, Mr. Davenport, although but little is known with regard to the circumstances. At this time there were quarrels between Theresa and the servants, and this added to Rousseau's annoyance, and his agitation began to increase. He thought that his correspondence was everywhere watched, that he was everywhere surrounded by spies, and that his enemies were upon the point of taking possession of the manuscript of his "Confessions." He writes to Dupeyron: "On all sides I am in the snare, and am unable to bring myself out of it. In the hands of every-one, I can carry out no plan for freeing myself. Oh, miserable fate!

Oh, my friend, pray for me! It seems to me that I have not deserved the sufferings that bear me down."

To free him from the care of his papers Dupeyron asked an acquaintance to go to Wootton and take the writings in charge. Still Rousseau was not quieted. He had reached the conclusion that the people who brought and opened his letters, the postal authorities, and in short the whole world, were in the service of his enemies, and that it was designed to break off all intercourse with him and thereby to rob him not only of assistance, but even of sustenance.

Further residence at Wootton now became unbearable, and on the first of May he suddenly ran away with Theresa, leaving money, papers, and all else behind. After a fortnight Mr. Davenport received a letter from him dated at Spalding, in Lincolnshire.

Mr. Davenport sent a servant to Spalding to accompany Rousseau back, but before he reached there the poor creature had again disappeared. To the village parson he had appeared cheerful and good humored, and they had spent several hours in company each day. While in Spalding he wrote a long letter to the Lord Chancellor praying that he would appoint a guard at Rousseau's own expense to escort him in safety out of the kingdom where enemies were plotting his life. At Dover, where he was next heard of, he wrote a letter to Gen. Conway setting forth his delusion in full form. He is the victim of a plot; the conspirators will not allow him to leave the island, lest he should divulge in other countries the outrages to which he has been subjected here; he perceives the sinister manœuvres that will arrest him if he attempts to put his foot on board ship. But he warns them that his tragical disappearance cannot take place without creating inquiry. Still if Gen. Conway will only let him go he gives his word of honor that he will not publish a line of the memoirs he has written nor ever divulge the wrongs he has suffered in England. "I see my last hour approaching," he concluded; "I am determined if necessary to advance to meet it, and to perish or be free; there is no longer any other alternative." On the same evening that he wrote this letter he took boat and landed at Calais, where he seems at once to have recovered his composure.

We have followed Rousseau's career up to this point with considerable minuteness, and have attempted to show how one event logically followed another; how from birth he was the slave of his temperament, always yielding to the pleasant and agreeable, never choosing the harder part if it were to result in a loss of sensuous enjoyment. To the psychologist no historical character is more worthy of study; to the alienist the story of his life affords an unmatched clinical history of the evolution of systematized delusions of persecution. It is not possible here to follow in detail the further particulars of his mental disease, and the remaining events must be passed over rapidly.

After landing at Calais he was secretly conveyed by the Marquis of Mirabeau to Fleury, but remained here only a few weeks. Then he was installed by the Prince of Conti at Tyre, one of his country seats, where he went by the name of Renou.

Of the remaining years of his life we may let Morley speak, for he tells in striking language of the clouded life of a person suffering with chronic delusional insanity.

"Rousseau remained for a year at Tyre (June, 1767—June, 1768), composing the second part of the "Confessions," in a condition of extreme mental confusion. Dusky phantoms walked with him once more. He knew the gardener, the servants, the neighbors, all to be in the pay of Hume, and that he was watched day and night with a view to his destruction. He entirely gave up either reading or writing, save a very small number of letters, and he declared that to take up the pen even for these was like lifting a load of iron. The only interest he had was botany, and for this his passion became daily more intense. He appears to have been as contented as a child, so long as he could employ himself in long expeditions in search of new plants, in arranging a herbarium, in watching the germ of some rare seed which needed careful tending. But the story had once more the same conclusion. He fled from Tyre as he had fled from Wootton. He meant apparently to go to Chambéri, drawn by the deep magnetic force of old memories that seemed long extinct. But at Grenoble, on his way thither he encountered a substantial grievance. A man alleged that he had lent Rousseau a few francs seven years previously. He was undoubtedly mistaken, and was fully convicted of his mistake by the proper authorities, but Rousseau's correspondents suffered none the less for that. We all know when monomania seizes a man, how adroitly and how eagerly it colors every incident. The mistaken claim was proof demonstrative of that frightful and tenebrous conspiracy, which they might have thought a delusion hitherto, but which, alas, this showed to be only too tragically real; and so on, through many pages of droning wretchedness. Then we find him at Bourgoin, where he spent some months in shabby taverns, and then many months more at Monquin on adjoining uplands. The estrangement from Theresa, of which enough has been said already, was added to his other torments. He resolved, as so many of the self-tortured have done since, to go in search of happiness to the western lands beyond the Atlantic, where the elixir of bliss is thought by the wearied among us to be inexhaustible and assured. Almost in the same page he turns his face eastward, and dreams of ending his days peacefully among the islands of the Grecian archipelago. Next he gravely, not only designed, but actually took measures, to return to Wootton. All was no more than the momentary incoherent purpose of a sick man's dream, the weary distraction of one who had deliberately devoted himself to isolation from his fellows, without first sitting down carefully to count the cost, or to measure the inner resources which he possessed to meet the deadly strain that isolation puts on every one of a man's mental fibres. Geographical loneliness is to some a condition of their fullest strength, but most of the few who dare to make a moral solitude for themselves, find that they have assuredly not made peace. Such solitude, as South said of the study of the Apocalypse, either finds a man mad or leaves him so. Not all can play the stoic who will, and it is still more certain that one who like Rousseau has lain down with the doctrine that in all things imaginable it is impossible for him to do at all what he cannot do with pleasure, will end in a condition of profound and hopeless impotence in respect to pleasure itself.

"In July, 1770, he made his way to Paris, and here he remained eight years longer, not without the introduction of a certain degree of order into his outer life, though the clouds of vague suspicion and distrust, half bitter, half mournful, hung heavily as ever upon his mind. The Dialogues, which he wrote at this time to vindicate his memory from the defamation that was to be launched in a dark torrent upon the world at the moment of his death, could not possibly have been written by a man in his right mind. Yet the best of the Musings, which were written still nearer the end, are masterpieces in the style of contemplative prose. The third, the fifth, the seventh, especially abound in that even, full, mellow gravity of tone which is so rare in literature, because the deep absorption of spirit which is its source is so rare in life. They reveal Rousseau to us with a truth beyond that attained in any of his other pieces—a mournful sombre figure, looming shadowily in the dark glow of sundown among sad and desolate places. There is nothing like them in the French tongue, which is the speech of the clear, the cheerful, or the august among men; nothing like this sonorous plainsong, the strangely melodious expression in the music of prose of a darkened spirit which yet had imaginative visions of beatitude. . . . . Rousseau seems to have repulsed nearly all his ancient friends, and to have settled down with dogged resolve to his old trade of copying music. In summer he rose at five, copied music until half-past seven; munched his breakfast, arranging on paper during the process such plants as he had gathered the previous afternoon; then he returned to his work, dined at half-past twelve, and went forth to take coffee at some public place. He would not return from his walk until night-fall, and he retired at half-past ten. The pavements of Paris were hateful to him because they tore his feet, and, said he, with deeply significant antithesis, 'I am not afraid of death, but I dread pain.' He always found his way as fast as possible to one of the suburbs, and one of his greatest delights was to watch Mont Valérin at sunset. 'Atheists,' he said calumniously, 'do not love the country; they like the environs of Paris, where you have all the pleasures of the city, good cheer, books, pretty women; but if you take these things away, then they die of weariness.' The note of every bird held him attentive, and filled his mind with delicious images. A graceful story is told of two swallows who made a nest in Rousseau's sleeping-room, and hatched the eggs there. 'I was no more than a doorkeeper for them,' he said, 'for I kept opening the window for them every moment. They used to fly with a great stir round my head, until I fulfilled the duties of the tacit convention between these swallows and me.'"

In 1772 he became acquainted with Bernardin de St. Pierre, author of the immortal *Paul and Virginia*, and for a time their friendship was warm and cordial. St. Pierre has given some graceful pictures of Rousseau's life at this time. Of Rousseau himself he says: "He was thin and of middle height; one shoulder struck me as higher than the other . . otherwise he was very well proportioned. He had a brown complexion, some color on his cheek-bones, a good mouth, a well-made nose, a rounded and lofty brow, and eyes full of fire. The oblique lines falling from the nostrils to the extremity of the lips, and marking a physiognomy, in his case expressed great sensibility and something even painful. One observed in his case three or four of the characteristics of melancholy—the deep receding eyes and the elevation of the eyebrows: you saw profound sadness in the wrinkles of the brow; a keen and even caustic gaiety in a thousand little creases at the corners of the eyes, of which the orbits entirely disappeared when he laughed."

All went smoothly for a time between the two friends, but finally St. Pierre shared the fate of his predecessors. Once more we will let Morley tell the story, and this time to the end. "Things did not continue to go thus smoothly. One day St. Pierre went to see him, and was received without a word, and with stiff and gloomy mien. He tried to talk but only got monosyllables; he took up a book, and this drew a sarcasm which sent him forth from the room. For more than two months they did not meet. At length they had an accidental encounter at a street corner. Rousseau accosted St. Pierre, and with a gradually warming sensibility proceeded thus: 'There are days when I want to be alone, and crave privacy. I come back from my solitary expeditions so calm and contented. There I have not been wanting to anybody, nor has anybody been wanting to me,' and so on. He expressed this humour more pointedly on some other occasion, when he said that there were times in which he fled from the eyes of men as from Parthian arrows. As one said who knew from experience, the fate of his most intimate friend depended on a word or a gesture. Another of them declared that he knew Rousseau's style of discarding a friend by letter so thoroughly that he could supply Rousseau's place in illness or absence. . . . . With Gluck he seems to have quarrelled for setting his music to French words, when he must have known that Italian was the only tongue fit for music. Yet it was remarked that no one ever heard him speak ill of others. His enemies, the figures of his delusion, were vaguely denounced in many dronings, but they remained in dark shadows and were unnamed. When Voltaire paid his famous last visit to the capital (1778), some one thought of paying court to Rousseau by making a mock of the triumphal reception of the old warrior, but Rousseau harshly checked the detractor. . . . . He was extremely poor these last eight years of his life. He seems to have drawn the pension which George III had settled on him, for not more than one year. We do not know why he refused to receive it afterwards. A well-meaning friend, when the arrears amounted to between six and seven thousand francs, applied for it on his behalf, and a draft for the money was sent. Rousseau gave the offender a vigorous rebuke for meddling in affairs that did not concern him, and the draft was destroyed. Other attempts to induce him to draw this money failed equally. Yet he had only about fifty pounds a year to live on, together with the modest amount he earned by copying music.

"The sting of indigence began to make itself felt towards 1777. His health became worse, and he could not work. Theresa was waxing old and could no longer attend to the small cares of the household. More than one person offered them shelter and provision, and the old distractions as to a home in which to end his days began once again. At length M. Girardin prevailed upon him to come and live at Ermenonville, one of his estates about twenty miles from Paris. A dense cloud of obscure misery hangs over the last months of this forlorn existence. No tragedy had ever a fifth act so squalid. Theresa's character seems to have developed into something truly bestial. Rousseau's terrors of the designs of his enemies returned with great violence. He thought he was imprisoned, and he knew that he had no means of escape. One day (July 2, 1778), suddenly, and without a single warning symptom, all drew to an end; the sensations which had been the ruling part of his life were affected by pleasure and pain no more, the dusky phantoms all vanished into space. The surgeons reported that the cause of his death was apoplexy, but a suspicion has haunted the world ever since that he destroyed himself by a pistol shot. We cannot tell. There is no inherent improbability in the fact of his having committed suicide. In the New Heloïsa he had thrown the conditions which justified self-destruction into a distinct formula. Fifteen years before he had declared that his own case fell within the conditions which he had described, and that he was meditating action. Only seven years before he had implied that a man had the right to deliver himself of the burden of his own life, if its miseries were intolerable and irremediable. This, however, counts for nothing in the absence of some kind of positive evidence, and of that there is just enough to leave the manner of his end a little doubtful. Once more, we cannot tell.

"By the serene moonrise of a summer night, his body was put under ground on an island in the midst of a small lake, where poplars throw shadows over the still water, silently figuring the destiny of mortals. Here it remained for sixteen years. Then amid the roar of cannon, the crash of trumpet and drum, and the wild acclamations of a populace gone mad in exultation, terror, fury, it was ordered that the poor dust should be transported to the national temple of great men."

V.—MISCELLANEOUS.

Erster Nachtrag zur Bibliographie des modernen Hypnotismus. MAX DESSOIR. Berlin, 1890. pp. 44.

The excellent bibliography published by this author in 1888 here receives a supplement carrying the literature up to May, 1890. This record of two years work contains no fewer than 382 references,—certainly an enormous, not to say an alarming increase. The plan of arrangement is precisely the same as that followed in the original bibliography. France still leads in the number of contributions, but Germany is not far behind. Thirteen languages and 113 periodicals (47 of them new ones) are represented in the bibliography. The author certainly deserves gratitude and credit for the able execution of a rather unpleasant task. J. J.

Laura Bridgman; Erziehung einer Taubstumm-Blinden. Prof. W. JERUSALEM. Wien, 1890. pp. 76.

There has not, it appears, been any adequate account of Laura Bridgman in German till the publication of this study. On the basis of Dr. Howe's reports and all the important publications concerning his pupil and his method of educating her, Prof. Jerusalem reviews her early life, her education, her sense perceptions, speech, thought, feelings and dreams, and also adds matter relating to other similar cases. Though we have now at length a reprint of Dr. Howe's Reports, besides Mrs. Lamson's book and other less important literature accessible in English, Prof. Jerusalem's pamphlet probably furnishes the matter of immediate interest to psychology and pedagogy in the most convenient compass.

Epitomes of Three Sciences. The Open Court Publishing Company, 169 LaSalle street, Chicago, 1890. pp. 139.

This little volume gives a bird's-eye view of the present state of things in Comparative Philology, Scientific Psychology, and Old Testament History. The authors are Prof. H. Oldenberg of Kiel, Prof. Joseph Jastrow of the University of Wisconsin, and Prof. C. H. Cornill of Königsberg. The epitomes, (which have previously appeared in the *Open Court* and part of them also in German publications), were written from the scientific standpoint. They are here gathered for the contribution that they may make to questions of philosophy and religion, perhaps especially to the detheologized kind which the *Open Court* represents. The epitome of Scientific Psychology, though made by a writer uncommonly well equipped for such work, sufferes from the vast variety of matter to be epitomized.

The Monist. Vol. I, No. 1, October, 1890. A quarterly magazine published by the Open Court Publishing Company, Chicago. Yearly subscription $2.00, single numbers fifty cents.

The monistic tendency of modern philosophical, religious, and scientific thought has an able representative in this new quarterly. The journal's standpoint is expressed in the following sentence from its announcement. "The thinkers of mankind, whatever may be their philosophical or religious views, are working, every one in his own province, at one and the same great problem, which is a unitary conception of the world, free from contradictions and based upon the facts of life." Its aim is to present "the best, the maturest, and the most progressive work of human thought at present carried on in both hemispheres." The table of contents of the first number shows an array of distinguished names—Romanes, Binet, Cope, Mach, Carus, Dessoir, Salter. In addition to contributions by the writers mentioned, the number contains literary correspondence from France by Lucien Arreat, an account of the instruction in philosophy in a number of leading American Universities, and critical reviews of philosophical literature. One or two of the articles are practically restatements of matter already once published, but in each case the matter is of sufficient value to be well worthy of republication. Judging from this first number *The Monist* bids fair to be a valuable instrument in the spread of philosophic and scientific thought. W. H. B.

The Ethics of Evolution J. H. HYSLOP. New Englander and Yale Review. Sept. 1890.

The evolution of which Prof. Hyslop speaks is that of the animal series, with its struggle for existence and survival of the fittest; its ethical principle is the right of the strongest. That such an ethical ideal would shiver civilization, if once it should be practiced, can readily be admitted; and by citations of early and later opinions of Huxley, Spencer, Darwin and Carlyle the author endeavors to show the power of this ideal to force itself upon the minds of those that have to do with it—that "nature is a Medusa head on which no moralist can look and live." The theory of evolution then furnishes no principle of ethics which can for a moment be accepted; "the whole of man's moral achievements have been effected *by putting limits to the struggle for existence*;" his moral ideals must come from elsewhere. Much that is here said of animal evolution is by no means true of that broader theory which would make the heroic revolt against nature spoken of by the author itself a product of evolution; but this he seems to complain would rob the theory of its force as a controversial weapon.

Philosophy in Homeopathy. C. S. MACK, M. D. Gross and Delbridge, Chicago, 1890. pp. 174.

In the several addresses, etc., which make up this little book are developed with some repetition the author's idea of the rationale of homeopathy. There are facts, he believes, beyond inductive science which are endorsed and substantiated by the reason of man, and from which he may proceed deductively in the development of the art of medicine. Such a principle is the homeopathic *similia similibus curantur*. By a process of logical exclusion he shows that there are no other methods of cure than that so stated. By "cure," however, he means not the recovery of the patient, which may take place of itself when the exciting cause of his trouble is removed (a method of treatment often justifiable), but the production of such a change in the vital processes as shall set them right. When he would explain how "*similia*," as he calls it, secures this change, it is a mystic and Swedenborgian explanation that he furnishes. The author's spirit is non-polemical, but we must tell him that his method of deduction from principles other than those inductively established has been the mother of numberless follies in medicine already, and that the less of such philosophy in homeopathy the better for it.

Ueber die Methoden der Messung des Bewusstseinsumfanges. W. WUNDT. Philos. Studien, Bd. VI, H. 2, S. 250; 1890.

In this short paper Prof. Wundt discusses the methods of measuring the *Umfang* or extent of consciousness and replies to the criticisms of Schumann on his method (see review of Schumann's paper in this JOURNAL, Vol. III, p. 290). The question of the extent of consciousness in this sense is not very different from that of how many simple ideas can be present in the mind at one time. Prof. Wundt's method, as applied by his pupil Dietze, was in principle this: a series of regularly timed sounds are produced; as each member of the series is given, it rises in the focus of consciousness, and then giving place to the next, it advances by degrees toward the limit of consciousness, which it finally passes. If by any means it is possible then to find the number of sounds in a series of which the first is just on the point of disappearing when the last is just in the focus of consciousness, that number would be a measure of the extent of consciousness. In Wundt's method that number is found by finding the longest series that can be accurately compared with a slightly longer or shorter series (of course without counting), on the hypothesis that two series cannot be compared accurately when they are so long as to extend beyond the bounds of consciousness. The essence of Schumann's criticism, if we understand him, is that each sound as it comes is commonly responded to by some sort of a muscular contraction, and that after a few repetitions of the first or standard series the *number* of muscular contractions becomes established, unconsciously of course, and that same number is repeated when the second or comparison series is given. If the muscular contractions cease before the second series is ended the series is judged to be longer; if they over-run, the series is judged to be shorter. [For brevity we may call this adjustment of the muscular responses an unconscious counting of them.] A comparison of the number of sounds in two series, made in this way would be as useless for determining the extent of consciousness, as one made by conscious counting; what would really be measured would be how many sounds a man can count unconsciously. To this Prof. Wundt replies that he observes a clear difference in the process of comparison between series that can be compared as wholes and those that cannot be so compared. The line of demarkation between series that can be compared with some certainty, and those where the comparison is made uncertain by increasing length, is sharply drawn; as it should be if there is a change such as Prof. Wundt observes in the method of comparison. To the reviewer's mind however, he fails to answer satisfactorily Schumann's main point namely that the series are compared by means of what is little less than unconscious counting.

E. C. S.

NOTES.

It is announced by the *Revue Philosophique*, Oct. 1890, that a Laboratory for Physiological Psychology under the direction of Sergi is to be opened at the University of Rome.

In the *Vierteljahrssch. f. wiss. Philos.*, XIV., (1890), 1, M. Radakovic makes a careful study of the fundamental assumptions of Fechner's logarithmic formulæ for the relation of intensity of stimulus to intensity of sensation, and endeavors to re-deduce it in a way less open to criticism.

G. Itelson, in an article entitled Zur Geschichte des psycho-physischen Problems, *Arch. f. Gesch. d. Philos.*, III, 1890, 282, concludes from the negative assertions of past philosophers that there is need of a critical determination of whether or not sensations are measurable. In reviewing his article in the *Zeitsch. f. Psych.*, I, 128, Prof. Ebbinghaus reminds him that Comte's assertion in 1834 that the chemistry of the stars would never be known, was by 1860 a wholly antiquated and unfruitful speculation.

On the new façade of the cathedral at Florence is a white marble balustrade through the decorative openings in which one can look eastward against the blue sky. When one looks at these openings in the afternoon, with the sunlight on the surrounding marble and the sky a deep blue, they appear, says Prompt (*Archives de physiol.*, 1890, No. I, p. 59), not as openings but as if filled with a blue mosaic; there is no separation of the sky from the balustrade. When one looks in the morning, with the eastern sky bright and pale and the surrounding marble in shadow, there is no such illusion. This observation falls in with the author's theory that by such differences in light and shade we perceive the relief of distant objects; we habitually locate dark figures on light ground in that ground, but light figures on dark ground apart from it.

In opposition to the theory that the lack of muscular co-ordination in ataxy is due to the lack of normal sensations from the joints, tendons, etc., of the limbs affected, Rumpf urges (*Deutsch. Arch. f. klin. Med.*, XLVI, p. 35) that cases of severe sensory disturbance are not always attended by ataxy. A normal person, writing with closed eyes, writes as usual; a patient with reduced sensibility in his hand and arm writes larger under those circumstances; an ataxic patient shows his inco-ordination. The first, he explains, simply shifts from ocular control to control by the sensations from the writing member; the second has to make greater movements to get recognizable sensations, but need show no ataxy.

The editors of the new *Zeitschrift für Psychologie* are most fortunate in being able to secure for their review department abstracts of important papers by the writers of them. In the second number, Oehrwall, of Upsala, gives the outline of his researches on the sense of taste (see note below epitomizing this abstract), and Goldscheider resumés two of his papers on muscle-sense, some of the points of which have already been noticed in this JOURNAL. In the third number Preyer treats similarly of the new edition of his *Die Seele des Kindes*, Gaule of his counting of the fibres in the spinal cord of the frog, and Kronthal of his note in the *Neurolog. Centralbl.* on the large cells of the anterior horns. Other things being equal, no one is so well able to present the salient points of his paper as the author of it. In this day of multiplied and elaborate research there is much propriety in an author's thus furnishing for hurried workers in other departments an authoritative statement of his results.

A magnificent experiment in the psychology of courage will be tried when the new long range guns and smokeless powder are first brought into actual use on the battle-field. The problem was thus stated by a writer in the New York *Evening Post*, some time since: "Will the soldiers' morale stand the comparatively normal atmosphere of future battle-fields? Without forcing the note, as some writers do who speak of a verdant country where no noise is heard, where nothing stirs, but out of which death is belched through invisible cannon and guns (simple physical laws are opposed to this uncanny conception of a silence so deep and invisibility so complete), it must be granted that with shooting at long range there will be perplexity in the apparent emptiness of the field. This uncertainty will have limits; but to what extent the soldier's nerves will be tried when, the stimulating excitement of smoke and noise failing, he will be more keenly alive to the horrors of the battle, is a question that without actual experience no knowledge of humanity can answer,"

After canvassing former analyses of the sensations of taste, Oehrwall (*Skandinav. Archiv f. Physiol.* Bd. II. (1890) S. 1–69) ranges himself with those that find only four tastes, to wit: bitter, sweet, salt, sour. Between these there are no transitions; nor can a mixture of them, like a mixture of colored lights, give rise to a new inseparable sensation; nor are there contrast or compensation phenomena to be found among them. These four are as distinctly different senses as those of heat, cold, and pressure, the independence of which is becoming generally recognized. This view is supported by the facts that the same substance may excite different taste sensations, as it is applied to the tip or back of the tongue; and that the reaction-time for bitter at the tip of the tongue is longer than for the other three. The electrical taste, which has given trouble to the physiologists, is explained as due to stimulation of special end organs in the tongue and not, as Hermann contended, to action upon the nerve fibres and their sheaths. Cocain applied to the tongue abolished both normal and electrical taste sensations, but not those of temperature. The major part of the paper is devoted to Oehrwall's own experiments. After the manner of Blix and others, in studying the hot and cold spots, he has studied the isolated papillæ on the tip and sides of the tongue, using a fine brush dipped in tastable solutions. He got no taste sensations from the filiform papillæ, but unmistakable ones generally from the fungiform. Of 125 papillæ examined, 27 responded neither to sour (*Weinsäure* of 2-5 per cent. strength), bitter (quinine, 2 per cent.), nor sweet (sugar, 40 per cent.) Of the remaining 98, 60 responded to sour, bitter and sweet. Of the rest some responded to sour and sweet, but not bitter; some sour and bitter, but not sweet; and still others to sweet, but not sour or bitter; and so on. All the papillæ were sensitive to contact and temperature; the order of sensations being first, contact, at the same instant, or immediately after, cold, then taste. When mixed sugar and quinine were used the sugar was tasted first. Electrical stimulation of single papillæ with a weak induction current called out tactual and temperature sensations and generally also those of taste; most frequently sour, but also sweet and bitter. With the constant current the positive pole was most effective, bringing out a sour taste with a sensation of heat.

The negative pole excited chiefly sweet and bitter sensations, with that of heat, and sometimes at the same time that of cold. Weak currents brought out only such taste sensations as were to be gotten in the ordinary way. The author considers that these results are only to be explained by the presence of special end-organs differently distributed to the different papillæ. This brings the sense of taste into line under the general law of the specific energy of nerves.

In the spring of 1885 Goldscheider and Schmidt made experiments on the sense of taste, but being prevented from completing them made no announcement of their results till moved to do so by the appearance of Oehrwall's work. Their experiments were made in much the same way as his and though less extended lead to similar results and have a corroborative value. Their results are briefly set forth in the *Centralbl. f. Physiol.* Bd. IV, S. 10—12, April, 1890. They found evidence, among other things, for a fatigue of the taste organs (a point not recorded by Oehrwall), as follows: after several applications of quinine to a circumvallate papilla, the bitter taste failed though the papilla responded to sweet; after the use of acetic acid the taste was equally dulled for all four stimuli. In many subjects the only taste sensation excited on the hard and soft palates, especially near the middle line, was that of sweet.

The mysterious case of Caspar Hauser never came to trial, but the Polish newspapers have this spring contained an account of the trial and acquittal of a Polish nobleman, Count Zoronboff, who was charged with sequestering four children and rearing them as animals. It is said that the children were purchased of their poor parents. It would appear, if the meagre accounts at hand are reliable, that they came from four different families, had been dowered for life by the count, had been confined each in a large well lighted and heated and ventilated room, well fed, and occasionally washed by a deaf mute; that they were unclad, never punished or restrained in any act; that two of the children have been confined thus three, one four, and one four and a half years. The defense of the count was that he was conducting a scientific experiment to learn what were the natural instincts and the intuitions really innate in the human species. The count was acquitted. The age of the children is not reported. They did not speak, and made barking, growling noises, and precipitated themselves upon their food like animals. (See Emile Cere, *Revue Internationale de l'Enseignement des Sourds-Muets*, Mars, 1890.)

The following experience, related at first hand in a private letter to the editor, lacks the objective character of a full hallucination, but may perhaps be an interesting intermediate between ordinary experience and those rarer cases aimed at by the Census of Hallucinations of which Prof. James has charge for this country.

"From a youth up I have been subject to impressions more or less distinct and vivid, which seemed to come to me as if from some influence outside of myself. Most generally these impressions would come in a form of words as if a voice spoke them to me. But I have never once thought I had heard an *actual voice*. However vivid and distinct the impression of an utterance of words might be, it was always an inward voice, heard only in the mind.

"The most remarkable instance of the kind I ever experienced took place quite a number of years ago. But the whole incident was so peculiar that every incident of it is just as distinct in my mind as if it were only yesterday.

"I was going away from home to be gone two or three days, and it was very desirable that I should see a certain man before I went. But my time was limited, as my business had detained me so late in the forenoon that it would only be possible for me to take the one o'clock train if I used all diligence in getting ready. So it was out of the question for me to think of calling at his house to see him. In the meantime, while I was shaving myself at the mirror in the back part of the kitchen, and inwardly fretting to myself that I must go away without seeing him, these words were distinctly spoken to my mind, 'You will have a chance to see Brother M. before you go, after all.' I smiled to myself, for the impression could not have been any more vivid that something outside of myself had addressed those words to me, if the same words had actually been spoken to me by some person in the room with me. It was also quite improbable that I should see him at that hour as he was generally quite prompt at his dinner, and it was then a full half hour past his time. While these things were revolving in my mind, the words came to me: 'If you will go to the door you will see him.' But the whole thing seemed so curious as well as incredible that I did not at once go to the door; and in a moment more the words came: 'Be quick! or you will miss him.' Of course I delayed no longer but started for the door, and, as I opened it, Brother M. was at that instant passing the front gate. He had been detained at his office and was going home to a late dinner. Such are briefly the facts."

W. W. C.

CASE. I.

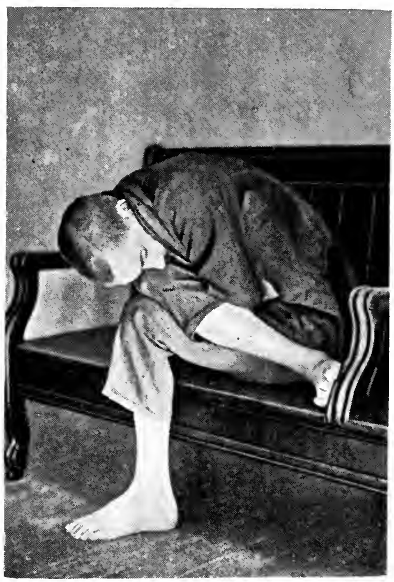
Melancholia with Stupor.

CASE II.

Melancholia with Stupor.

CASE III.

Chronic Dementia.



CASE IV.

Chronic Dementia.

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AUTOMATIC MUSCULAR MOVEMENTS AMONG THE INSANE; THEIR PHYSIOLOGICAL SIGNIFICANCE.

CHARLES P. BANCROFT, M. D.

Recent physiological research recognizes the significance of the relationship between muscular movement and cell activity of the central nervous system. Hughlings Jackson has said "that the whole brain is made up of structures that subserve sensori-motor processes, and that into such processes all its functions may be resolved." Gowers likewise remarks "that every structure of the brain concerned with sensation proper is connected directly or indirectly with a part concerned with motion." These views have received fresh recognition and confirmation in Dr. Francis Warner's interesting volume on "Physical Expression," and in a recent article by the same writer in the *Journal of Mental Science*, April number, 1889.

This intimate relationship between functional activity of the central nervous system and muscular movement is well illustrated by Dr. Warren P. Lombard, in an article, entitled, "The Effect of Fatigue on Voluntary Muscular Contractions," which appeared in the *American Journal of Psychology*, January number, 1890. The interesting experiments made by Dr. Lombard demonstrated the fact that the fatigue attendant upon continuous voluntary muscular exertion, and the consequent periodical variation in the strength of voluntary muscular contractions is due to alterations "in some of the central nervous mechanisms which lie between the areas of the brain which originate the will impulse, and the centrifugal nerves." Although the nature of these alterations in the central nervous mechanisms is not explained, still the close relationship between automatic functional activity of the central nervous system and the muscular periphery is clearly established. Muscular movement, whether of the face or other parts of the body, represents cerebral cell activity. That mysterious property which, for want of a better name, we call nerve-force, is undoubtedly being constantly generated and stored up within the brain cells, and, upon the presentation of the proper stimulus, is as regularly discharged from them. The laws, which govern this elimination of nerve-force, are similar to the laws governing force in general. The great law of conservation of force or energy prevails in the field of cerebral cell activity as elsewhere. When chemical or other changes take place within the delicate nerve centres of the brain as a consequence of external stimulation through the senses, or internal stimulation following mental activity, the result conforms to the requirements of this universal law. Either the force generated by these chemical changes remains stored up in the cerebral cells as potential energy, to be called forth at some future time by stimulation, or it is transferred from the cells along the proper efferent tracts to the muscular system, and appears as motion. This is the physiological explanation of physical expression.

Now a certain constant and regular transmission of this nerve-force, from central cells to the muscular periphery, is natural and in accordance with a state of health. Indeed, a condition of what we call general good health demands this outward relief for the potential energy constantly accumulating within the brain cells. Thus the excessive muscular activity of all young and growing animals, the playfulness of young dogs and kittens, the pranks and follies of boyhood, are oftentimes merely the expression of this great natural law. In adult life, the potential energy of the cerebral cells is manifested in more practical and useful ways, but still in the more tangible results of a successful business, professional or mechanical life, we recognize the outward manifestation of the potential energy which has been stored up within the brain cells until the proper stimulation called forth its discharge.

This intimate relationship between muscular movement and central cell activity within the cerebrum, has been discussed in Dr. Francis Warner's writings already referred to. This author calls attention to the fact that these outward manifestations of central cell activity begin at birth, and are witnessed in the countless random and meaningless movements of infancy, to which he has given the name of *microkinesis*. Undoubtedly, at a very early age, healthy inhibition of muscular movement begins. One by one useless and superfluous movements are checked, eliminated or co-ordinated in such a way that when adult life is reached, the individual, if in health, manifests those muscular activities which subserve the general purposes of the will and intelligence. Even at this period of life many movements remain fulfilling no particular purpose, but representing mere automatic cell activity, which has either been acquired by the individual or transmitted to him by heredity. The various movements and positions of the facial muscles, which, in their totality, make up the individual physiognomy, belong to this automatic and acquired class. Facial muscular action repeated in the same manner for months and years will, as Schack says, end by impressing "permanency and stability" upon those very lines which were at first only fleeting in character. It is undoubtedly in this mechanical way that heredity, the character of the social, intellectual, and moral life of the individual moulds the physiognomy, by continuous action of certain cerebral centres upon the terminal muscular expansions in the facial region. Facial expression, therefore, is only one of a large class of automatic and involuntary muscular movements that follow central cell activity within the cerebrum.

The close relationship between automatic muscular movement and the inhibitory power renders a study of the latter quite essential to a complete understanding of the subject of automaticity in health and disease. In health, this inhibitory power, which varies with individual growth and development, exercises a marked restraining influence over all muscular movements that follow central cell activity, particularly all those movements that do not subserve a useful purpose. Exactly what this inhibitory power is, is still a question for physiologists and psychologists to determine. It is recognized as playing a most important part in the intellectual and physical life of man. Whether inhibition is a purely metaphysical attribute of mind or a special function having its seat in specific centres of the brain, its importance as a factor in the life of the individual cannot be doubted. Many writers have denied the existence of special inhibitory centres, and many physiological and psychological facts confirm their views.

G. H. Lewes, in "The Physical Basis of Mind," argues with much force against the existence of special centres of inhibition. He attempts to explain the phenomena of inhibition by what he calls the Law of Arrest. "The Law of Arrest," he says, "is only another aspect of the Law of Discharge, and may be regarded as the conflict of excitations." According to this theory, each nerve tract and centre possesses inherent inhibitory properties of its own. The strongest excitations prevail; "the discharge is only the resultant of the conflict along the line of least resistance, the arrest is the effect of the conflict along the line of greatest resistance."

Meynert advances the theory that the gray matter of the brain and cord presents a certain resistance to nerve conduction. Increased irradiation of any irritation is accompanied by increased resistance in nerve conduction. "It is evident, then," he says, "that inhibition, resulting from resistance introduced in nerve tracts, accompanies the simplest reflex processes."

This property of resistance may be increased by individual training and experience. The inhibitory power will, therefore, vary with the person; there is no universal inhibitory standard that can be applied to all alike. The most perfect inhibitory capacity is usually met with in those individuals that present a strong and healthy will power. Inhibition represents gradual growth, and varies at different periods in the life of the same individual. At birth and during early infancy, it scarcely exists. Every act that the infant performs is the impulsive and somewhat spasmodic response to sensory stimulation. During childhood, the inhibitory power receives its first training and development. The child learns to govern himself. Experience and his parents teach him that the mere impulsive gratification of every whim that may arise, of every appetite that suggests itself, is not only not desirable, but may be fraught with disastrous results, both here and hereafter. In youth and manhood this power of inhibition receives constant education. The experiences of life all tend to develop it, if the will insists upon it. Finally, the inhibitory resistance, implanted in the nervous system in these various ways, is, to a certain extent, transmitted by heredity, so that those individuals, as well as races of men, present the most perfect manifestation of inhibitory power in whose ancestry this special faculty has been developed by training and experience.

Inhibition, therefore, seems to be a restraining power which is implanted in the mind, and incorporated as it were in the nervous mechanism of the individual. It is largely a matter of individual growth, and depends for its successful development upon the strong and healthy exercise of the will power. There is good evidence that inhibition is modified in various ways by climatic and hereditary influences. It is also evident that when once this inhibitory and restraining power is implanted within the nervous organization of an individual, its habitual and almost involuntary exercise is elicited by the presentation of the proper stimulus. Thus it is that habits and tendencies, which have only been repressed with the greatest difficulty and after the most active exercise of the will, receive frequent and comparatively easy restraint when once a tendency to their inhibition has been fairly established by the individual.

It is evident that this inhibitory power is intimately associated with all the higher faculties, and in common with them must seek expression through functional activity of the cerebral cortex. The inference is natural that functional or organic disturbance of this region should be attended by disordered inhibition. In health, the inhibitory function is exercised in a two-fold manner: *First*, in checking irrelevant trains of thought, repressing whatever is impertinent to the subject engaging the attention; and, *second*, in checking certain muscular movements which, though they naturally succeed the stimulation that has preceded them, still for the time being and with other objects in view, are undesirable and out of place. It is with the general reflex motor disturbances, due to irregular and defective inhibitory action of the nerve centres of the central nervous system, that occur in the different phases of insanity, that this paper is chiefly concerned.

Normal muscular movement is the result of a certain transmission of nerve force from the central nerve centres along various efferent tracts to individual muscles. All such movements are either purposive in action, or, if involuntary, do not exceed the limitations established by health and which are recognized by all students of physical expression. Pathological motor activity, on the contrary, is spasmodic, irregular and purposeless. In diseased conditions of the brain, the pathological irritation of these delicate nerve centres may be so great as to overcome any acquired inhibitory resistance, and thus liberate an excess of nerve force, which will seek an outlet in the usual way by passing along efferent tracts to the muscles, and there appearing as muscular movements. Striking illustrations occur in cases of chorea and epilepsy. There seem good reasons for believing that in these diseases the brain cells are in an unstable condition, owing to hereditary, traumatic, or nutritive disturbances, and that, as Gowers says, the discharge of these same cells "may depend on the production of force within, being increased in excess of the resistance, or on the resistance being duly lessened."

In the functional and organic brain disturbance that accompanies insanity, pathological muscular activity and inactivity, are constant symptoms, and merit the careful study of the psychologist. The muscular disturbances of insanity are threefold, and represent three different central conditions.

1. *States of excessive nerve-muscular activity due to central irritation.* The constant muscular agitation of acute mania, *melancholia agitata*, the active stages of paretic excitement, and of many cases of recurrent mania, illustrate this form of motor activity. The central irritation is so great as to overcome all inhibitory resistance. The destructiveness, constant

pacing to and fro, jumping and running of patients of this class is an evidence of the purposeless, irregular, and spasmodic character of pathological motor activity due to morbid irritation of the central cells.

2. *States of deficient nerve-muscular activity due to central degeneration.* The general motor impairment that attends nearly all cases of permanent mental enfeeblement, and is witnessed in the slouchiness, feeble gait, and general helplessness of patients afflicted with terminal dementia, is an illustration of the deficient nerve-muscular activity that represents the degenerative processes occurring in the brain cells in nearly all cases of structural disease of that organ.

3. *States of automatic cell activity in the cerebrum, occurring not infrequently in acute insanity, and quite constantly in the chronic forms of the disease.* It is to this third form of pathological motor activity that this paper is especially limited.

The subject of automatic nerve activity is so well understood that any extended allusion to it would be superfluous. It has been a matter of frequent physiological observation that all nerve structure manifests a tendency toward automatic activity. This attribute, inherent in nerve tissue, is noticeable in the lowest forms of animal life, possessing only the simplest and most rudimentary suggestion of a nervous system. The ascidian, for instance, illustrates this peculiar mechanical and automatic action of a very simple organism that is wholly unprovided with anything like consciousness. The simple muscular movements that occur in this animal, upon the presentation of the proper stimulus, are entirely involuntary and reflex, and are always repeated in identically the same way during the life of the ascidian.

As we ascend the scale of animal life the nervous system becomes more complex; entire regions are specialized, one part becoming subordinate to another, until we reach man, in whom the completest subdivision and specialization has been attained. In him the higher centres in the anterior cerebral region preside over the nerve structures below in the brain and cord. Still even these more highly specialized centres of the human brain manifest the same tendency to automatic and mechanical activity.

In one respect, however, man differs from the other forms of animal life. His *will power* presides over and directs those various processes which in the lower animals are automatic, instinctive, and largely involuntary. In man a few of the activities of organic life—such as respiration, the beating of the heart, and the like—are transmitted at birth fully established, and are entirely independent of the will. Other processes, such as walking, writing, and the like, are acquired after a most careful direction of the will, and laborious practice, and then become automatic. Still other higher processes, such as the psycho-intellectual activities of the individual, while under the guidance of the will, conform to the universal law of automaticity. Thought runs in certain well-established channels, and "Mechanism in Thought and Morals" is as susceptible of proof as the automatic action of the heart or the lungs during the processes of circulation or respiration—the only difference being that the intellectual and acquired activities are under the guidance of the will.

A high volitional power, therefore, distinguishes man from the lower animals. Even the most highly developed of these lower orders possess limited volitional power, while some would deny that they possess it at all. Many of their acts that seem to display a high degree of intelligence and to suggest the power of voluntary selection, prove, on closer examination, to be merely the result of unreasoning instinct that would not have admitted of any other course. In man, on the contrary, while his daily life is largely made up of various automatic activities, still the range of purposive selection is large, so that the "mechanism of thought and feeling" is made to serve the best interest of the individual through the guidance of the will.

In some way, at present obscurely understood, will power and functional activity of the cortex are mutually interdependent. Hence disturbance of these centres in insanity caused by impaired nutrition, defective functional activity, or more gross structural lesions weakens the will power of the individual. The functional activity of the cortical centres may be completely disarranged by insanity, and, as a result, the normal exercise of the will may be disturbed if not entirely suspended. At the same time, however, the activities of the basal ganglia, no longer under the guiding and controlling influences of the cortical centres, continue automatically. As a result, purposeless thought and action of an automatic character are quite apt to follow those serious disturbances of the higher cerebral centres during attacks of severe acute and especially of chronic insanity.

The inference is quite natural that in cases of extremely active acute mental disease and in a majority of the cases of terminal dementia, there is morbid disturbance of that region referred to by Dr. Lombard in the article previously cited: "the central nervous mechanisms that lie between the areas that originate the will impulse and the centrifugal nerves." In many cases of insanity that portion of the brain that "originates the will impulse" is cut off by reason of organic or functional disturbance, and consequently the areas that lie nearer the centrifugal nerves are left to act independently of will and inhibition. In Dr. Lombard's experiments these areas acted with a certain periodical variation, owing to processes of fatigue and recuperation; in cases of insanity this same region may display peculiar and persistent automatic activity by reason of cerebral excitation accompanied as it is with loss of function of the higher brain.

There is abundant clinical evidence in every hospital for the insane of this involuntary action of cerebral areas that lie between the centres originating will power and inhibition and the centrifugal nerves. In passing through wards containing the chronic and demented insane, one is struck with the evidence on every side of automatic activity. Here you will notice a man walking backward and forward in a mechanical way for hours together, until he has worn a beaten path in the floor; there will stand one who picks away at a certain place on his clothing for an indefinite period until he has worn the garment through to the skin. Quite frequently will be heard curious, meaningless noises, singular repetitions of words or sentences entirely meaningless. It is not an uncommon thing for a chronic patient to have some peculiar word or phrase, or even a single articulate sound that he will repeat in an irrelevant way for years. In like manner you will meet with patients who make strange motions with the arms and hands, and maintain singular attitudes in a mechanical way. It is difficult to arouse the attention of such patients; their monotonous repetition of words and movements continues just the same regardless of the presence of others, and with little reference to any attempts made for their diversion. All this variety of automatic action and speech indicate that the healthy functional activity of the highest cerebral centres has been disturbed and partially suspended, and that other centres are acting in a mechanical manner and without the normal volitional and inhibitory control.

Prolonged automatic activity in thought, speech and action among the insane suggests a serious lesion in the higher brain. The more mechanical and purposeless the acts and words of the patient, the graver is the prognosis. The nervous system, indeed, manifests a striking tendency to mechanical repetition of any process once initiated within its centres. In health, habits and personal idiosyncrasy are illustrations of the facility with which automaticity is established in the central nervous system. The same tendency is equally noticeable in diseased conditions. One epileptic attack is likely to be followed by another, and a number of seizures renders the prospect of others quite certain, until in a short time the disease becomes firmly established. Both mania and melancholia manifest tendencies to repetitions of the attack, and each new attack renders the probability of another quite certain, until recurrency or permanent insanity is established.

It is when the inhibitory and volitional functions of the higher brain are suspended, and when unrestrained and undirected action occurs in those centres that are nearest to the outgoing motor tracts that the most peculiar evidences of automaticity are witnessed. In the advanced stages of fevers, such as typhoid and scarlatina, the higher functions of the mind are often suspended, either from exhaustion or because the cortical centres have been disturbed by the severity of the febrile action. In these grave physical conditions the automatic and purposeless repetitions of words and muscular movements becomes quite noticeable. *Subsultus tendinum*, *carphologia*, tiresome utterance of some particular sound or word indicate that the higher cerebral functions have been suspended and that the lower centres are acting as it were at random and without the direction of the former. In this case the prognosis is grave because the vital forces themselves are waning and volitional activity is suspended through exhaustion of the cortical centres.

In chronic insanity the prognosis as to mental recovery of the patient may be equally grave, for the reason that healthy functional activity of the cortex has been permanently disturbed by the disease, which, though not necessarily fatal to life, is most assuredly so to mental restoration. The chronic insane are extremely liable to develop objectionable habits for the physiological reasons suggested. The special study of the physiological causes that underlie the peculiar habits so frequently met with in individual cases of insanity is both interesting and instructive.

Two laws underlie every form of nervous activity, and furnish a physiological explanation for the tendency toward the formation of strange habits and a certain automaticity in conduct and speech that is so frequently exhibited by the chronic insane, in whom it is to be remembered inhibitory impairment always exists.

1. The discharge of the nerve centres occurs along those tracts that offer the least resistance.

2. The more frequently the discharge occurs along a given line, and the weaker the inhibitory resistance, the easier does a repetition of the discharge become, and the more certain its permanent automatic establishment.

If, for instance, in those conditions of mental disease characterized by a weakening of the will power, one especial route is, for one reason or another, established on account of some delusion or mere fortuitous circumstance, the probability is that this particular route will continue to be the one most frequently traversed by nervous force in its passage from the brain to the periphery. A delusion, an hallucination of sight or hearing, some peculiar condition in the patient's environment may havê first initiated certain actions which, by being unresisted and hence repeated, lead to the establishment of a habit. Probably in some such simple and purely fortuitous way are developed the pulling out of the hair, tearing the clothing, walking in a beaten path, making singular motions or uttering meaningless sounds; in fact, any of the strange habits of the insane. It matters little whether the performance of these habits is painful or disagreeable; no other alternative seems open to the patient when, through weakness of will and intelligence, the morbid route has once been established. Some morbid sensation in the scalp or chin to act as an excitor, or merely the absence of anything of an intelligent character in the mind to engage the attention, may lead to the plucking out of the hair or beard, which impulse, meeting with no resistance, soon developes into a persistent habit. A delusion about the bed may lead the patient into the habit of standing up all night, and, if not interrupted, nothing short of restraint will prevent exhaustion, so persistent will the impulse become to remain on the feet.

The importance of the early breaking up of bad habits among the insane will be readily understood. Fortunately, the same tendency to automaticity of action may be utilized in a good as well as a bad direction. By careful supervision, we may succeed in breaking up many useless and vicious habits by supplying some simple mechanical occupation for the hands, thereby utilizing the automatic nerve-activity characteristic of the disease. And in doing this, we may even seem to retard mental deterioration. Judiciously selected mechanical employment among the insane has become, therefore, a valuable means of treatment.

Strange postures, cataleptic attitudes among the insane, particularly those singular positions assumed by patients manifesting that particular group of symptoms, to which the name of *katatonia* has been given by some writers, possess the same interest for the psychologist as do the peculiar habits just mentioned. The significance of postures in health has been ably treated by Dr. Francis Warner in an article on "Muscular Movements in Man" in the *Journal of Mental Science* for 1889, April number. He says: "Postures depend upon the ratios of nerve-muscular action, and to some extent they indicate the present ratios of static efferent force proceeding from the centres concerned. Observations show that the postures when not due to a present stimulus, or when produced by a weak stimulus from without, such as a sound or sight, correspond to and are signs of the general condition of the central nervous system." These remarks are particularly applicable to the singular attitudes seen in different cases of insanity. The postures that are oftentimes maintained for long periods by the insane are a pretty sure index of profound morbid disturbance of the central organ of innervation. Cases of *melancholia attonita* and chronic dementia afford the most frequent illustrations of morbid posture. The fantastic attitudes frequently associated with these two types of mental disease are undoubtedly due to the suspended functional activity of the higher brain. In melancholia this suspension of function may be only temporary, while in dementia it is permanent on account of structural changes that have occurred in the nervous centres. In stuporous melancholia the ideational centres appear to be almost functionally inactive. Either they are incapacitated by shock or impaired nutrition consequent upon a deteriorated state of the blood, or the slight activity they do retain, is restricted to the evolution of a single morbid and overwhelmingly insistent idea. The result is imperfect and misguided motor activity noticeable in perverted and meaningless posture. The condition itself, even though it is of recent date, is a serious one, and the prognosis is necessarily surrounded with doubt. So profound a disturbance of normal function in the ideational centres renders permanent instability of this region extremely probable, if it is not fatal to life itself.

The study of morbid postures among the insane is a subject of great psychological interest. The careful investigation into the early development of mechanical attitudes and movements, and meaningless habits among the insane, would amply repay the time and labor expended in this direction, and throw some light on the processes of cerebration and their connection with muscular movement. Quite frequently a single morbid dominant idea induces the patient to assume a peculiar attitude; to this attitude no opposition is presented through the damaged inhibition and volition, and, in a short time, the posture becomes permanent by reason of the continued transmission of efferent force along this particular route. So insidiously are these postures developed that before the physician is aware of it, they have become established, and the real causes that lead up to their final establishment are lost sight of. Among the chronic delusional insane that are well-advanced toward terminal dementia, a single active delusion leads to a peculiar posture or movement; this soon becomes permanent because the motor impulses, originated by the morbid insistent idea and having met with no resistance, continue to pass along this particular efferent route until automaticity is established. The original idea that initiated the posture, in fact, all active ideation, may cease as a result of the brain disease, and yet the peculiar motor condition will persist.

Case II, represented in the plate at the beginning of the article, illustrates an attitude taken by a young man suffering from melancholia with stupor. At the time the photograph was taken, the patient was laboring under a second attack of the same disease, which proved fatal in the course of a few months. He would stand in the posture represented both day and night unless held or restrained. His position was constrained and tense, usually one side a little more elevated than the other, his arms and hands maintained in a rigid position, and all his facial muscles in a state of extreme tension. This position was taken in a very early stage of his disease, at a time when it was possible to elicit a few ideas from him. In reply to the question why he maintained this uncomfortable posture, he replied that he felt positive his bowels would be more certain to act were he standing rather than seated or lying down. When asked to sit in a chair, he always protested, saying that he could not do so, and it was only by the exertion of some force that he could be induced to take a seat. His position, if seated, was one of intense constraint. Generally, he would only half sit in the chair resting one thigh, and apparently partially holding himself up with his feet or hands. These peculiar postures were undoubtedly maintained partly by the intensity of his delusion and partly by the failure of inhibition to restrain nervous energy from taking the particular efferent routes suggested by the morbid reasoning. Had this case entered a state of dementia secondary to his acute insanity, we might expect to see these same attitudes and movements continued in a mechanical and automatic manner long after the active delusion which first instigated them had ceased. Nerve-muscular activity having traversed the efferent routes leading to these particular groups of muscles, and having for so long a time met with weak resistance, it results that this route becomes permanent, as well as the easiest, and in this way a morbid posture is established. Should we see for the first time such a posture as is represented in Case II after it had been established many years, we should find an explanation extremely difficult. But had we been able to trace its gradual development from the active delusions of an acute insanity, we should quite readily understand the peculiar attitude and its relation to the mental condition at the present time.

Case I represents a peculiar posture that was maintained for hours by a patient laboring under an attack of melancholia with stupor. This young man made no remarks ; he kept his eyes tightly closed so that the secretions would accumulate under the lids ; he would stand or sit in a rigid position with his head thrown far back on his shoulders, and any effort to induce a change of posture met with firm resistance.

Cases III and IV show singular and uncomfortable attitudes occurring in conditions of chronic terminal dementia. The postures were gradually assumed by the patients while under the writer's care, and yet so very slowly were they initiated that they became fixed and habitual positions before any especial attention was called to the fact. In this way the real causes that led up to the final establishment of the habitual posture were lost sight of. From what was known of Case III, the impression would be readily formed that the patient, owing to delusions of suspicion or fear, or a dislike to seeing persons about, gradually acquired the habit of hiding the face, as is often witnessed among timid and bashful children. As this particular case became more demented, a position which was at first assumed as the result of an active delusion, finally developed into a permanent habit, simply because nervous force flowing along this route from centre to periphery for so long a time in obedience to impulses derived from morbid ideas and meeting with little inhibition, continued to take this route long after active thinking had ceased.

Another interesting fact concerning these strange attitudes is the apparently analgesic condition of the patients themselves; they all seem utterly oblivious to the discomfort and even the painfulness of these constrained positions. Case IV would maintain the posture shown in the picture for hours continuously; and Case III, from the hour of rising until bedtime, was continually in the attitude shown in the photograph. That these postures would be painful to a person in health, any one can demonstrate by attempting to maintain similar positions for even a few minutes at a time. The muscles concerned in the maintenance of these postures were in a high state of tension, showing that a certain amount of "static efferent force" was being transmitted continuously from the centres within the sensorium to the periphery over these morbidly pre-established routes. Nearly all the healthy activities of mind appeared in these cases to have ceased, and there seemed little left beside the mere processes of organic life; apparently, the entire energy of the sensorium was expended in keeping up these automatic and useless positions. Any attempt to move the arms into a more easy position was met by a firm resistance, which was not spasmodic, but persistent in character.

In conclusion, it may be said that automatic activity of the cerebral centres in health is quite largely under the direction of volition and inhibition, and the result is motor activity that is purposive. Automatic activity of these same centres in disease of the mind seems to be less under the guidance of the inhibitory power and the will, and the resulting action appears purposeless. In proportion, as inhibition and volition are weakened by the brain disease, to just that extent do meaningless automatic activities prevail. Inhibition and volition both being identified with healthy functional activity of the highest centres in the cerebral cortex, it naturally follows that varying degrees of automatic muscular movement will characterize some acute and nearly all chronic insanities.

THE PSYCHOLOGY OF TIME.

BY HERBERT NICHOLS.

I.—HISTORICAL.

In the history of language, words for 'time' are long preceded by words for 'past,' 'present,' and 'future,' and in myth and philosophy, Time makes a late appearance. The early Greek philosophers, even Parmenides and Heraclitus, naïvely took it for granted. Yet in this period questions were discussed that involved time; it is certain that the speculation of Pythagoras regarding number, descended with direct formative influence upon Aristotle's philosophy of time, and problems like Zeno's of Achilles and the tortoise, turned attention critically toward time.

All of previous philosophy is said to be summed up in PLATO. I have discovered nothing more indicative of the status of time philosophy in Plato than the following found under 'time' in Day's "Analytical Index" of Plato's Dialogues (London, 1870.) "Time is the image of eternity (Tr. ii, 341, 342; Tim. 37 D, E; 38 A, B, C, D, E; Tr. vi, 155; Tim. 97 C);[1] belongs wholly to generation (Tr. ii, 338; Tim. 35, B, C; 36, A); is measured by the movements of heavenly bodies (see references above); time to depart and die (Tr. 129; Apol. 42, A); time is short compared with eternity (Tr. ii, 298, 186; Rep. 608, C; 498, D; see references in Stallbaum); time is nothing, and is not deserving of the solicitude of an immortal being (Tr. 298; 608, C); time and tune synonymous with good education (Tr. ii, 96; Rep. 413, D)." Time, *per se*, is nowhere psychologically contemplated by Plato; his nearest approach is in the Timæus as above. Time is not one of his five categories given in the Sophist, (being, rest, motion, sameness, difference). He conceived that motion was given to things because necessary to change; to the Kosmos alone was given rotation in a fixed circle, this being

[1] "Tr." refers to translation in Bohn's Classical Library; numbers and capital letters refer to the register of Ast and Stallbaum.

"the movement most in harmony with reason." With the rotation of the Kosmos began the course of Time — years, months, days, etc. Anterior to the Kosmos, there was no time, no past, present and future; no numerable or measurable motion or change. The ideas being without fluctuation or change, existing *sub specie æternitatis,* had only a perpetual present, no past or future; along with them subsisted only the disorderly, immeasurable movements of Chaos. The nearest approach which the Demiurgus could make in copying these ideas, was by assigning to the Kosmos an eternal and unchanging motion, marked and measured by the varying positions of the heavenly bodies. For this purpose the sun, moon, and planets were distributed among the various portions of the Circle of the Different, while the fixed stars were placed in the Circle of the Same, or the outer circle, revolving in one uniform rotation, and in unaltered position in regard to each other. The interval of one day was marked by one revolution of this outer or most rational circle, etc. . . . The phenomena of vision and hearing are included among the works of reason, because the final cause of these higher senses is to give men perceptions of number through contemplation of the measures of time. . . . An eternal sameness or duration, without succession, change, generation or destruction, this passes into perpetual succession or change, with frequent generation and destruction, into time.[1] This is the most specific conception previous to Aristotle, but it is really the naïve idea of time interwoven with Plato's doctrines of creation. In later philosophers the problems of time and memory are closely involved, but for Plato the latter is only "the power which the soul has of recovering, when by itself, some feeling which it experienced when in company with the body." His illustration is that of impressions left in wax.[2]

ARISTOTLE was the first to ask *how* we perceive time.[3] He did not conceive his Kosmos to have had a beginning; all in it is an eternally changing correlation between matter

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[1] "Plato and other companions of Sokrates" by George Grote, (London, 1865) III, 248—257, and notes.

[2] Phædo, 73, 74.

[3] Alfred Wm. Benn, "The Greek Philosophers," I, 326. Wilhelm Volkmann, "Lehrbuch der Psych.," I, 37. Edwin Wallace, "Aristotle's Psych.," introduction. Also Grote, Lewes, etc.

and form.[1] "Matter is the original substratum, while form is nothing apart from form."[2] There are all gradations of this correlation, from clay bank to statue, from statue to human soul.[3] Soul ranks with form, not with matter. The matter to which soul stands correlated, is a natural body (*i. e.*, a body having within it an inherent principle of motion and rest) organized in a certain way, or fitted out with certain capacities and preparations to which soul is the active and indispensable complement.[4] The soul is dependent on the body for all its acts and manifestations, and brings to consummation what in the body exists as potential only.[5] . . . We do not say the soul weaves or builds;[6] we say that the animated subject, the aggregate of soul and body, *the man*, weaves or builds. So we ought also to say, not that the soul feels anger, pity, love, hatred, etc., but that the man with his soul does these things. . . . This is true, not only in regard to our passions, emotions, and appetites, but also in regard to our perceptions, phantasms, reminiscences, reasonings, efforts of attention, etc. . . . The actual movement throughout these processes is not in the soul, but in the body . . . They are at once corporal and psychical. . . . Soul is the movent, inasmuch as it *determines* the local displacement, as well as all the active functions of the body—nutrition, growth, generation, sensation, etc.[7] . . . Soul in all its varieties proceeds from the Celestial Body or abode of Divinity.[8] . . . The varieties of soul are distributed into successive stages. . . . The lowest soul is the primary cause of digestion and nutrition; it is cognate with celestial heat.[9] . . . We advance upward now from the nutritive soul to that higher soul, which is at once nutritive and sentient . . . with multiple faculties and functions. . . . Sensible perception with its accompaniments, forms the char-

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[1] De Celo, Bk. II, Ch. 1 (Ed. Sprengel); Wallace, op. ct., p. xii.
[2] Metaph. Z, 8, 1033, b. 12 seq.; Θ. 3, 1047 a. 25.
[3] De Anima, II, 2, 414; Physica, II, 2, 194, C 8; Metaph. H 6, 1045, C 18; De Gener. Aninal. II, 1, 735 a 9; De Celo, IV, 3, 310, C 14.
[4] De Anima, II, 1 sq.
[5] De Generat. Animal. II, i, p. 731, b. 29.
[6] De Anima I, iv, p. 408, b. 12.
[7] De Anima II, iv, p. 415, b. 1.
[8] See Grote, Ibid. 220.
[9] De Anima II, i, p. 731, b. 33.

is that which gives thereto definite individual being. Matter acteristic privilege of the animal[1] . . . and admits of many diversities from the simplest and rudest tactile sensations . . . to the full five senses.[2] . . . The sentient faculty, even in its latest stage, indicates a remarkable exaltation of the soul in its character of form. . . . The soul, *qua* sentient and percipient, receives the form of the *perception*[3] . . . as wax from a signet.[4] . . . The sentient soul (its 2d stage) requires a cause to stimulate it into actual seeing or hearing, . . . a stimulus from without, from some individual object, tangible, visible or audible; but the noëtic or cognizant soul (3d stage) is put into action by the abstract and universal . . . so that a man can at any time meditate on what he pleases[5] . . . All the objects generating sensible perception are magnitudes.[6]

Some perceptions are peculiar to one sense alone, as color to the eye, etc. There are some perceivables not peculiar to any one sense alone, but appreciable by two or more . . . such are motion, rest, number, figure, magnitude.[7] "But each single sense perceives nothing but one single quality or group of qualities.[8] . . . There is required then some one function of the mind, by means of which it gains perceptions of all objects,[9] . . . some common central organ of perception in which the separate communications of the senses are combined; . . . it must within one and the same moment of time, present before itself two or more reports of sense."[10] . . . This exercise of comparison, which Aristotle thus assigns to the central or the common sense, is not, however, restricted to the work of distinguishing the separate communications of the senses; it displays further its synthetic power in grasping the common properties which are involved in the

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[1] De Sensu., i, p. 436, b. 12.
[2] De Anima II, iii, p. 414, b. 2; 415 a. 3; III, i, p. 424, b. 22; xiii, p. 435, b. 15.
[3] Ibid. II, xii, p. 424, a. 32, b. 4.
[4] Ibid. II, xii, p. 424, a. 19.
[5] Ibid. II, v, p. 417, b. 22; III, iii, p. 427, b. 18.
[6] De Sensu., vii, p. 449, a. 20.
[7] Grote's Aristotle II, 186-198; De S. et S. i, p. 437, a. 8; iv, p. 442, p. 4–12.
[8] Psychology iii, 7, p. 431, a. 24.
[9] De S. et S. 7. p. 449, a. 8.
[10] Psy., p. 426, b. 22.

existence of the qualities of the body.[1] For at the same time as we perceive, say color, we perceive it, further, as a colored surface or *magnitude*; at the same time as we have the sensation of notes following on one another, we perceive the fact of *number*; and at the same time again, as we feel a surface hard or soft, we perceive it as some kind of *figure*. Beyond these, the particular objects of the single senses, we require to recognize a number of qualities ("categories") which enter more or less into each of our sensations . . . and which, in Aristotle's words, "we perceive immediately in connection with each perception."[2] Chief of these qualities or "categories" were "*motion*" and "*rest*;" next came "*number*." Finally, for our purpose, Aristotle remarks: "*Time is the number of motion*."[3] Psychologically considered, then, time *is an immediate (central) sense-perception of "the number of motion*."

But is not memory requisite for perception of time? We are told "Memory, as well as phantasy (imagination) are continuations, remnants, traces or secondary consequences of the primary movements of sense. Both of them belong to the same psychological department—to the central sentient principle, and not to the cogitant or intelligent *nous*."[4] "In acts of remembrance we have a conception of past time, and we recognize what is now present to our mind, as a copy of what has been formerly present to us either as perception of sense or as actual cognition[5]; while in phantasms there is no conception of past time, nor any similar recognition, nor any necessary reference to our past mental states." "What is remembered is a present phantasm assimilated to an impression of the past."[6] Aristotle draws a marked distinction between the (memorial) retentive and reviving functions, *when working unconsciously and instinctively*, and the same two functions when stimulated and guided by a deliberate purpose of our

[1] De Anima III, i, p. 425, a. 15.
[2] De S. et S., C. 4, p. 442, b. 4; De A. II, 6, p. 418, a. 17. Wallace's Aristotle, Psych., lxxvi–lxxix.
[3] De Celo, Ch. 9, 8–10.
[4] De Memor. et. Remin. i, p. 451, a. 5; p. 449, a. 10.
[5] Ibid. i, p. 449, b. 22.
[6] Ibid., p. 450, a. 30; 451, a. 15; De Memor., p. 240.

own, which last he calls reminiscence. He considers memory as a movement proceeding from the centre (heart) and organs of sense to the soul, and stamping an impression thereupon; while reminiscence is a counter-movement proceeding from the soul to the organs of sense."[1-2-3]

On occasion, however, he used time both to denote an objective and a subjective concept. "Both motion and time are thus eternal, both are also continuous; *for either the two are identical*, or time is an affection (πάθος) of motion."[4]

Thus in brief, time-perception with Aristotle was a direct sense-perception — the immediate function of the sentient faculty or soul; this, whether under the presentation of primary sensation or of memory. We have given much space to this remarkable first exposition of time because it is most important historically, and in its essential features it has survived in all ages, and is even now the accepted theory of prominent psychologists.

POST-ARISTOTELIAN AND MEDIÆVAL discussions of "the faculties" are important, in so far as they lead to later theories. The doctrine of soul faculties is so old that Diogenes Laertius cites Pythagoras as its source. After Aristotle, the Stoics found difficulty in agreeing upon the number of the faculties, and in reconciling any plurality of them with the unity of the soul. To these perplexities the Neo-Platonists joined that of the self-consciousness of the soul. Philo compared the relation of the soul to the faculties to that of the house to its tenants. The Patristic authorities insisted on the strict unity of the soul. Tertullian substituted the term "soul-faculties" for the older term "soul parts" or "soul divisions," and compared the soul to the wind which blows the pipes of an organ; the pipes representing the faculties. Gregory of Nazianz revived the simile of Plato, that the

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[1] De Anima I, iv, p. 408, b. 17; De Memor. i, p. 450, a. 30; ii, p. 453, a. 10.

[2] Grote. op. ct. II, 212–215.

[3] Memory "is the permanent possession of a sensuous picture, as a copy which represents the object of which it is the picture." De Memor. I, p. 451, a. 15. He adds that memory is the function of our ultimate faculty of sense which "is also that by which we gain a consciousness of time." Ibid., p. 450, a. 12.

[4] Metaph. Λ, p. 1071, b. 15.

soul was the driver of the wagon; and the faculties were the horses. St. Augustine developed advanced ideas of memory, but with the revival of Aristotle among the Scholastics, "the faculties" again rose almost to supreme discussion; all deemed themselves bound to maintain the unity of the soul. The view of Thomas Aquinas was that most commonly held, *i. e.*, "the faculties, from the essence of the soul, *sicut a principio fluunt*."[1] Roger Bacon contended for the *sensus communis* of Aristotle, whose philosophy in general he accepted.[2] With Wm. of Occam, all thoughts are "conditions of the soul."[3] During the Reformation, the orthodox doctrine was defended by Suarez, while Melanchthon held nearly to the teachings of Aristotle. Thus the opposing views of "unity" vs. "faculties" occupied the field, at the date of Descartes, Hobbes, and Leibnitz.

René Descartes followed the orthodox schoolmen as against Aristotle in considering the soul as one indivisible "thinking substance;" its diverse "faculties" are but different *modes* of the one "*facultas cognoscitiva*"—the "thinking soul."[4] Aristotle at least caught sight of the mystery of our perceiving at the single moment that *is*, the 'fore and aftness' of a series which *has past*, and he conceived apparatus and processes to account therefor. Descartes, with naïveté, looked on such mental acts as direct and indissoluble "modes," or "conditions," of the "thinking soul."[5] In this conception is the foundation of his philosophy; the soul sees directly; ideas are intuitions, "the innate power of thought itself;" "they are in the mind, and when exercised, are perceived to have been there before."[6] Certain of these innate concepts lie at the foundation of all the rest; without them no

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[1] For full references for above see Volkmann's Psychologie (1885), I, 22, sq.
[2] Erdmann's Hist. Philos., I, 478-481.
[3] Ibid., 504.
[4] Pass. de l'âme I, 47 sq.; Med. end of II, IV; VI, 77, etc.; Prin. d. Philos. I, LIII; Kuno Fischer—Descartes and his School—Tr. Gordy, p. 419.
[5] Letter to Vatier, Nov. 17th, 1643; Ed. Elz. 1, Ep. 116; Ibid., Ep. 105; Princ. i, § 57-59; Med. III.
[6] Règ. iii, p. 211-214; V, 225; Med. V, 64; Erdmann's Hist. Philos., Hough, Tr. II, 26.

kind of conception of anything is possible. *Space and time are such direct, innate, and fundamental concepts.*

Descartes makes one advance upon Aristotle, in specially distinguishing duration from the "numbering of motion." "We shall also have most distinct conceptions of duration, order, and number, if in place of mixing up with our notions of them, that which properly belongs to the concept of substance, we merely think that the duration of a thing is a mode under which we conceive this thing in so far as it continues to exist;"[1] "for we do not indeed conceive the duration of things that are moved, to be different from the duration of things that are not moved."[2]

Descartes distinguished two kinds of thought—"active" and "passive;" the active are the "different modes of willing;" the "passive" include time-perceptions. Yet time was not with Descartes a *sense* perception as with Aristotle; *his time-perceptions spring innately "from the intellect" or soul "alone."*[3]

Yet Descartes' physiology is not always easily harmonized with his philosophy, nor his mechanical explanations of memory with *entirely* innate intuitions of time. He says "Recollections are traces of images on the brain" — "traces of previous movements left in the brain like folds in paper;" the movements of the vital spirits through these traces "become for the soul, occasion and opportunity for calling forth ideas which resemble them."[4] "By memory, we connect present and past." "When I think of myself as now existing, and recollect besides that I existed some time ago, and when I am conscious of various thoughts, whose number I know, I then acquire the ideas of duration and number, which I can afterwards transfer to as many objects as I please."[5] Descartes tells us "the movements of the brain affect the soul or mind."[6] "Perception is impossible without

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[1] Prin. d. Phil., I, LV, 137.
[2] Ibid., I, LVII, (Tr. Ed. Edinburgh, 1873.)
[3] Ibid., I, XXXII; Med., II, etc.
[4] Notæ ad. progr. quodd., p. 185–188; Erdmann op. ct. II, 28.
[5] Med. VI, 88; III, 45.
[6] Prin. d. Philo. I, XLVIII, 170.

the body."[1] "From the motion of the body alone, can the various sensations be excited."[2] "The soul perceives only in so far as it is in the brain."[3] Yet he as distinctly says "by the omnipotence of God, the mind can exist without the body,"[4] and one of his commentators says "according to the fundamental principles of his philosophy, mind, on account of its absolute diversity from body, is supposed to hold no immediate converse with matter, but only to be cognizant of it by means of its own modifications, determined hyperphysically on occasion of certain affections of the body with which it is conjoined."[5] Kuno Fischer shows that it was these uncertainties or contradictions of Descartes, which led in opposing directions to the occasionalism of Geulinx, the systems of Malebranche, of Spinoza and of Leibnitz."

THOMAS HOBBES declared that the soul is known only through faith, and is not a subject of philosophy; he was the first to confine his speculations to "mental facts," avoiding cognative "faculties;" though he did at times "see the need of some other sense to take note of sense by," he yet presaged so much that is explanatory in the unfathomed *processes* of thought, as bravely to declare "that all that is wanted to account for such introspective consciousness could be found in memory."[6] He says all sense and all thought are "subjective;" are "something that lies entirely in us;" "yet is as mechanical as nature." "According to a universally valid law of nature, the affections of the sense organ, when the impression has ceased, must continue, and this echo of the impression is called memory, thought, or imagination. It is so inseparable from the sensation that it may be compared to a sixth sense accompanying the rest. . . . *Like water troubled, an organ of sense will remain in motion. . . . In that case the corresponding phantasm is called imagination; or memory, if regard is had to the fact of the lapse of time, which like distance in space, is found to render the phan-*

[1] Med. II, 27.
[2] P. d. P. IV, CXCVII.
[3] Ibid. IV, CXCVI.
[4] Reply to the several objections—Prop. 14, (Tr. Edinburgh, 1873.)
[5] Ibid. Note, p. 200; where see several references.
[6] "Hobbes" by George Croom Robertson (1886), p. 124.

tasms of sense both less clear as wholes, and less distinct in parts."[1]

In his De Corpore, Hobbes devotes Chapter VII to space and time. "All body . . . exists with one constant attribute of extension mentally represented as space; and all its variable and varying aspects explicable in terms of motion, are mentally represented in time." Time is "a phantasm produced by body in motion;" it is "simply the idea of motion, or of moved body." Yet he adds that time "*stands rather for the fact of succession or before and after in motion.*"

As far as I know, the word "succession" or any exact equivalent, here enters the discussion for the first time. "The comparison or assimilation of sense impressions into time percepts gets little further attention from Hobbes, though he notes in one place its ground-form, the recognition of identical experiences had at different times."[2] Hobbes is the Father of the English School of Association.[3] His importance in the history of the problem of time rests on his being the first of moderns to plant himself on this doctrine, namely: "There is no conception in a man's mind that hath not at first totally or by parts, been begotten upon the organs of sense. The rest are derived from that original."[4]

With SPINOZA time was a mode of his all-embracing substance.

JOHN LOCKE believed in an immaterial soul that thinks.[5] Its faculties are not "separate agents," but "different ways" or "powers" of thinking; the first "power" is to perceive.[6] There are two sources of ideas: First, sensation, and, second, "perception of the operations of our mind within us," which he calls "reflection."[7] "Which operations, when the soul comes to reflect on and consider, do furnish the understanding with another set of ideas, which could not be had from things

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[1] Human Nature, C. 3. Also he speaks of memory as "decay of sense;" *i. e.*, fading.

[2] Robertson, op. ct. 127.

[3] Lewes Hist. Phil., p. 232; Sir Wm. Hamilton in "Reid's Works," p. 898.

[4] Leviathan, C. i. See Robertson, op. ct., p. 84.

[5] Essay Concerning Human Understanding; Bk. II, Ch. xxiii, Sec. 22.

[6] Ibid. vi, 2; ix, 1.

[7] i, 3 and 4.

without; and such are perception, thinking, doubting, believing, reasoning, knowing, willing, and all the different actings of our mind; which we, being conscious of and observing in ourselves, do from these receive into our understanding as distinct ideas as we do from bodies affecting our senses. This source of ideas every man has wholly in himself."[1] One of the fundamental acts or powers of mind is that of "*bringing two ideas, whether simple or complex, together, and setting them by one another so as to take a view of them at once . . . by which it gets all its ideas of relations.*"[2] He devotes more than one chapter to "*relations,*" *which, I believe, though destined to an important place, are here, for the first time, brought onto the psychological field, as separate mental elements*—surely the mark of an epoch, good or bad. Locke tells us that relations "consist in the consideration and comparing one idea with another."[3] Had he been asked what "considering and comparing" were, he probably would have said, "the act of perceiving relations." He says "the ideas of relations are often clearer than the subjects related."[4] He devotes a good share of his work to proving, against Descartes, that ideas are never *innate*, yet it is fundamental with his own system that these "relations" are perceived *intuitively*. With simple relations, "the mind is at no pains of proving or examining, but perceives the truth, as the eye doth light, only by being directed toward it. Thus the mind perceives that white is not black; that a circle is not a triangle; that three are more than two, etc."[5] "In every step reason makes . . . there is (and must be) an intuitive knowledge."[6]

Locke classifies time-perception as partly sensation and partly reflection. He sums up his chapter on our subject with six propositions: "(1) By observing what passes in our minds, how our ideas there in train, constantly some vanish and others begin to appear, we come by the idea of succession.

[1] i, 3 and 4.
[2] xii, 1.
[3] xii, 7.
[4] xxv, 8.
[5] IV, ii, 1.
[6] IV, ii, 7.

(2) By observing a distance in the parts of this succession, we get the idea of duration. (3) By sensation observing certain appearances, at certain regular and seeming equidistant periods, we get the ideas of certain lengths or measures of duration as minutes, hours, days, years, etc. (4) By being able to repeat these measures of time, or ideas of stated length of duration in our minds, as often as we will, we can come to imagine duration where nothing does really endure or exist; and thus we imagine to-morrow, next year, or seven years hence. (5) By being able to repeat ideas of any length of time, as of a minute, a year, an age, as often as we will in our thoughts, and adding them one to another, without ever coming to the end of such addition any nearer than we can come to the end of number, to which we can always add, we come by the idea of eternity, etc. . . . (6) By considering any part of infinite duration, as set out by periodical measures, we come by the idea of what we call time in general." He says "by reflection, we perceive directly and intuitively the time-relation between these ideas."[1] "Most of the denominations of things received from time are only relations."[2] . . . "When one fixes his thoughts intently on one thing . . . he lets slip out of his account a good part of that duration, and thinks that time short." He denies, as against Aristotle, that we get our idea of succession from motion.[3] If motions are too slow, he says, we do not perceive their succession; if too fast, neither their duration or succession. The following presages psycho-physics: "Our train of ideas, when awake, probably succeed one another, in our mind at certain distances, not much unlike the images of a lantern turned round by the heat of the candle. This appearance of theirs in train, though perhaps it be sometimes faster and sometimes slower, yet I guess varies not very much in a waking man; *so has a certain degree of quickness*, with bounds beyond which it can neither delay or hasten. . . . *So that* to me it seems that the constant and regular succession of

[1] "Whenever the memory brings any idea into actual view, it is with a consciousness that it had been there before, and was not wholly a stranger to the mind." I, iv, 20.

[2] II, xxvi, 3.

[3] II, xiv, 6.

ideas in a waking man is, as it were, the measure and standard of all other successions."[1] He says "no two parts of duration can be certainly known to be equal." . . . "Time is not the measure of motion," but space *and* time . . . "time is to duration what place is to expansion."[2] In a word, time with Locke was an intuitive perception of relation between successive durative ideas; his discussions show much advance in our subject.

LEIBNITZ conceived the universe to comprise an infinite number of individual soul-units or monads, without causal relations to each other; by pre-established harmony each monad developed within itself a psychic life, "mirroring" or corresponding to the world within a certain scope around it.[3] Faculties, he declared, "were but fictions." The soul did not think, feel and perceive; but thought, feeling, perception, *were* the soul itself under different forms of activity. Time was one of these forms.[4] All thoughts were innate; "the mind itself is innate;" "all soul life develops from within itself."[5] Time, therefore, is innate, and but a "phenomenon" of soul development.[6] Leibnitz can with more consistency than Descartes declare ideas to be innate, as in his system *each* of his monads mirrors every event in the entire universe. Each is *unconscious* of all below a certain stage; thus all sensations and ideas are in the mind from the beginning, but rise to consciousness only when apperceived.[7] Characteristically of his system, he says space and time "express possibilities;" "they are of the nature of eternal truths, which relate equally to the possible and to the existing;" they determine existence in some of its relations, and as such are logically prior to any given form of existence. "Time (not duration) exists only as events are occurring, and is the relation of their succession." Time is purely rela-

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[1] II, xiv, 8–12.
[2] II, xv, 5.
[3] Monadologie, p. 709, sq.
[4] De phen. real. p. 444; à Bayle, p. 159.
[5] Prin. d. l. Nat., p. 714.
[6] Compare Noveaux Essais, LIV, ii, Ch. i; 1, IV, i; à. Bayle, p. 159; à. Clarke.
[7] à. Borguet, p. 720; à. Bayle, p. 187; Monadologie, p. 706; System Noveau, p. 127; Prin. d. l. Nat., p. 715; ad. Des Bosses, p. 740.

tive and ideal;[1] a relation, he says, cannot be in the thing which it relates; "can not have one leg in one object, and the other leg in the other." The relation exists alone in the mind; yet, if all objects and events were annihilated, time and space would still have their ideal existence in the intelligence of God as the eternal conditions of all phenomena. Leibnitz gives us few psychological details of time; he included all vaguely under his *Vorstellungskraft.* He was perhaps the first of moderns to emphasize some requirement for "joining the manifold in one."[2]

CHRISTIAN WOLFF clarified the ideas of Leibnitz with greater influence upon German psychology in general than on our particular subject.[3]

SIR ISAAC NEWTON[4] and SAMUEL CLARKE (the latter by controversies with Leibnitz[5]) focused to clearer definition the thought of their day regarding space and time.

GEORGE BERKELEY instituted one of the greatest epochs in psychology by first disclosing the complex make-up of seemingly elemental sensations, but gave attention to space rather than time. "When abstracted from the succession of ideas in our mind, I can form no idea of time at all; it is nothing."[6] He looked upon time perception as an act of reason rather than of sense. "Sense supplies images to memory; these become subjects for fancy to work upon. Reason considers and judges of the imaginations." "Number is no object of sense." "The mind so far forth as sensitive, knoweth nothing."[7] "There is that in us not given by sense, though it is only in a latent state." Yet with Berkeley ideas were not innate preconditions as with Descartes; all thoughts are the direct gift of God; for as processes and laws they fall directly from His will.[8]

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[1] Opera Philos., p. 682, 752.

[2] Ep. III, ad. Des Bosses, op. Phil., 438.

[3] His chief departure from Leibnitz is that he denied that *all* monads are perceptive.

[4] Newton thought the omnipresent existence of the Deity constituted space and time. Principia, Ch. 1.

[5] Complete Works, London, 1732–42.

[6] Prin. of Human Knowl., § 99.

[7] Ibid. XXV; Siris § 288, 305.

[8] See Campbell Frazer's Berkeley, Phila., 1881.

DAVID HUME was critical rather than constructive. From Aristotle, we have seen the requirement for some "faculty" to join the manifold of mind steadily forcing itself upon consideration. Hume stripped the problem of vagueness. After reducing mind to a succession of impressions, ideas, and relations, he declares at the end of his treatise: "All my hopes vanish when I come to explain the principles which unite our successive perceptions in our thought or consciousness. . . . In short, there are two principles which I can not render consistent, nor is it in my power to renounce either of them, viz., that *all our distinct perceptions are distinct experiences*, and that *the mind never perceives any real connection among distinct existences.* Did our perceptions either inhere in something simple or individual, or did the mind perceive some real connection among them, there would be no difficulty in the case."[1] Here is the essence of our time-problem set forth for the first time with isolated explicitness, if yet imperfectly. It is perhaps the clearest proof of Hume's greatness, that, seeing the difficulty, and not seeing the answer, he refrained from a "system."

Following Locke, Hume recognized "perceptions of relation" to be the "essence of cognition."[2] Perception of time-relations, thus became an act of reason—something more than sense. All reasoning "consists in nothing but comparison and discovery of the relations, either constant or inconstant, which objects bear to each other."[3] Yet all he can explain of relation is, "that quality by which two ideas are connected."[4]

With Hume, "the ideas of space and time are *copies of impressions perceived in a particular manner.* The idea of necessary connection is merely the reproduction of an impression which the mind *feels* compelled to conceive in a particular manner." Our idea of time "is derived from the succession of our perceptions of every kind."[5] "All impressions

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[1] Works (ed. 1854), ii, 551; Hume says it will ever be impossible to decide as to the origin of impressions—p. 113.

[2] Ency. Brit.

[3] Ibid. i, 100.

[4] Ibid. i, 29.

[5] Ibid., p. 54. Hume thinks that the idea of duration is derived from succession of change. "We associate the continual successions of our mind with steadfast objects; this gives us the idea of their (the steadfast objects) duration; without this associate succession, they would not appear in time." pp. 90, 57.

and all ideas are received or *form part of a mental experience only when received in a certain order — the order of succession.*" Yet he distinctly declares that "*Time is not a particular impression* . . . it rises from the manner of the succession of the impressions, *yet without making one of the number.*" "Five notes, played on a flute, give us the impression and the idea of time, though time be not a sixth impression, which presents itself to the hearing or any other of the senses. Nor can the mind by revolving over a thousand times all its ideas of sensation, ever extract from them any new original idea, *unless nature has so framed its faculties*, that it *feels some new original impression* arise from such a contemplation. But here it only takes notice of the *manner* in which the different sounds make their appearance, and *that* (the manner) it may afterwards consider, without considering the particular sounds, but may conjoin it (the consideration of the manner) with any other objects. The ideas of some objects it certainly must have, nor is it possible without these ideas, ever to arive at any conception of time, which since it appears not as any primary distinct impression, *can plainly be nothing but different ideas, or impressions, or objects, disposed in a certain manner, that is, succeeding each other.*"[1] It is difficult to reconcile Hume's above "*ideas* of time *derived* from succession," with his declaration that it "*can plainly be nothing but different ideas* . . . *succeeding each other.*" He did not quite arrive at the great question whether the *idea* of time is "nothing but ideas succeeding each other," yet no one has more lucidly cleared his mind to what time-perceptions are not. He was hampered by traditions of "relations," and that all ideas must be "unit representations" and "individual pictures;" yet he continually struggled toward the thought that time-perception should be explained by succession alone. One strangely isolated declaration markedly indicates his genius and the drift of his mind from his traditions. He says in his chapter on Ancient Philosophy: "The imagination readily takes one idea from another . . . is carried from one part of it (the succession) by an easy transition . . . *This easy transition is the*

[1] Ibid., p. 56.

effect or rather the essence of relation."

HARTLEY first sought to carry back much of psychology to physiology,[1] yet conceived memory and time-perception to be fundamental acts of mind.

CONDILLAC, abandoning Locke, declared "all our knowledge and all our faculties to be derived from sensations."[2] A sensation, which "preserves its vivacity," becomes attention. "If a sensation acquire greater vivacity than the former, it will become in its turn attention. . . . Our capacity of sensation, therefore, is divided into the sensation we have had, and the sensation we now have; we perceive them both at once, but we perceive them differently; the one seems as past, the other as present. The name of *sensation* designates the impression actually made upon our senses (present); and it takes that of *memory* when it presents itself to us as a sensation which has formerly been felt (past). Memory is only the transformed sensation. When there is double attention (to present sensation and past memory) there is comparison; for to be attentive to two ideas, and to compare them, are the same thing. But we can not compare them without perceiving some difference or some resemblance between them; to perceive such relations is *to judge*. The acts of comparing and judging, therefore, are only attention; it is thus that sensation becomes successively, attention, comparison, judgment. . . . . . Numbering, imagining, wondering, having abstract ideas, *having ideas of time* and number, knowing general and particular truths, are only different ways of attending;"[3] *i. e.*, are but different successive combinations of sensation.

Thus by Condillac, for the first time in history, is absolutely the whole of mind conceived to be but different successive combinations, derived from a like source and of essentially like nature; the insufficient praise, which is bestowed upon Condillac for this position, is indicative of even a present lack of appreciation of its pre-eminent truth and importance; a truth toward which all modern psychology seems gradually tending.

It is just to PETER BROWN, Bishop of Cork, to note that he

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[1] See his Theory of Vibratiuncles.

[2] Traité d. Sensations, p. 1 sq. For condensed exposition see first chapters of his Logique.

[3] Ibid.

had, perhaps, previously arrived at a similar conception, though indefinitely. Condillac preserved his belief in the soul as an entity; his follower, DE TRACY, abandoned such, while CABANIS and HELVETIUS avoided the question. Cabanis, for the French, inaugurated the epoch of considering psychology as entirely dependent on physiology. That part of his work, which has most bearing upon the matter in hand, is his physiological differentiation of internal from external sense. HELVETIUS' views are practically those of Condillac[1]. FRANCESCO MARIA ZANNOTTI, an Italian disciple of Hartley, held developed conceptions of time-associations.[2]

IMMANUEL KANT took up the problems stated by Hume; these were the mysteries of Mental Veracity and of the Unity of Diversities. For the solution of these questions Kant started with traditional belief in the dualistic entities, souls and things-in-themselves.[3] His day had not outgrown the error of conceiving the soul or mind to be the direct, active, and sole *organ* of thought; according to this view, things are known and seen immediately; the bodily organism is looked upon as a mere spy-glass, or rather, is practically neglected altogether. To Kant's clear mind, the first essence of ultimate material entity was plainly, in the light of the discussions of his day, immunity from change;[4] inasmuch, therefore, as to him, there was nothing but souls and things, since change could not happen to things, there was no alternative, but that such must be an effect or characteristic of mind.[5] This, then, is the first fundamental thought of, and key to, Kant: *The cause of all change lies in the mind.* But mental change means mental diversity; and having started with the unity of the soul, Kant was compelled to look upon mental Unity of Diversity as an ultimately insoluble mystery. Now comes the supreme merit of Kant, in that he inserted a clear wedge of distinction between the *causative* and the *caused* within the mind. He saw that diversity was a characteristic of the product or content of mind, while unity was characteristic of the way this

[1] See his De l'Homme, Vol. I, c. iv; De l'Esprit, Ch. 1.
[2] Della forza attrativa delle Idei, (1747 (?) to 1790).
[3] Critique, 2d Ed.; Meiklejohn's Tr.; pp. 22, 45, 104, 167, etc.
[4] Ibid. 29, 136, etc.
[5] Ibid. 25, 29. To Kant our bodily organism was but more "things."

content was held or bound together within or by the soul; Close at hand follows Kant's great demerit and confusion. While he is clear and consistent throughout in distinguishing the diverse content from the unitary form, he is neither clear nor consistent anywhere, in distinguishing between unitary form as *cause*, and as some sort of conscious *result*—self-conscious, even though he might conceive that result to be, in delusive distinction from other mental content or result.

Time with Kant is an *à priori* form of mind (p. 22). But confusion and contradiction is betrayed in this phrase from the outset; does he mean mind as *cause?* or mind as *result*, as *content?* Surely a result, a content, never is *till* it is, therefore the term *à priori* is never in any way applicable to it; yet we shall find Kant continually speaking of time as an *à priori intuition*, and classifying intuitions as *content* of mind.

This confusion is vital to Kant's philosophy; to understand it we must discover its origin. It will be noted that he first investigates space, and most profoundly; then he places time on precisely the same basis as space, as a "form of thought." Now when we consider sight, and remember that Kant was little, if at all, familiar with post-Berkeleyan psychology which splits up space-perception into disparate elements, we easily discover how he became impressed with the apparent unity of the visual field, in contradistinction to its diverse objective content; here "nothing objective is added to the field, when two objects appear *beside* each other;" this apparent "besideness" is nothing added to the objects, or to their objectivity, or to the objectivity of the whole field; it is, so it appeared to Kant, something apart from objectivity, from sense; he called it an "intuition." These objects are not *thought* beside each other; they merely *are* in that mental aspect. In this way space, in the abstract, appeared to him something apart from objectivity; Kant identified besideness with space, the apparent unity of abstract space with the apparent unity of the visual field; he assumed that the ultimate cause of both lay in the unity of the soul. Conceiving both to be attributes of mind, in order to designate "the field" from its objects, and space from its make-up content, he called the one "matter," the other "form." Falling in with the confusion of ages, in using mind indifferently as an equivalent both of soul and of consciousness—that is, as *cause* and as *result*, it was easy for him to fall into like confusion as to *forms* of mind, and as to space and time as such forms; and finally he accustomed himself to declare that space and time are *à priori intuitions*[1], though evidently he never intended to mean that intuitions as present mental *results* were *à priori.*

It remains to discover how he came to put time upon the same basis as space as an *à priori* form or intuition. This appears to have come about entirely through careless susceptibility to analogy. Having worked out his problem with reference to the above and below of spatial diversities, it was easy to conceive that the same formula explained the fore and aftness of temporal diversities; here was change, and again "nothing objective added," yet mental perspective and intuition of relation; once more, according to his fundamental proposition, all cause of change can alone lie in the mind (soul); here, then, is but another *à priori* form of mind, needing nor permitting further analysis. The crucial error of Kant lay in not perceiving that the "unity of diversity" problem, and the "unity of space" problem, were, at the same time, time problems. Take away the co-existence of the diversity and there is no unity of diversity—these same diversities could then succeed each other in as many individual minds, as well as in an individual mind; we are then compelled to investigate whether mere succession in an individual mind may be conceived to yield perceptions of time relations or not. Our present purpose is in no way critical; we only wish to make plain that Kant did hold that the simplest possible succession in our mind was accompanied necessarily with some sort of intuition of fore and aftness, and to show how he came to this belief. The latter I have sufficiently indicated; it remains to give clear evidence of the extent of his theory. Too frequently to be mistaken, he makes explicit his position as follows: "Time is a necessary representation lying at the foundation of all intuitions. With regard to phenomena in general, we can not think away time from them" (p. 28). "It is the subjective

[1] Chapter on Time, p. 28; p. 22, 30 § 7.

condition under which all our intuitions take place" (p. 30). "Time is the formal condition *à priori* of all phenomena whatsoever" (p. 30). "All phenomena in general, that is, all objects of the senses, [not things, but all their objective representations], are in time, and stand necessarily in relations of time" (p. 31). Hume's notes, therefore, according to Kant, carry with their occurrence some sort of intuition, or awareness of their succession, and of their time-relation. There is, we think, abundant evidence for this interpretation and none whatever against it. It is in harmony with his system of philosophy as a whole. His declarations of it are explicit and comparatively numberless. The genetic progress of his Critique shows how he arrived at this view. His whole future *à priori* handling of the categories and of the synthetic activities of the understanding conforms to and supports it. It is upon precisely this conception that Kant, from the first, makes his main and fundamental division of the mental faculties; drawing a sharp line between two chief faculties, the one passively receptive, the other active or spontaneous, he classifies intuitions entirely among the former; to the latter belong all acts of the understanding.[1] There can be no doubt that any such complicated act as memory, used in the English school sense of the term and involving recognition of *having been before*, etc., would have been classed other than as passive intuition; *i. e.*, than as he did classify time-intuition; yet excluding recognition or memory proper from reproduction, we have Kant's imagination; which, in so far as intuition of sequence or fore and aftness may be concerned, he placed undoubtedly upon identically the same footing as original sensations themselves.[2] There should be no reasonable doubt, therefore, by any school, that Kant's real position as to the time problem was that all mental series whatever, however

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[1] pp. 18, 21, 45, etc. No metaphysician excels Kant in precision in defining his faculties. We have *Vorstellen*, representation; *Wahrnehmen*, perception; *Kennen*, knowing; *Erkennen*, cognizing; *Verstanden*, understanding; *Einsehen*, perspecting; *Begreifen*, comprehending. See appendix, Tr. Critique, London, 1838. An intuition with Kant was not even a perception, because not conceived as implicating self-consciousness, p. 86. Much less did time intuition include the English act of memory.

[2] No student of Kant will declare that he conceived memory *necessary* to an intuition of time.

simple, or whether original sensation, or reproductions thereof, were necessarily and invariably accompanied by some vague awareness or intuition of their successiveness—their time order, and that the cause of this fact lay *à priori* in the soul; that the tying or joining lay altogether below the surface of consciousness in the substance of mind. It will be observed that in proportion as this conception expands in the mind and is extended over the whole range of associated reproductions, the less demand is there for any further explanation of memory; in fact, strictly speaking, this view does not require any further explanation for memory, and, as a final confirmation of the interpretation of Kant, which I have given, I would call attention to one of the most unique facts in all literature, (one I have nowhere seen mentioned), namely, that in Kant's Critique of Pure Reason, in which time-intuition plays such a preponderating part, both fundamentally to the system, and also in the page-surface of the book *the subject of memory is not once referred to, nor even the word memory or its equivalent once used, not even incidentally throughout.* This—unless in some obscure place, it has escaped my special search for it, line by line, from cover to cover. Nothing could more conspicuously emphasize Kant's preternatural genius for following out precisely and consistently any principle, right or wrong, once believed to be determined. Kant's entire system is built up on the *à priori*; and when we come to think of it, *à priori memory* would have contradiction in the very sound of it; and Kant, with instinctive and colossal consistency, actually builds up his system of mind utterly without memory.

Kant nowhere approaches discussion of particular time relations, or of how any one relation is intuited rather than another, and this is the whole problem. He tells us "time ever flows;" he does not make plain to us how his *à priori* conditions of the mind ever flow, and continually so adjust themselves that an event happening yesterday will inevitably be intuited by us to-day *as* yesterday, and a year from to-day be intuited by us as last year. Of one of a series of five notes,

[1] We do not intend to say he does not treat of memory in any of his works; he does so in the Anthropology.

say the fourth, it would be interesting to know what particular time order Kant would have conceived it *necessarily* to appear in; would it be as after the second, or as after the first, or only as after the third? or again perhaps would it be before the fifth? or if related to any event in particular, why not to one of last week, or to the last century, or to all events all together?

Thus it must be seen that Kant's own conception of an "intuition" of time, at best could have been but a vague awareness of succession in general or in the abstract,[1] and the close student of the time problem must judge for himself what that could really mean or how much he has gained by this, or by being told by Kant that time is an *à priori* form of mind.

MARCUS HERTZ[2] and other followers of Kant, wrote in explanation of his views of space and time which were adversely criticised, and particularly by ADAM WEISHAUPT.[3] JACOBI in defending empiricism, denied the *à priori* space and time; so also HERDER. SCHLEIERMACHER held space and time to be both forms of intuition and forms of objective things.

REINHOLD followed Kant in essentials, but turned the current of Germany toward "a single faculty." Perceiving Kant's confusion of causative form, with formed content, he confines his definition of time to the latter, but includes therein, as did Schleiermacher, both the matter and the form of the content. Yet this more objective ever-present time and space, which he calls "mere time" and "mere space," he insists is not empty time and space. What it is, as "ground form of all receptivity," he does not make quite clear. His struggle for more precise definition than his master, only brings more plainly to view the inherent vagueness of Kant's theory[4].

SCHULZE (Ænesidemus) and SOLOMON MAIMON threw over Kant's *Ding-an-sich*, and set the stream toward idealism. Still struggling with the "Unity of Diversity," they

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[1] p. 147.

[2] "Reflections in Speculative Philosophy." (Königsberg, 1771).

[3] "Zweifel über die Kant'schen Begriffe von Zeit u. Raum" 1787. The author has not been able to procure the above two works, and is unable to speak of them except at second-hand.

[4] "Versuch einer neuen Theorie." Buch III, S. 378–421.

reversed the usual deduction of time from the manifold—from "number of motion," and declared "Without space and time nothing would be discriminated, or separate in consciousness.'"[1] With them, time was as well a concept as an intuition.[2]

BECK has kinship with Jacobi and Reinhold, but particularly he influenced Fichte. It was Beck who introduced "*the mental act*" into philosophy; no phrase was ever more pregnant of systems. What this "mental act" is, other than the coming and going of mental content, I do not find them to have made comprehensible. A self-consciousness of the act is of course supposed to be involved. With Beck space and time are *Acts* of Synthesis; not Intuition, etc., but Intuiting, Representing, Perceiving. Before the synthesis space and time are not; they are generated in the act. Consciousness resulting from the synthetical act is "pure intuition." Continuation of the synthesis of space results in sequence. Synthesis of sequence is time. The act of synthesis must have a product; *i. e.* the spatial figure or the time must be fixed; this "fixing" of the product gives definite particular figures or times.[3]

FICHTE aspires to tell us the Why and the How, causative of mental life; to disclose that which Kant assumed as a beginning. He admits that his first step is purely an assumption, and that the consequences that can be made to result therefrom are the only warrant therefor.[5] He assumes the mental act of Beck,[6] then declares that every mental act presupposes a power or force.[7] (Why more than it presupposes a thing forceful or a soul mindful?) Thus he transposes every mental fact into a mental act, and finds for each act a

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[1] Maimon's, Versuch über d. Transcendental Philos. S. 16–18.
[2] Ibid. S. 33, 36, etc.
[3] Einzig möglicher Standpunkt u. f. t. Abschn. II. § 3, § 141–167; Grundriss d. Kritischen Philos. I, § 10, 11. 12, 13.
[4] Samm. Werke (Berlin 1845), "Ueber d. Begriffe d. Wis. 1794," I, 70; "Fichte's Science of Knowledge," Tr. by Kroeger (London,1889), p. 49; Werke, "Grundriss," I, 411.
[5] "Begriffe, 1794," I, 58 sq.; 74; "Grundlage, 1794," 92, 101, 226, etc. Tr. p. 34 sq., 54, 64, 75, 185.
[6] "Grundriss," I, 333 sq.; Tr. p. 192; "Begriffe, 1794," I, 63, 70, etc.; Tr. p. 40, 49, etc.
[7] Grundriss I, 372; Tr. 221.

power; whereupon, strangely enough, he is able to reveal to us the truth that these powers so comport themselves as to produce and explain every possible mental phenomenon, thus entirely warranting and confirming his prime assumption. For example, a red spot appears to us spatially to exclude a blue spot: Fichte tells us that a red spot is a "deed-act," the blue spot another "deed-act," that all "deed-acts" mutually exclude each other, and *therefore it is* that red spots appear to exclude blue spots.[1] Of course the value of such a system as this must depend somewhat upon the maker's preliminary interpretations of psychological facts; so long as psychology remains undetermined, or uncertain, the most that can be said for such a system would seem to be that "if things work in this kind of way, why! then this is the kind of way that things work."

According to Fichte, space deed-acts exclude or condition each other co-existingly above, below, etc. Time deed-acts condition each other in the order of a series, that is: Of a series A, B, C, D; C conditions D; B conditions C; A conditions B; A is unconditioned of B, C, or D; B is unconditioned of C or D; C of D. Thus conditioned we *must* think them in the order of their series.[2]

Fichte adds the weight of his opinion to the theory that "There is for us no *past*, except in so far as it is thought in the present . . . Whatsoever was yesterday *is not;* it *is* only in so far as I think in the present moment *that it was.* . . . Of course a time is past, if you posit one as past; and if you ask that question (is it past?) you do posit a past time; if you do not posit it you will not ask that question, and then no time has past for you."[3] Thus time with Fichte is a present thought.

SCHELLING characteristically defines time as "The I itself thought in activity."[4] Erdmann finds Schelling's deductions of space and time "most interesting" in connection with the

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[1] Grundriss 391–405; Tr. 235–249. Also, see Kuno Fischer, Geschichte d. n. Phil., V, 476, u. s. f.

[2] Grundriss 405–411; Tr. 249–255; Kuno Fischer, V, 476.

[3] Grundriss 409; Tr. 253.

[4] Tr. Idealism. Ep. II; D, III, S. 467.

"distinction of outer and inner sense in consciousness;" also, his combination of space and time with the categories.[1]

HEGEL devotes §§ 257–260 of his Philosophy of Nature to time, and treats the subject less particularly in various places. Translated into ordinary language, § 257 tells us that time involves existence or being; § 258 that it involves ceasing to exist, and coming into existence, *i. e.* change and "becoming." Then follow discussions of duration and eternity. No man will more rightly appreciate Hegel than the psychologist who sits down to discover precisely what the "Great Master" really tells him about some definite modern problem, say time. Imagine his satisfaction at having it revealed to him at the outset that "the Present" is "the transition of Being into Nothing, or of Nothing into Being" (§ 259). A watchmaker might be equally pleased to learn in some supposed supreme treatise on his art, that a chronometer is a continued Identification of the Now. Perhaps the most definite thing regarding our subject which we learn of Hegel, is that, in comprehensible moods, he classed time as a "Pure form of Sensibility." (§ 258).

ARTHUR SCHOPENHAUER declares "From Kant's doctrine of the Transcendental Aesthetic, I know of nothing to take away; only of something to add."[2] What he "adds" particularly for us, the following will indicate: "Time is primarily the form of inner sense. . . . The only object of inner sense is the individual will of the knowing subject. Time is therefore the form by means of which self-consciousness becomes possible for the individual will, which originally and in itself is without knowledge. In it the nature of the will, which in itself is simple and identical, appears drawn out into a course of life."[3] Also, "Time, space, and causalty are that arrangement of intellect by virtue of which the *one* being of each kind which alone really is, manifests to us a multiplicity of similar beings, constantly appearing and disappearing in endless succession."[4]

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[1] Gesch. d. Philos. § 318. Tr. p. 567.
[2] World as Will and Idea. Tr. Haldane and Kemp. (Boston, 1888) Vol. II, p. 33.
[3] p. 207.
[4] p. 224.

In a more empirical mood he declares "Succession is the whole nature of time";[1] this is adverse to the side of the great debate which Fichte took in declaring time to be not "succession" but a "present thought."

CHR. HERMANN WEISSE and I. H. FICHTE (half-Hegelians) criticised their master for not treating space and time as any of the other categories of knowledge or "forms of reality," and in his Logic rather than in his Philosophy of Nature.[2] Fichte developed space and time from certain "*feelings of duration and extension which are inseparable from self-consciousness, and which feelings have their basis in the soul's own objective nature.*"[3] From a similar standpoint, E. H. WEBER, in 1852, coined the now famous phrase "*The Space-sense,*" and following him CZERMAK first used its analogue "*The Time-Sense.*" These are important events in the experimental history of time. Weber and Czermak looked upon space and time as being senses as disparate as sight and hearing. Yet from their universality they called them General Senses as opposed to the special.[4]

FRIES was most influenced by Jacobi, but declaredly clung to Kant's views of time.[5] Yet he distinguishes between *à priori* "cause" of intuition, and intuition *per se*.[6] He begins to take the bodily organism a little into account,[7] and was troubled as to what *particular* time-relations would be perceived from Hume's mere sequence of notes; but he thought "in some sort of a way I get possession of these co-existently" (p. 142). He vaguely described this "some sort of a way" as "a fundamental determination or fixing of the mind."[8] He declares that all sense perception must appear in the mind "joined" (*verbunden*). Particular time-relations Fries derives from the "reproductive" and "produc-

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[1] p. 9.
[2] Article by Weisse in Fichte's Zeitschrift, 1837.
[3] Ibid, new Vols. 55, p. 237 sq.; Vol. 56, p. 47, sq.
[4] Weber, Berichte ü. d. Verhandlungen, d. K. S. G. W. Math. Physische Classe, 1–4, S. 85. Jahrgang, 1849–52. Czermak — Gesamm. Schriften, I, 416.
[5] Kritik d. Vernunft (Heidelberg, 1828), Vol. I, p. 173, etc. Erdmann's Hist. Philos. (Tr. 1890), II, 454.
[6] p. 173 sq.
[7] p. 94.
[8] p. 69, 106, 110, 120, 124, 141, *171*, 174, *177 sq.* 188.

tive powers of Imagination"; by which they are "attributed" their proper time-aspect in the passing content of mind.[2] In proportion as he conceived the course of our thoughts to be determined at will, these time-aspects were bestowed voluntarily.[3] Yet more than any German of his day he gave consideration to the rôles which memory,[4] association, habit, training,[7] "former occurrence,"[8] "fading,"[9] etc., play in "mental inter-determination." In these he is abreast with the best of the Scotch-English school of his day. In all but the vague "some-sort" of intuition of sequence, Fries' time-relations are *perceptive acts.*[10] He also inclined to a more objective conception of space and time than Kant, in that he at times conveys the idea that space is "visible extension void of particular or limited content"; and that time is some sort of analogous objective inner sense. Fries is also more generous to realism than Kant, and is inclined to conceive relations actually existing between things, to which in themselves he consequently carries over Space, Time, Motion and Change.[11] In view of the importance which the phrase, "The idea of succession is not a succession of ideas" assumes in subsequent stages of the discussion, it is important to note that Fries apparently was the first definitely to emphasize the declaration that "all the terms or elements of unification, comparison or relationship must be before consciousness at the same time."[12]

Thomas Reid deserves great credit for bringing out many of the difficulties of the problem to clear and simple view. He declares: "I think it would be impossible to show how we could acquire a notion of duration, if we had no memory." This is against Kant's view. "Memory implies a conception and a belief of past duration. . . . Remembrance is a

[1] p. 102, 137, 145, 161, *175*, 177, 178 sq., 185, 188, 192.
[2] p. 161, *175*.
[3] p. 77, 83, 163, 185, 187 sq., 196.
[4] p. 135 sq. 161, 165.
[5] p. 142, 148, 153 sq., 160, 162 sq., 187 sq., 193.
[6] p. 168.
[7] [8] p. 137, 160, 162 sq., 165.
[9] p. 138.
[10] p. 86.
[11] p. 77, 83, 163, 185, 187 sq., 196.
[12] p. 141, 180.

particular act of the mind of which we are conscious. . . . I believe that I washed my hands and face this morning; how do I come to believe it? I *remember* it distinctly—that is all I can say. . . We know many past events by memory; but how it gives us this information I believe is inexplicable. . . . I think it appears that memory is an original faculty, given us by the author of our being of which we can give no account, but that we are made so. . . . All our original faculties are unaccountable."

Yet Reid makes contributions to the time-problem. He takes Locke to task for confounding succession with duration: "the notion or idea of duration must be antecedent to its being measured"—to succession.[1] Also we must crown Reid for grasping more definitely than anyone before his time this cardinal aspect of the subject: "It may be observed," he says, "that if we speak strictly and philosophically no kind of succession can be an object of either the senses or of consciousness; because the operations of both are confined to the present point of time, and there can be no succession in a point of time; and on that account the motion of a body, which is a successive change of place could not be observed by the senses alone without the aid of memory" (p. 348). Criticising Hume for saying that impressions reappear, he declares "the thing is impossible." "Impressions are fleeting perishable things, which have no existence but when we are conscious of them" (p. 357). He makes rather lame fun of Hume's explanations of time by "reappearances of varying intensity." "Suppose a man strike his head against the wall, this is an impression; now he has a faculty by which he can repeat this impression with less force. . . . This by Mr. Hume's account must be memory" (p. 357). Reid admits that "it is probable that in the human frame memory is dependent on some proper state or temperament of the brain; yet says he "if we knew distinctly that state of the brain which causes memory we should still be as ignorant as before how that state contributes to memory" (p.354); "an ability to revive our ideas or perceptions after they have

[1] Works. Edinburgh, 1872, p. 339–360.

ceased to be, can signify no more but an ability to create new ideas or perceptions similar to those we had before" (p. 355). How we recognize perceptions we have had before, is to Reid inexplicable.

DUGALD STEWART advances our problem only in a general way by forcible analysis of such questions as Identity, Association, Memory and Reason. He says, "the idea which is commonly annexed to *intuition* as opposed to *reasoning*, turns, I suspect, entirely on the circumstance of time."[1] "For this reason I look upon the distinction between our intuitive and deductive judgments as, in many cases, merely an object of theoretical curiosity" (p. 71). He declared like Reid "the theories which attempt to account for the phenomena of memory by means of impressions and traces in the brain, are entirely hypothetical, and throw no light on the subject which they profess to explain" (p. 393).

THOMAS BROWN deserves conspicuous rank among the Fathers of Psychology. One of his services was to disclose (it is not yet dispelled) what Prof. James calls the "Great Psychological Fallacy;" this consists in unconsciously carrying over and accrediting to some psychological act or phenomenon which we may be analyzing, those other feelings, mental acts or states which we have *while* introspectively making this analysis. This fallacy had led to the great debates before Brown's day, relative to the distinction between sensation and perception, till then it having been almost universally maintained that perception included self-consciousness, a knowledge of *a* mind looking on *at* mind. Brown says, "to me it appears, that this attempt to double, as it were, our various feelings, by making them not to constitute our consciousness, but to be the object of it, as of a distinct intellectual power, is not a faithful statement of the phenomena of the mind. . . . . Sensation is not the object of consciousness different from itself, but a particular sensation is the consciousness of the moment. . . . 'I am conscious of a certain feeling' really means no more than 'I feel in a certain manner.'"[2] Also Brown's revelations regarding the genesis and make-up of

[1] Works—(Cambridge, 1829), II p. 69.

[2] "Lectures on the Philosophy of the Human Mind." (Philada. 1824), Vol. I, p. 135, sq.

our conception of space are important contributions to psychology; from these he carried over certain analogous determinations to the enrichment of the time problem. Having deduced the notion of space from motion, and that of length from continued or successive motion, he conceived the origin of the idea of time to lie in identically the same thing—that length of extension and length of duration are ultimately one —(p. 305). He discovered this element of length in all mental processes. "Continuous length and divisibility, those great elementary notions of space and time and of all that space contains, are thus found in every succession of our feelings" (p. 306). He also gives us a nearer view of their development. "If," says he, "we gradually extend our arms in various directions, or bring them nearer to us again, we find that each degree of the motion is accompanied with a feeling that is distinct, so as to render us completely conscious of the progression. The gradual closing of the hand, therefore, must necessarily give a succession of feelings, a succession, which of itself might, or rather must furnish the notion in the manner before stated, the *length* being different according to the degree of the closing, and the gradual stretching out of the arm gives a succession of feelings, which in a like manner must furnish the notion of length—the length being different according to the degree of the stretching of the arm. . . . The Infant . . . by frequent renewal of the series of feelings involved in each gradual contraction, cannot fail to become so well acquainted with the progress as to distinguish each degree of contraction, and at last, after innumerable repetitions, to associate with such degree, the notion of a *certain length of succession*. . . . In these circumstances of acquired knowledge (after the series of muscular feelings, in the voluntary closing of the hand, has become so familiar, that the whole series is anticipated, and expected as soon as the motion has begun) when a ball or any other substance, is placed for the first time in the infant's hand, he feels that he can no longer perform the usual contraction; or in other words, since he does not fancy that he has muscles which are contracted, he feels that the usual series of sensations does not follow his will to renew it; he knows how much of the accustomed succession is still remaining, and the notion of the particular length which was expected and interrupted by a new sensation, is thus associated with the particular tactual feeling excited by the pressure of the ball. . . . By frequent repetition and association . . . these two feelings flow together; . . . it becomes, at last, as impossible to separate the mere tactual feeling, from the length of feeling (time) as to separate the whiteness of a sphere in vision, from that convexity of the sphere, which the eye, of itself, would have been forever incapable of perceiving" (p.309 sq.). "The series of muscular feelings of which the infant is conscious . . . must on these principles, be accompanied with the notion . . . of a certain length of succession, and each stage of the contraction, by frequent renewal, gradually becomes significant of a particular (time) length corresponding with the portion of the series" (p. 297). These deductions hold of all, as well as of the muscular sense. "Time or succession then, involves the very notion of longitudinal extension and divisibility and involves these, without the notion of anything external to the mind itself; for though the mind of man had been susceptible only of joy, grief, hope, and the other varieties of internal feeling, *without* the possibility of being affected by external things, he would have still been capable of considering these feelings as successive to each other in a long continued progression, divisible into separate parts. The notion of length, then, and of divisibility, ~~are~~ is not confined to external things, but ~~are~~ is involved in that very memory by which we consider the series of the past, not in the memory of distant events only, but in those first successions of feeling by which the mind originally becomes conscious of its own permanence and identity. The notion of time, then, is precisely coeval with that of the mind itself; since it is implied in the knowledge of succession, by which alone, in the manner above explained, the mind acquires the knowledge of its own reality, as something more than the mere sensation of the present moment. Conceiving the notion of time, therefore, that is to say, of feelings past and present, to be thus one of the earliest notions which the infant mind can form, so as to precede its notions of external things, and to involve the notions of length and divisibility, I am inclined to reverse exactly the process commonly supposed, and instead of deriving the measure of time from extension, to derive the knowledge and original measure of extension from time" (p. 307).

This is one of the most noteworthy passages in the history of our subject; particularly so when we compare its truly remarkable penetrations and suggestiveness with its glaring contradictions; evidently the crucial question, whether time is an idea or a succession of ideas had not come to a focus in the mind of this acute psychologist; within short spaces he confounds the two concepts in a way that must necessarily lead him to false conclusions.[1] All through the above discussion we have been led to believe that the idea of time lies in the successions themselves, in precisely the same way as Brown took so much pains to explain that "perception of a sensation" was the sensation itself; but the moment he takes up the subject of time under another aspect—that of memory or of relations—his traditions prove stronger than his originality, and he tells us that "*certain feelings of relation*" constitute our notion of time.

Before examining this let us make sure what, in the conception of this great mental-chemist, these "relations" were. He says, "the feelings of relations are states of the mind essentially different from our simple perceptions or conceptions of the objects that seem to us related, or from the combinations which we form of these in the complex grouping of our fancy." "There is an original tendency or susceptibility of the mind, by which on perceiving together different objects, we are instantly, without the intervention of any other mental process sensible of their relations in certain respects, as truly as there is an original tendency or susceptibility of the mind, by which, when external objects are present and have produced a certain affection of our sensorial organ, we are instantly affected with the primary elementary feeling of perception." "As our sensations are of various species, so are there various species of relations . . . the number of relations, indeed, even of external things being almost infinite," etc., (p. 146).

[1] Compare p. 297 with p. 307.

We now may understand Brown when he says "time, as far as we are capable of understanding it, is nothing more than the varieties of the felt relation; which in reference to one of the subjects of the relation we distinguish by the word *before*, in reference to the other, by the word *after* . . . All of which we can be said to be *conscious*, is certainly the present moment alone. But of that complex state of mind, which forms to us the present moment, there are parts which impress us irresistibly and beyond all the power of scepticism with the relation, which, as I have already said, we term *priority* in reference to the one, and *succession* or *subsequence* in reference to the other; time as felt by us, being this relation of the two and nothing more."[1] . . . "It is a relation we may remark, which we feel, nearly in the same manner as we feel the relation which bodies bear to each other as co-existing in space."

This last is remarkable from one who has deduced space from time—from the mere successive feelings of "length" in stretching the arm. Also Brown's genesis of time as detailed above, and his notion that time is one of the earliest notions of the infant, "preceding its notion of external things," are difficult to reconcile with his declaration that "if we had been incapable of considering more than two events together, we probably never should have invented the word time" (p. 90). We have to regret that Brown did not give the same weighty scrutiny to "relations" which he gave to the analysis of space.

Brown developed further the common doctrine of association or "suggestion" as he termed it, by adding thereto a further class or realm, of association among "relations"; the former he termed "simple suggestion;" the latter "relative suggestion." Among these last he classed time perception. Thus it must be observed, though arrived at from entirely different standpoints these "*feelings* of time relation" are essentially kin to the disparate "time-sense" of Czermak and Vierordt, and the time "feeling" of I. H. Fichte, and as we shall see later of Horwicz, and James.

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[1] Ibid, Vol. II, 91.

Sir William Hamilton falls back from Brown toward Kant. He nowhere gets beyond the antique vagueness that "time is the necessary condition of every conscious act."[1]

Herbart is the Morning Star of modern German Psychology. Schwegler describes his system as "an extension of the Monadology of Leibnitz."[2] Herbart's monads, however, are "eternally unchangeable," and in place of the Pre-established Harmony of Leibnitz, the reciprocal interactions of the monads or "reals" are the direct cause of their intelligence. The diversities of mental content are primarily due to respectively diverse kinds of "reals"—for every red, shrill or cold sensation, a red, shrill, or cold monad.[3] Mind as the product of the interactions of these monads is a mathematical mechanism.

The following indicates Herbart's mechanism of time. Some "real" attacks our "real" (the soul) which "seeking to preserve its own condition," a corresponding sensation *a* results; *a* thus rises in consciousness till equilibrium is reached between the force of the "real" and the "self-preserving" force of the soul; *a* "sinks" as the soul gains the mastery and restores itself by expelling the attacking "real." The level at which any consciousness begins is its "threshold."[4] If while *a* durates in consciousness, another sensation *b* similarly rises, then *a* and *b* "fuse" (associate) proportionately to their "remnant" or remaining co-presence, height or intensity in consciousness; thereafter, whenever either *a* or *b* appears in consciousness, it tends to bring back the other with a force proportional to the above "fusion." If *a b c d* rise in an original sequence, and *a* by any cause be brought back into consciousness, it will tend to bring with it *b; b* to bring *c;* and *c* to bring *d;* thus the whole series will repeat itself in the time order of its original occurrence.[5] If, moreover, at any time thereafter *c* be the first of the series to be brought back, then its influence will work in two directions; the series *c d* will repeat itself as in the original

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[1] Lectures (Boston, 1871), I, 548.
[2] Hist. Philos. (Sterling Tr. Edinburgh, 10th Ed.) p. 285.
[3] Lehrbuch zur Psychol., § 150 sq., etc.; Allgemeine Metaph. § 312, "Wie viele Merkmale—so viele Ursachen."
[4] Lehrbuch, ch. 1.
[5] Ibid. § 29 sq.

sequence; but at the same time *c* will act both upon *b* and upon *a* in proportion to its former "fusion" with each of these; consequently, while *c d* reinstates itself as a "series of evolution," the combination *a b c* rises simultaneously through "involution" *c* appearing brighter than *b*, and *b* than *a*, *i. e.*, fixedly in proportion to their original fusion—that is again, in brightness proportional to the time-order of their original appearance.[1] These laws may be carried out through all the familiar complexities of Association, "series and ever-compounding series of series" being substituted for the letters of our formula.

But in particular how are time-perceptions formed? Suppose an original series *a b c d e*, as above. Should *a* be again presented the series tends to repeat itself by "evolution" in its original direction. Should *e*, however, be the first to appear of a re-presentation, then the series tends to be brought back as a whole, co-existently and by the above process of "involution." Finally, should *a* and *e* be reproduced *simultaneously*, a compound result would now occur; a result including and combining both the previously mentioned results: that of the "involution," occurring from *e*, and the "evolution" following from *a*. In this final process, it will be observed, are involved three requisites: (1) *The involutive product*—in which all the members of the series are simultaneously represented, but each with a brightness corresponding to its time order or degree of "fusion" in the original sequence. This may be called the *presentation of the series.* (2) *The evolutive product*—which is an actual re-occurrence of the original series in the same time order, and each member in proportion though not with equal brightness, with that in which it first appeared. This may be called the *presentation of the succession*—that is, of the process itself or of change. (3) By the combination of (1) and (2) the two end terms of a series are presented in a proper double simultaneous relation, that is as both co-existently *present*, yet both also in serial perspective of fixed single direction. This may be called *the presentation of their terminal time-relation.* Thus in (1), (2) and (3) together, we have the three elements,

[1] Ibid. § 167 sq.; 75 sq.; 89 sq; Psych. als W. § 94, 112, 115.

which Herbart conceived to be essential to a complete perception or idea of time; namely: An idea of the series, an idea of succession or change, and an idea of definite terminal relations.[1]

Suggestive as is the method, and scientific as is the spirit of Herbart's time theories, it is of chief importance for us to note accurately Herbart's true position regarding time-perception as an instantaneous state, or a succession of states; this especially because of the weight of Herbart's opinion as an authority; of his great influence upon the German Psychology of to-day; of the constant misconception and misquotation of his opinion, and of the crucial value of the question itself. By holders of the first view, much is made of Herbart's phrase, "Succession in presentation is not a presentation of succession."[2] While to any student of Herbart it is plain that *not every* succession of mental content suffices to constitute or yield an idea of time-relation, yet it is just as plain that no single *simultaneous* condition of mind does or can constitute the same. Herbart's time-perception is a three-fold *process*—not a single present *state.* It is also important to note that Herbart imports into his three-fold process no extra or disparate sense or feeling; *Herbart's perception of time-relation, consists of certain proper successive combinations of our ordinary sensations or feelings, or of their reproduced representatives.*

FRIEDRICH EDUARD BENEKE founded a new psychological system more or less kin to that of Herbart and to the English Empirical School, but he gave no new explanations of time.[3]

MORITZ WILHELM DROBISCH, a disciple of Herbart, declared space and time to be but "forms of succession" (*Reihenformen*).[4]

THEODOR WAITZ, from an Herbartian starting point,[5] introduces a new aspect of the problem—one that assumes great importance in the modern psychology of Wundt, Münsterberg,

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[1] Ibid. § 167 sq.; § 75 sq.; § 89 sq. Psych. als W. § 94 sq.; § 112 sq.; § 115.

[2] Lehrbuch zur Psych. § 174; Allg. Metaph. ch. 1 sq.

[3] "Die neue Psych." Berlin, 1845; Lehrbuch d. n. Psych. 2d Ed. (Berlin, 1845); Pragmatische Psych. (Berlin, 1850), 2d Ed.

[4] Empirische Psych. (Leipzig, 1842), p. 67.

[5] Lehrbuch der Psych. (Braunschweig, 1849), p. 580, 583.

et al. He points out that "certain conditions of feeling" such as constitute waiting, impatience, tediousness, straining of attention and the like, always accompany our objective contents of thought; and he holds that these are fundamental in the formation of our time percepts. The process by which this happens is not unlike that given above from Thomas Brown. A well remembered series of these obscure inner feelings, that is, a series of them which has been frequently repeated in us, is compared with, that is, "*runs its course simultaneously with*" a new objective series, say of vision: the new visual series over-runs, or runs short of the old constant series of feelings, and the shortage or overplus of these last constitute our means of judgment, or time-measures of the new series. These overplus and shortage earmarks become "fused" or associated with all sorts of combinations and abstractions, and form the fundamental measure elements of all our time concepts.[1]

Rudolph Hermann Lotze, notwithstanding his eminence in modern philosophy and the originality of his determinations regarding "local signs" and space, adds little to the discussion of the time problem. He believed in the "power of the soul to preserve impressions independently of physical conditions."[2]

Heinrich Czolbe, of all moderns, must be credited with the most unique view of time. He regarded all sensation as extended in space, and time as a fourth dimension of space.[3]

Wilhelm Rosenkrantz, last of the School of Schelling, newly discussed time as a category or form of thought in its intercourse with the outer world.[4]

Leopold George, pupil of Schleiermacher and Hegel, declared: "By means of memory the moment of time is introduced in the [*i. e.* his] system of localized points"; but "memory does not reproduce traces of sensation as is generally thought, but reproduces combinations, the occasions

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[1] Ibid. § 52.

[2] Medicin. Psych. § 36, p. 473.

[3] Posthumous Work, "Outlines of an Extensional Theory of Knowledge. Edited by Dr. Johnson (1875). Compare with this from Diogenes L. VII, 141, "Time is the extension of the motion of the world (διάστημα τῆς τοῦ κόσμου κινήσεως). It is infinite both in the direction of the past and of the future.

[4] Die Wissenschaft des Wissens (Munich).

for which have been supplied by the sensations."[1] Particularly he combats the time theories of Trendelenburg.

TRENDELENBURG, going back to Aristotle, held space and time to be products of motion.[2] In opposition to Kuno Fischer he particularly criticized the time theories of Kant and Herbart.[3]

ULRICI examines the subject from the stand-point of "Speculative Theism," and semi-Hegelianism, but gets little further than such declarations as that "Thought is bound by certain rules, of which time is one."[4]

FECHNER discusses time, space and motion, as it would seem, with particular reference to the writings of Trendelenburg, but without his usual originality.[5]

BRENTANO, Professor of Philosophy at Vienna, in his Psychologie vom empirischen Standpunkte (Leipzig, 1874), gives an interesting exposition of the views of a certain current transitional school, but does not focus definitely on the subject of time.

HORWICZ is a prominent advocate of the modern tendency to make physiology the sole source and guide of both psychology and philosophy.[6] The metaphysical question of *how* the body excites any feeling at all in the soul, he considers vanity and folly. (I. 143). Soul is "a collective designation for all psychic phenomena." (I. 135). He reduces all of mind to simple elements of "feeling." Change in feeling follows change in nerve substance. (2 Vol. III, 41). "All soul processes are built up (of the ultimate feeling elements) through repetition and complication." (I, 202). Frequence of repetition plays the fundamental rôle (p. 345 sq.). Certain frequency gives us sight, another sound, etc. Time-sense, and space or place sense are special senses to be classed

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[1] Lehrbuch der Psych. (Berlin, 1854). p. 222, 399.

[2] Logische Untersuchungen (Berlin, 1840). Vol. VI.

[3] Vol. III. Hist. Beiträge zur Philos.; (pamphlet) "Kuno Fischer und sein Kant" (Leipzig, 1869); K. Fischer's Geschichte d. neuren Philos. (2d ed.) Vols. III and IV, 1869.

[4] Das Grundprincip der Philosophie, Leipzig 1845–6; System der Logic (1852); Compendium der Logik (1860 and 1872); Outline of Practical Philos., pp. 1–208.

[5] Physik. u. Philos. Atomenlehre (Leipzig, 1855–1864). Appendix.

[6] Psychologische Analysen auf physiologische Grundlage, 1st Part. Halle, 1872, 2d Part (2 Vols. Halle und Magdeburg, 1875–1878).

with sight, hearing, etc. (p. 340). This, though time appears *only with* and *always with* other sensation. Horwicz's classification of the senses, according to their *objectivity*, is strangely in opposition to Kant: "Objective (end of scale); Time-sense, space-sense, eye, ear, pressure, temperature, smell, taste, general feeling of the skin, feeling of the organism or general feeling; subjective (end of scale.)"

Sensations, on their physical side, leave effects in the nerve elements, which are the basis of our ideas or reproduced sensations. Metaphysical identity Horwicz declares to be an insolvable metaphysical question, but mental or objective identity is at least an "unsuspected likeness" (p. 107). From reappearances of these unsuspected likenesses under the usual laws of reproduction and association, Horwicz builds all our concepts of memory and of time-relation. He plants himself unmistakably on the side of those who declare all perceptions of time-relation to be only certain successions of properly compounded sense presentations, or feelings.

Horwicz betrays the influence of modern experimental time psychology; rhythm now plays the important rôle. Rhythm he declares to be the measure and the only measure of time; a being incapable of regular periodic intervals could attain no conception of time. All the rhythmic functions of the body serve this purpose; as breathing, pulse, leg-swing and other such movements, hunger, sleep, labors, duties, customs of all kinds. Thus our time measures spring from and enter into the most fundamental and most subtle depths of our being (III, 145).

WILHELM WUNDT, at present the most conspicuous figure in German Psychology, has given us positive determinations of unusual originality and value; this whether the merit of his system be as entirely obvious or not.[1] He reduces all mind to ultimate elements of "will;" indeed, elementary acts of will, as activities, rather than as sensations, are the ultimate constituents of the entire universe.[2] Higher manifestations of these elementary will components are feelings and

[1] For English criticism see "Mind," January, 1890.
[2] System der Philosophie (Leipzig 1889), p. 438

sense-perceptions. Combinations again of these last mentioned products, give us sensations proper, but as a matter of fact, we never experience even sensations, as single elements, but alone complex combinations of them, such as our ordinary complex sights, sounds, etc.[1] The nature of this lowest element of mind is, however, that of a judgment; in the merest experience, say of red, is a recognition—a judgment of it as red. Therein lies the root and nature of all reason, of all mental acts; which acts are but complications or compilations of elementary willful judgments.[2] Inherent in the nature of this ultimate unitary judgment, is the problem of recognition of identity.[3] Why elements of mind exist at all we do not know; why diversity rises from these units we do not know; why we judge or identify the diverse we do not know. That we *do* these things is assumed as an ultimate fact. From these ultimate assumptions all mind develops; the processes of its development are alone the province of psychology; what may lie back of these is the province of metaphysics.

In the same way that the *content* of mind is ultimately incomprehensible, so also is the fact that its diversities succeed each other; the nature and the manner of these successions is all that psychology can study. All mind then is but a succession of diversities; certain of these we call ideas, perceptions, conceptions or postulates — among others are those of time.[4] Yet not every mental succession suffices to constitute an idea or perception of time—an idea or even the simplest possible perception being a highly complex product. The crucial process of time-perception Prof. Wundt describes as follows: "Assume that . . . similar pendulum strokes follow each other at regular intervals in a consciousness otherwise void. When the first one is over, an image of it remains in the fancy until the second succeeds. This, then, reproduces the first by virtue of the law of association by similarity, but at the same time meets with the aforesaid persisting image. . .

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[1] Grundzüge der Physiologischen Psychologie (Leipzig 1887) II, 226.
[2] System, p. 573.
[3] System, p. 504.
[4] System, p. 428 sq; 431 sq.

Thus does the simple repetition of the sound provide all the elements of time-perception. The first sound [as it is recalled by association] gives the beginning, the second the end, and the persistent image in the fancy represents the length of the interval. At the moment of the second impression, the entire time-perception exists at once, for then all its elements are presented together, the second sound and the image in the fancy immediately, and the first impression by reproduction. But, in the same act, we are aware of a state in which only the first sound existed, and of another in which only its image existed in the fancy. Such a consciousness as this is that of time. . . . *In it no succession of ideas takes place.*"[1]

It can not fail to be observed that the above time-perception is a *process* and not a *state*. Notwithstanding Wundt's last words in italics this process is surely a succession of some kind or kinds; though of course it is not a "succession of ideas," if by idea is meant the process as a whole. There seems no good reason for confusion on this point.[2]

Prof. Wundt discusses constancy (duration), change, and rhythm with perspicuity and truth.[3]

Prof. LIPPS one of the representative German Psychologists describes the time-process as follows: "Sensations arise, occupy consciousness, fade into images and vanish; according as two of them, *a* and *b*, go through this process

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[1] Physiological Psychol. 1st Ed. p. 681-2. Tr. in James' Psychology, Vol. I, 608. James adds "note here the assumption that the *persistence* and the *reproduction* of an impression are two processes which may go on simultaneously. Also that Wundt's description is merely an attempt to *analyze the deliverance* of a time-perception, and no *explanation of the manner in which it comes about*."

[2] Prof. Wundt contributes confusion as follows: Logik p. 432. "Die Vorstellung zeitlicher Aufeinanderfolge ist nicht selbst eine Aufeinanderfolge von Vorstellungen, sondern eine aus der letzteren hervorgehende *simultane* Anschauung, in welcher sich die Wahrnehmung zweier getrenter Vorstellungen. die als Anfangs- und Endpunkt einer Zeitreihe gegeben sind, mit dem Bewusstsein eines sie trennenden andersartigen Inhaltes verbindet. Dabei kann dieser letztere, entweder bloss aus der Nachdauer der ersten Vorstellung, oder ausserdem, aus neuen Vorstellungen bestehen, deren Nach-wirkungen zu derjenigen einer ersten Vorstellung hinzu tretten. Wesentlich für die Anschauung der Zeit, ist somit, einerseits die Verbindung verscheidener getrennter Vorstellungen mittlest der Reproduction, und anderseits das ebensfalls durch Reproduction vermittelte Bewusstsein ihrer Trennung."

[3] p. 435.

simultaneously, or as one precedes, or follows the other, the *phases of their fading* will agree or differ; and the difference will be proportional to the time-difference between their several moments of beginning. Thus there are differences of quality in the images, which the mind may *translate* into corresponding differences of their temporal order. There is no other possible middle term between the objective time-relations and those in the mind than these differences of phase."[1]

Prof. Lipps calls these "temporal signs"; what his process of mental translation of these signs may be is difficult to conceive, and it were about as easy to call the whole problem an inexplicable mystery and be done with it.

ERNST MACH, a prominent representative of the experimental school, also carries back our problem to a special time-*sense* or feeling, "as special as that of color."[2] He says we can separate the rhythm of a melody from the tone, as much as the contour from a painting, and that this would not be possible were the rhythm not a separate series. He suggests that there may be in the ear some accommodation apparatus like that of the eye, which may be the organ of the temporal sense. Time-sense, therefore, would be, and is closely allied to the workings of attention; certain "fixation" sensations arise from this accommodation organ, varying according to intensity, duration, pause, etc.; a greater amount of attention always indicates the *later* impression; this happens by reason of association with sense of fatigue of the organ. "But adapted condition" would in time be called up by external happenings, as in eye-adaptation and these called-up ear-marks thus give us temporal distance and sequence, in the same way as we get visual distance and perspective.[3]

DR. HUGO MÜNSTERBERG finds in respiration a solution of the time-problem (analogous to Mach's theory above) which

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[1] Grundtatsachen des Selenlebens (Bonn, 1883). p. 588. Tr. James' Psy. p. 632.
[2] "Untersuchen über den Zeitsinn des Ohres," § IV. "Beiträge zur Analyse der Empfindungen," pp. 6–14.
[3] Ibid, p. 103 sq.

will be considered presently in connection with the work of other experimentalists.

Prof. WILHELM VOLKMANN discusses time with his usual comprehensiveness. A brief review of his discussion will close the history of the German schools, and thus, what may be considered a fair representation of the latest status of our problem in that country, will be brought into close comparison with the views of James Mill of the English school, which will then follow.

The general system of Volkmann is so essentially that of Herbart as to need no further exposition here. Regarding time, however, Volkmann takes a more literal position than his master as to whether the idea of succession is or is not a succession of ideas. He says: "Indeed when one considers the matter precisely, he discovers the antithesis, that the presentations *A* and *B*, in order to be perceived as successive, must be presented simultaneously; that is, in order to *appear* to be after each other, they must *be* present."[1] "In order to become conscious of a presentation as ended, we must bring it into some other presentation which appears to us as going on." In original sensations as opposed to their reproduced images he finds the requisite data of distinction for the "going on;" these form our present. Of a succession of sensations *A B C* only one is present—"the present of one excludes that of the others. But this exclusion is purely negative; if a time-presentation is to arise, the not-present (say of *A* and *C*, while *B* is present) must be raised from the negative to the positive form." "This happens in that *A* and *C* (while *B* is present) each in a different manner, continue to influence B" (according to ordinary Herbartian psycho-mechanics). *A*, although having passed out of the focus of sensation, struggles to preserve to itself that condition as against *B*; *B* repells this endeavor, and in the reflex, which the presentation of *A* in itself suffers, lies the perception *(Bewusstwerden)* of time as *a quality of A, i. e.* the perception of it as "no more." Thus with Volkmann this secondary reflex feeling of strife,

[1] Lehrbuch der Psychologie von Standpunkt des Realismus (Cöthen, 1885), II, p. 12.

suffered by reason of the contention of the sensations themselves for the focus-point or present of consciousness, is the essential element of time-perception. Similarly to this struggle of "no-more," or "feeling of past," of *A*, is developed the "not-yet" of *C*, *i. e.*, the feeling or intuition of future. The time-sense with Volkmann is, therefore, more thoroughly a disparate sense, though also a "general sense," than even sight or hearing.

"No-more and not-yet," he continues, "are the specific *(eigentlichen)* time-feelings, and we should never become conscious of time otherwise than through these feelings. . . . When a series has once taken on this time-form (as above) it preserves the acquired characteristic, in future reproduction of the same, but only when, and in so far as the same conditions are renewed, under which the original time-form was developed. . . . The presentations *(A B C)* remain what they are, but the manner of their presentation changes; all time-consciousness, as feeling, is a perception (*Bewusstwerden)* of presentations" (§§ 86, 87).

Regarding duration, a corresponding struggle to that of "no-more" and "not-yet-there," gives us the feelings of "yet-there." Complications of these constitute our feelings of tediousness, ennui, expectation, monotony, haste, fast, slow, etc. "The rise and fall of these strifes, bring into the life of the individual certain rhythms" which become our measures of duration and of time. So separate is the *sense* of time from the *content*, that various presentations may produce the same feelings of time or of duration, *i. e.*, the same perceptions of time-length and time-relationship (§ 88).

Upon these main principles, Volkmann develops all the more varied and complicated time concepts, up to those of eternity and of time in the abstract. This, in a truly masterly manner, whether the fundamental metaphysical assumption of all his strife mechanism between mental elements be in any way warranted or not.

James Mill follows Thomas Brown in denying any difference of essential nature between sensation and perception. He took upon himself the task of removing still more completely the "Psychological Fallacy" of self-consciousness, from our conceptions of mental processes.[1] Yet Mill was not altogether able to free himself at once from the inbred uses of language, or even from the habits of thought current in his age, and indeed still current in the popular psychology of to-day. If, however, Mill's point of view be borne in mind and his meaning be sought for with any generosity and fairness, psychological truths and subtle suggestions of the profoundest and most far-reaching importance may be found in his writings in germ, if not always fully developed.

Time, memory and personal identity are intimately intertwined; the same fundamental mystery lies at the root of all three. With Herbart and his school Mill distinctly declares that not any and every mental succession will give us a perception either of time-relation, of memory, or of identity: and in close accord with Herbart, he asserts, that *certain proper successive combinations of sensations, their reproductions, and repetitions of these reproductions do alone and of themselves constitute all possible forms of all three.* He says: "Imagination consists of ideas. . . . Memory has in it all that imagination has, but it must also have something more. . . . In memory is not only the idea of the thing remembered, there is also the idea of my having seen it. Now these two, (1) the idea of the thing, (2) the idea of my having seen it, combined, make up, it will not be doubted, the whole of that state of conscience which we call memory. But what is it that we are to understand by what I have called 'the idea of my having seen the object'?" (p. 32d). To clear up this question he supposes a case as follows: "I have one sensation, and then another sensation; call them *A* and *B*, and I recognize them as successive." Then, "the consciousness of the present moment (by law of association) calls up the idea of the consciousness of the preceding moment. The consciousness of the present moment is not abso-

[1] "Analysis of the Phenomena of the Human Mind" (London, 1869) I, p. 235. A pregnant passage in Mill is "The term 'I conceive' has the form of an active verb, and with the form of an active verb, the idea of action is so frequently conjoined that we are rarely able to separate them." Perhaps the chief point of difference in the general systems of Brown and Mill is, that the latter abandons "relations" as a separate element or phenomenon of mind.

lutely simple; for whether I have a sensation or idea, the idea of what I call myself is always inseparably combined with it. The consciousness then of the second of the two moments in the case supposed, is the sensation combined with the idea of myself, which compound I call 'Myself Sentient.' This Self Sentient, in other words, *sensation B combined with the idea of self*, calls up the idea of *sensation A combined with self*. This we call Memory" (p. 337). Memory then, Mill finds to consist of three parts: "the remembering self; the remembered self; and the train which intervened. Of these three parts, the last has been fully expounded. The recalling of the successive states of consciousness, which composed the intervening train, is an ordinary case of association; the other parts, *the two selves*, at the extremes of this train, require further consideration. The self at the first end, is the remembered self; *the self which had a sensation or an idea*. The idea of this self, therefore, consists of two parts: of self, and a sensation or an idea. The last mentioned part of this combination, the sensation or idea, needs no explanation; the first, that which is called self, does. The self at the other extremity of the chain of consciousness, is the *remembering self*. Remembering is associating. The idea of this self, then, is the combination of self with the idea of associating. And here, too, associating needs no explanation; it is the other part of the combination that does. The analysis, then, of self, or the account of what is included in that state of consciousness commonly called the *idea of personal identity*, is still wanting to complete the development of memory" (p. 338). In modern times the associational conception of self, or personal identity, is too well known to need here that long and subtle explanation which Mill in his day found it difficult to express with any sort of comprehension. The self-problem is abstruse and obscure even in our day of "fringes," and of feelings of "ifs, buts and ands." It is not to be wondered, therefore, that Mill's first handling of the subject should contain contradictions and short-comings of the grossest order; but the student who is alive to its full significance will find in Mill's elucidations the traces of a master psychologist.

The gist of Mill's theory, and particularly as applied to time, is, that we do not go outside of our ordinary sensations and their corresponding reproductions, as governed by the natural laws of production, association, and reproduction, in any of the processes of mind whatever; whether of personal identification, memory or perception of time relations.

This view differs from that of Herbart chiefly, in that the elements of sensation are not looked upon by Mill as "reals" between which there is direct attraction and repulsion, a metaphysical assumption for which there is to be found no scientific warrant; and it differs still more from the view of Volkmann in that no secondary feeling or sense of contention in the ordinary mental content, is needed; which secondary order of feeling is itself another metaphysical speculation without scientific justification or support.

John Stuart Mill sums up the case against the crucial point of his father as follows: "The distinction between a mere combination of ideas in thought, and one which reveals to us a combination of sensations as actually experienced, always returns on our hands as an ultimate postulate."[1]

But this can scarcely be conceived to be relevant to the position of his father, with whom a series of mental states actually occurring, that is, "a combination of sensations as actually experienced" *was* accepted as an ultimate postulate. The father's endeavor was, this *being* accepted or postulated, to show how the processes of memory worked *under* this postulate. With the elder Mill the ultimate postulate was that "series actually occurred"—out of these he developed the memory and the belief. His son first postulated the belief; the fault of which seems to be the same as postulating any other function, or faculty of the mind before inquiring if that faculty or function cannot be discovered to be a compound process. The "belief" can be deduced from the series, not the series from the "belief." J. S. Mill also went back to and emphasized the English school's theory of relations as taught by Brown.

Herbert Spencer's evolutionary system of realism is well known; it conceives the entire physical world to be devel-

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[1] Ibid. Appendix I, 416.

oped from ultimate homogeneous units, and all consciousness to be a corresponding development of mental units. The salient feature of Mr. Spencer's psychology is his theory of Relations. "The proximate components of mind are of two broadly contrasted kinds: Feelings, and the Relations between feelings. . . . Each feeling, as we here define it, is any portion of consciousness, which occupies a place sufficiently large to give it a perceivable individuality; which has its individuality marked off from adjacent portions of consciousness by qualitative contrasts; and which when introspectively contemplated, appears to be homogeneous . . . A relation between feelings is on the contrary, characterized by occupying no appreciable part of consciousness. Take away the terms which it unites, and it disappears along with them; having no independent place, no individuality of its own. It is true that under an ultimate analysis, what we call a relation proves to be itself a kind of feeling—the momentary feeling accompanying the transition from one conspicuous feeling to an adjacent conspicuous feeling. And it is true that notwithstanding its extreme brevity, its qualitative character is appreciable; for relations are distinguishable from one another, only by the unlikeness of the feelings which accompany the momentary transitions. Each relational feeling may, in fact, be regarded as one of those nervous shocks, which we suspect to be the units of composition of feelings; and though instantaneous, it is known of greater or less strength and as taking place with greater or less facility. But the contrasts between these relational feelings and what we ordinarily call feelings is so strong that we must class them apart."[1] Relations, then, with Mr. Spencer are an entirely disparate sense, as much as the time-sense of Czermak, or the time-feelings of Horwicz. "A succession of changes" Mr. Spencer declares to be "the subject matter of psychology; it is the business of psychology to determine the law of their order." Of particular importance for the time question is Mr. Spencer's fundamental conception of perceptions of likeness and unlikeness of relations of succession.

[1] Principles of Psychology (New York, 1877), I, 163.

"The requisite to the existence of a relation is the existence of two feelings between which it is the link. The requisite to the existence of two feelings is some difference. And therefore the requisite to the existence of a relation is the occurrence of a change, the passage from one apparently uniform state to another apparently uniform state, implying the momentary shock produced by the commencement of a new state."[1] "The ultimate relation therefore, is nothing more than a change in the state of consciousness; and we call it either a relation of unlikeness, or a relation of sequence, according as we think of the *contrast* between the antecedent and consequent states, or of their *order*."[2] Mr Spencer suffers much difficulty with his relations of likeness. "The two terms of a relation of likeness are the antecedent and consequent of what, in one sense, is *no change*; seeing that it leaves consciousness in the same condition as before." But as above, because "two states if not different can not exist as separate . . . accurately speaking, therefore, a relation of likeness consists of two relations of unlikeness which neutralize each other. It is a change from some relatively enduring state A to another state X (which represents the feeling we have while passing from one of the like things to the other) and a change from the transitory state X, to a second relatively enduring state A, which would be indistinguishable from the first state were it not divided from it by the state X" (p. 284). Surely here are contradictions as obvious as print can make them. Yet these are Mr. Spencer's theories of Relations, which he considers the fundamental principle of all reason and all intelligence,[3] including of course all problems of identity, memory and time-perception.

Mr. Spencer's manner of elucidating the latter is, however, more successful, and is perhaps more profound than that of

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[1] Vol. II, p. 287. Query: If a 'shock of relation' intervened between the two like states, would not this suffice, by Mr. Spencer's own theory, for the two states to be known *as* separate and also as like? Again: *Why* may not consciousness be in two states at the same time? Have we any proof that an area of red and an area of blue may *not* be simultaneously in consciousness? Rather this is what apparently does take place.

[2] Ibid.

[3] Ibid, chapters on Reason and Intelligence.

any other writer. This, if his theory of relations be borne in mind, may be sufficiently indicated by saying that it develops from his standpoint of Relations, along the traditional lines of English association (especially of James Mill), perfected and enlarged in accordance with the doctrines of evolution.

S. H. HODGSON, in his "Philosophy of Reflection" (Vol. 1, p. 248-254) has produced a discussion, which deserves a place here, if for nothing more than to sample the loose, irresponsible sort of imagination regarding the subject, that not only gets printed, but also gets quoted. "What I find, when I look at consciousness at all is, that what I can not divest myself of, or not have in consciousness, if I have consciousness at all, is a sequence of different feelings. . . . The simultaneous perception of both sub-feelings, whether as parts of a co-existence or of a sequence, is the total feeling—the minimum of consciousness—and this minimum has duration. . . . Time duration, however, is inseparable from the minimum, notwithstanding that, in an isolated moment we could not tell which part of it came first, which last. . . . We do not require to know that the sub-feelings come in sequence, first one, then the other; nor to know what coming in sequence means. But we have in an artificially isolated minimum of consciousness, the rudiments of the perception of former and latter in time, in the sub-feeling that grows fainter, and the sub-feeling that grows stronger, and the change between them. . . . In the next place, I remark that the rudiments of memory are involved in the minimum of consciousness. The first beginnings of it appear in that minimum, just as the first beginnings of perception do. As each member of the change or difference which goes to compose that minimum is the rudiment of a single perception, so the priority of one member to the other, although both are given to consciousness in one empirical present moment, is the rudiment of memory. The fact that the minimum of consciousness is difference or change in feelings, is the explanation of memory as well as of single perceptions. A former and a latter are included in the minimum of consciousness; and this is what is meant by saying that all consciousness is in the form of *time*, or that time is the form of feeling, the form of sensibility. . . . It is clear that the minimum of feeling contains two portions, a sub-feeling that goes and a sub-feeling that comes." Mr. Hodgson seems to mean by "having rudiments of perception," etc., that *alone* which he conceives to take place in a single momentary sequence; and by "knowing how these take place" to mean the long processes of his thought when he thinks *about* the rudimentary process; but why confuse the two so continually? To say that "a former and a latter are included in the minimum of consciousness" is in reality declaring that a former term of a sequence includes a latter term of that sequence.

E. R. CLAY, in his "The Alternative" (p. 167), also adds under title of the "Specious Present" another confusion to the problem. The gist of his view is as follows: "All the changes of place of a meteor seem to the beholder to be contained in the present. At the instant of the termination of such series, no part of the time measured by them seems to be past[1]." Supposing the meteor went on whirling about for an hour, a day, a year or two: there might continue to appear to the observer an unbroken streak of light around the heavens in the path of the meteor, yet would he never discover beside this simple case of visual after-image, certain sensations of motion "going on?" When he did discover the process of this going-on-series would "*all of this series seem to be contained in the present?*" The *continuing* after-image seems confounded by this author with a *remembrance* of the motion series; there is no more justification for confounding the *momentary* after-image with a *momentary* motion series than there would be for confounding a *week* of after-image with the eternal path of the hypothetical meteor.

M. GUYAU, in his "La Genése de l' Idée de Temps (Paris, 1890), from an entirely empirical standpoint, develops the idea of time out of our ideas of space. Every co-existent presentation which constitutes our idea of a series as such, is more or less a figurative presentation; *i. e.*, spatial. Both space and time he traces back to feelings of effort of motion. The will is the present; the desire is the future. M. Guyau

[1] Cited by Prof. James, I, 609.

fairly represents the present tendency of psychology in France.

The article on Psychology in the 9th edition of the *Encyclopædia Britannica*, by JAMES WARD, gives an admirable summary of the best current opinion on psychological matters, save perhaps with too much leaning toward the widely doubted theories of apperception put forth by Prof. Wundt.

Mr. Ward does not attempt metaphysically to go behind the data of psychology: "By pure Ego or Subject it is proposed to denote the simple fact that everything mental is referred to self" (p. 39). Of the origin of this self he says: "The body becomes in fact the earliest datum for our later conceptions of permanence and individuality" (p. 56). He adopts the Laws of Association as stated by Dr. Bain (p. 61) whose classification of the elements of the mind he also accepts, namely: sense, feeling, will (p. 40). This, with the following remark of Mr. Ward regarding the traditional discussion of perception *vs.* sensation, will make his general psychological standpoint sufficiently clear for our purpose: "It has been usual to say that perception implies both memory and imagination; but such a statement can be allowed only as long as these terms are vaguely used" (p. 61).

Approaching the subject of time Mr. Ward says: "Thus as the joint effect of obliviscence and reduplication we are provided with a flow of ideas distinct from the memory-train, and thereby with the material, already more or less organized for intellectual and volitional manipulation" (p. 62). That is for thought in general in distinction from actual remembrances. "Retentiveness is both a biological and a psychological fact; memory is exclusively the latter. In memory there is necessarily some contrast of past and present; in retentiveness nothing but the persistence of the old" (p. 47). "Memory includes recognition; recognition as such does not include memory. . . . But of the two characteristics of memory proper—(*a*) concreteness of circumstantiality, and (*b*) localization in the past—the latter is the most essential" (p. 63). With the content of memory or time-percepts we are not at present concerned; on how this content is localized in the past, Mr. Ward writes as follows: "To a being whose presentations never passed through the transitions which ours undergo—first divested of the strength and vividness of impressions (original sensations), again reinvested with them and brought back from the faint world of ideas—the sharp contrasts of 'now' and 'then,' and all the manifold emotions they occasion, would be quite unknown. . . . Time-order, succession, antecedence and consequence, of course, there might be still; but in that sense of events as 'past and gone forever' . . there is much more than time-order. . . . We have not to ask how time itself comes to be; but assuming it to be, we ask how the individual comes to know it. . . . . The present, though a point of time, is still such that we can and do in that moment attend to a plurality of presentations, to which we might otherwise have attended severally in successive moments. Granting this implication of similarity and succession, we may, if we represent succession as a line, represent simultaneity as a second line at right-angles to the first; empty time—or time length without time breadth—we may say is a mere abstraction. Now it is with the former line that we have to do in treating of time as it is, and with the latter in treating of our intuition of time, where, just as in perspective representation of distance, we are confined to lines in a plane at right-angles to the actual line of depth. In a succession of events, say of sense impressions A, B, C, D, E. . . . the presence of B means the absence of A and of C; but the presentation of this succession (as a whole) involves the simultaneous presence, in some mode or other, of two or more of the presentations A, B, C, D. In presentation, as we have seen, all that corresponds to the difference of past, present and future, is in consciousness simultaneously. This truism, or paradox, that all we know of succession is but an interpretation of what is really simultaneous or co-existent, we may then concisely express by saying, that we are aware of time only through time-perspective, and experience shows it is a long step from a succession of presentations, to such presentations of succession. The first condition is, that we should have represented together presentations that were in the first instance attended to successively, and this we have both in the persistence of primary memory-images, and in the simultaneous reproduction of longer and shorter portions of the memory-train. In a series thus secured there may be time-marks, though no time, and by these marks the series must be distinguished from other simultaneous series. To ask which is first among a number of simultaneous presentations is unmeaning; one might be logically prior to another, but in time they are together and priority is excluded. Nevertheless, after each distinct representation a, b, c, d, there probably follows, as has been supposed, some trace of that movement of attention of which we are aware in passing from one presentation to another. In our present reminiscence, we have, it must be allowed, little direct proof of this interposition; though there is strong indirect evidence of it in the tendency of the flow to follow the order in which the presentations were first attended to. With the movements themselves we are familiar enough, though the residua of such movements are not ordinarily conspicuous. These residua, then, are the temporal-signs, and together with the representations connected by them constitute the memory continuum. But temporal signs alone will not furnish all the pictorial exactions of the time perspective. They give us only a fixed series; but the working of obliviscence, by insuring a progressive variation in intensity and distinctness as we pass from one member of the series to the other, yields the effect which we call time-distance. By themselves, such variations would leave us liable to confound more vivid representations in distance, with fainter ones nearer the present, but from this mistake the temporal-signs save us; and as a matter of fact, when the memory-train is imperfect such mistakes continually occur. On the other hand, where these variations are slight and imperceptible, though the memory continuum preserves the order of events intact, we have still no such distinct appreciation of comparative distance in time, as we have nearer the present when these perspective effects are considerable." (pp. 64, 65.)

Two points are to be observed in the above: First, Mr. Ward does not go outside of his three classes of mental elements: Sense, Feeling and Will; does not posit any hypothetical special time-sense, feeling, intuition, concept, self or super-consciousness whatever; and second, he conceives every time-concept to be a complex co-existent state, and not a series of states.

Prof. WILLIAM JAMES devotes a chapter of his vigorous and suggestive Principles of Psychology to the perception of time. In general philosophical standpoint he confesses himself a spiritualist, but he is far from abhorring mechanism in memory and time-perception. He says "objects fade out of consciousness slowly. If the present thought is of A, B, C, D, E, F, G, the next one will be of B, C, D, E, F, G, H, and the one after that of C, D, E, F, G, H, I, the lingerings of the past dropping successively away, and the incomings of the future making up the loss. These lingerings of old objects, these incomings of new, are the germs of memory and expectation, the retrospective, and the prospective sense of time. They give that continuity to consciousness without which it could not be called a stream." (I, p. 606.) "The strict present . . . is in fact, an altogether ideal abstraction. Reflection leads us to the conclusion that it *must* exist, but that it *does* exist can never be a fact of our immediate experience." Prof. James then introduces Mr. Clay's "Specious Present" given above and proceeds—"In short the practically cognized present is no knife edge, but a saddle-back with a certain breadth of its own on which we sit perched, and from which we look in two directions into time. The unit of composition of our perception of time is *a duration*, with a bow and a stern, as it were, a rearward and a forward-looking end. It is only as parts of this *duration-block*, that the relation of *succession* of one end to the other is perceived. We do not first feel one end and then feel the other after it, and from the perception of the succession infer an interval of time between, but we seem to feel the interval of time as a whole, with its two ends imbedded in it. The experience is from the outset a synthetic datum, not a simple one; and to sensible perception its elements are inseparable, although attention looking back may easily decompose the experience and distinguish its beginning from its end. (pp. 608–610.) There is a certain emotional *feeling* accompanying the intervals of time" (p. 618). "The feeling of time and accent in music, of rhythm, is quite independent of that of melody." (p. 619.) "All continuous sensations are *named* [counted] in beats. We notice that a certain finite 'more' of them is passing or already past . . . the sensation is the measuring tape, the perception the dividing engine which stamps its length. As we listen to a steady sound, we *take it in* in discreet pulses of recognition, calling it successively the same! the same! the same!" "After a small number of beats our impression of the amount becomes quite vague. Our only way of knowing it accurately is by counting, or noticing the clock, or through some other symbolic conception. When the times exceed hours or days, the conception is absolutely symbolic. No one has anything like a *perception* of the greater length of the time between now and the first century than that between now and the tenth. There is properly no comparative time *intuition* in these cases at all. It is but dates and events *representing* time." (p. 622). "The feeling of past is a present feeling." "*A succession of feelings, in and of itself, is not a feeling of succession. And since, to our successive feelings, a feeling of their own succession is added, that must be treated as an additional fact requiring its own special elucidation*" (p. 628). He here introduces approvingly the time-theory of Mr. Ward given above. Then he proceeds "and since we saw a while ago that our maximum distinct *intuition* of duration [specious present] hardly covers more than a dozen seconds, we must suppose that *this amount of duration is pictured fairly steadily in each passing instant of consciousness* by virtue of some fairly constant feature in the brain process to which the consciousness is tied. *This feature of the brain process, whatever it be, must be the cause of our perceiving the fact of time at all.*" "Please observe, however, that the reproduction of an event *after* it has once completely dropped out of the rear ward end of the specious present is an entirely different psychic fact from its direct perception in the specious present as a thing immediately past. A creature might be entirely devoid of *reproductive* memory and yet have the time-sense, but the latter would be limited in his case, to the few seconds immediately passing by. Thus memory gets strewn with *dated* things dated in the sense of being before or after each other. The date of a thing is a mere relation of *before* or *after* the present thing, or some past or future thing. Some things we date simply by mentally tossing them into the past or future direction. So in space we think of England as simply to the eastward, etc." "But the *original paragon and prototype* of all conceived times is the specious present, the short duration of which we are immediately and incessantly sensible." (pp. 630 sq.) "*Now to what element in the brain-process may this sensibility be due?* It cannot, as we have seen, be due to the mere duration itself of the process; it must be due to an element present at every moment of the process, and this element must bear the same inscrutable sort of relation to its correlative feeling which all other elements of neural activity bear to their psychic products, be the latter what they may" (p. 632). "To state it in neural terms *there is at every moment a cumulation of brain processes overlapping each other, of which the fainter ones are the dying phases of processes which but shortly previous were active in a maximal degree. The amount of the overlapping determines the feeling of the duration occupied. What events shall appear to occupy the duration depends on just what processes the overlapping processes are.*" (p. 635.) "*Why* such an intuition should result from such a combination of brain-processes I do not pretend to say. All I aim at is to state the most *elemental* form of the psycho-physical conjunction." (p. 636.) "Longer times are conceived by adding, shorter ones by dividing portions of this vaguely bounded unit [specious present] and are habitually thought by us symbolically. Kant's notion of an *intuition* of objective time as an infinite necessary continuum has nothing to support it." (p. 642.)

Prof. James then passes to the consideration of memory: "*It is the knowledge* of an event, or fact . . . with the additional consciousness that we have thought or expressed it before." "No memory is involved in the mere fact of recurrence. The successive editions of a feeling are so many independent events, each snug in its own skin . . . . . Memory requires more than mere dating of a fact in the past.

It must be dated in *my* past" . . . "A general feeling of the past direction in time, then, a particular date conceived as lying along that direction, and defined by its name or phenomenal contents, an event imagined as located therein, and owned as part of my experience—such are the elements of every act of memory" (p. 650). "Memory is then the feeling of belief in a peculiar complex object; but all the elements of this object may be known to other states of belief; nor is there in the particular combination of them as they appear in memory anything so peculiar as to lead us to oppose the latter to other sorts of thought as something altogether *sui generis* needing a special faculty to account for it. When later we come to our chapter on belief we shall see that any represented object which is connected either mediately or immediately, with our present sensations or emotional activities tends to be believed in as a reality. The sense of a peculiar active relation in it to ourselves is what gives to an object the characteristic quality of reality, and a merely imagined past event differs from a recollected one only in the absence of this peculiar feeling relation. The electric current, so to speak, between it and our present self does not close. But in their other determination the recollected past and the imaginary past may be much the same. In other words, there is nothing unique in the *object* of memory, and no special faculty is needed to account for its formation." (p. 652).

Thus Prof. James' time-sense is a separate disparate feeling, like that of Horwicz, Czermak, *et al.* But do we have any such extra feelings? How could any such extra feeling be other than just another feeling as separate as all the rest? How could it join these overlapped feelings any more than they could join themselves—or than merely successive feelings could join themselves? Who is it that sits in the saddle-back and looks both ways? How does this Jack-in-the-saddle *know* which way to look; *which way* the overlapping feelings are overlapped? which way they *are* moving? *How does this feeling know or constitute anything regarding time direction, more or other than the passing sequence constitutes of itself?*

Casting an eye backward, we can but be struck by the wide variety of explanations offered for the time-mystery. Time has been called an act of mind, of reason, of perception, of intuition, of sense, of memory, of will, of all possible compounds and compositions to be made up from all of them. It has been deemed a General Sense accompanying all mental content in a manner similar to that conceived of pain and pleasure. It has been assigned as a separate, special, disparate sense, to nigh a dozen kinds of "feeling," some familiar, some strangely invented for the difficulty. It has been explained by "relations," by "ear-marks," by "signs," by "remnants," by "struggles" and by "strifes," by "luminous trains," by "blocks of specious-present," by "apperception." It has been declared *à priori*, innate, intuitive, empirical, mechanical. It has been deduced from within and from without, from heaven, and from earth, and from several things difficult to imagine as of either. Finally, one high modern authority has discovered that time is the long-sought-for fourth dimension of space. In one particular alone is there uniformity; with the exception of Condillac, James Mill, Herbart, and Horwicz, *all* have looked upon the mystery unqualifiedly and unmistakably as *a single state*. Among the best modern authorities the presentation of time-order and relation may be said to have worked itself out to what, though expressly declared to be otherwise, is really a sort of compromise position between a simple state and a simple *process*; to be looked upon as a certain definite, particular, complex, though co-existent *arrangement*. It is the most striking feature of the whole time investigation, that of all the philosophers and psychologists who have touched upon the problem, only *two* of the whole number, Condillac obscurely, and James Mill definitely, have solved the mystery by *letting the sequences themselves be the ultimate mystery*—by letting their process, as process and of itself, show forth its own explanation. It would not be surprising if such diversity of failures should be explained by such unity of neglect of careful and exhaustive consideration of this seemingly most natural and certainly most simple source of explanation. A further examination of this point will constitute a later section of this paper.

II.—EXPERIMENTAL INVESTIGATIONS.

The earliest empirical observation which I find recorded is otherwise unimportant. The Scotch philosopher, THOMAS REID, says: "I have found by some experiments that a man may beat seconds for one minute without varying above one second in the whole sixty; and I doubt not but by long practice he might do it still more accurately. From this I think it follows that the sixtieth part of a second of time is discernible by the human mind."[1]

As the philosophy of time has usually followed that of space, so experiments upon it were an outgrowth of those on space.

In 1852 E. H. WEBER published his famous discoveries regarding our appreciation of distance and direction on the surface of the body. That this appreciation varied without proportion to our sensitiveness to pressure or temperature for the same regions, Weber held as proof that our space perceptions were made by a strictly disparate sense, which, coining the phrase, he called the space-sense.[2]

JOH. NEP. CZERMAK, professor of physiology at Leipzig, perceived that these views necessarily involved our conceptions of time; he was, therefore, led to believe in still another disparate sense, which he named the time-sense.[3] As this invariably accompanied all other sensations, he termed it a general sense in distinction from the special senses. Unable to carry out his intentions he recommended the following to be determined: (1) The shortest interval perceivable in each of the separate senses. (2) How the same interval is interpreted by the different senses. (3) How like rates of motion are interpreted by various regions of the skin, determined by Weber to be of different spatial sensibility. (4) The least change

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[1] Complete Works (Edinburgh, 1872), p. 350.

[2] "Ueber d. Raumsinn u. d. Empfindungskreise in d. Haut u. d. Auge." D. königl. Säch. Gesell. d. Wiss. zu Leipzig. Sittung 18, Dec., 1852. Math. Phys. Classe, 1-4, Jahrgang, 1849-52, S. 85.

[3] "Ideen zu einer Lehre von Zeitsinn." Complete works (Leipzig, 1879); also Wiener akadem. Sitzungsberichte, 1857; Nat. Cl. Bd. XXIV, p. 231; and Moleschott's Untersuch., Bd. V, Heft. 1, 1858.

in rate of motion perceivable for various dermal regions. (5) The relations between rates of motion and changes in the angle of convergence of the eyes. (6) To investigate the formula $V = \frac{r}{t}$ for points of the retina or skin having different spatial sensibility (V, rate of motion; r, space; t, time). Some of the suggestions of Czermak, by reason of his high standing as a physiologist, were immediately undertaken. Nearly at the same time Vierordt, assisted by Höring and Camerer at Tübingen, and Mach at Graz, began the work.[1]

A. HÖRING. *Versuche über das Unterscheidungsvermögen des Hörsinnes für die Zeitgrössen.* Inaug. Dissertation, Tübingen, 1864.

Experiments: Eight beats were given by a Mälzel metronome; then without appreciable loss of time the weight was moved up or down or left as before. Subject without having seen the pendulum, was to judge if the second set of beats be "longer," "shorter," or "same" in comparison with the first set; the cases in which the subject was unable to decide were thrown out of the records. The experiments were made on Höring by Prof. Vierordt. A total of 1,885 sets of beats were taken, using intervals from .306 to 1.428 in length;[2] an average of 10 trials was made for each interval, and 82 was the maximum for any interval. The experiments were delayed through a half year to avoid fatigue and any unusual influences. The method used was that of Right and Wrong Cases.

Results: A constant inclination to misjudge the second or compared set of intervals; intervals of .454–1.428 were estimated to be shorter, and those of .306 to .365 longer than they were. Sensibility or discrimination decreases with lengthening of the interval.

Comment: No ordinary metronome is sufficiently accurate for this purpose; as it runs down, the strength of tick and length of beat varies; alternate beats can not be maintained of equal length; the weight can not be accurately adjusted without varying the interval between the first and second set of

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[1] It has seemed best in what follows to vary from the continuous narrative form of presentation toward that employed in the review department of the JOURNAL OF PSYCHOLOGY. Abstracts of contributions to the subject will be distinguished from my own comment by a different typography.

[2] In all cases not otherwise specified the unit is a second.

beats, which is important. Too few trials were made on each interval to warrant the conclusion that the results were more than mathematically fortuitous. Only one person was experimented upon, while contradictory individual differences are the rule. The results regarding sensibility have been confirmed; those as to the constant error have been variously confirmed and contradicted.

WILHELM CAMERER. *Versuche über den zeitlichen Verlauf der Willensbewegung.* Inaug. Diss. Tübingen, 1866. Zeitschrift für Biologie, Bd. XVII; S. 17.

Results: It was found that movements made in 1.5 could be adjusted to cover the distances tested with greatest accuracy; the hand attempting to measure off a given distance in a shorter or longer time, respectively, over-ran or fell short of the proper distance.

ERNST MACH. *Untersuchen über den Zeitsinn des Ohres.* Moleschott's Untersuchungen, 1866, Bd. X; S. 181; and Sitz. d. Wiener Akad. d. Wiss. Math. Kl. Bd. 51; Abth. 2, 1865.

Standpoint: Herbartian; and the time-sense looked upon as disparate. *Purpose:* To test Weber's law. *Apparatus:* Finely adjusted metronome, beating alternately long and short beats or the reverse. For very short intervals a spring was used, snapping upon teeth cut at iambic intervals upon the edge of a wheel which was revolved by hand mechanism. For very long intervals the assistant held a watch to the ear and beat with a hammer. *The method* used was Least Perceivable Difference. *Experiments* extended from year 1860 to 1865; it is indefinitely stated that "a great number of trials" were made upon six persons, using intervals from .016 upward. *Results:* Weber's law not valid. Sensibility inverse to length of interval, and varies daily; greatest sensibility shown for intervals of about .375. Threshold (for ear) about .016, and less for ear than for any other of the senses. When iambic intervals are repeated many times in same direction, we lose power to distinguish the longer from the shorter beat; this effect is counteracted by alternating the directions.

Comment: Turning a wheel, and beating with a hammer by the hand, can not give accurate results. The number of trials is not stated, and figures are given for but a few of the intervals tested. The paper is too indefinite to justify its results. The threshold found is far higher than subsequent experiments have established.

KARL VIERORDT. *Der Zeitsinn.* Tübingen, 1868.

Standpoint: Time perception is rather an act of judgment than of sense; "the soul is needed to explain many things." *Purpose:* To investigate the time-sense in general and the constant error in particular. *Apparatus:* Same as used by Camerer and Höring; also kymograph and a writing lever, one arm of which wrote directly on the drum, the other arm being worked by the finger. *Method:* Chiefly that of Right and Wrong Cases; asserts it was used in his laboratory as early as 1853. *Experiments:* (1) Two ticks of the metronome, self-recorded on the kymograph, were given by the assistant; the subject then pressed his finger to mark off on the drum an interval immediately following and equal to that given by the metronome. (2) Another set of experiments was like the above save that a pause, whose length was determined by the subject, was made between the normal or metronome interval and its reproduction. (3) Eight successive beats were given from the metronome, the subject immediately recording a like number of judgments. (4) Beats were given by touch on the back of the left-hand with a small steel point; two beats, pause, followed by single reproduction with right-hand as in (2); eyes and ears closed. (5) Subject chose any interval at random, and tried to record three beats inclosing two equal intervals. (6) Four beats in place of three, a pause being introduced between first and last interval as in (2). (7) Interval chosen at will as in (5), then reproduced from 4 to 120 times (generally about 4 reproductions). (8) Seven classes of judgments were made, namely: Very long, long, tolerably long, indifferent, tolerably short, short, very short; attendant then gave an interval repeating it 10 times, and the subject assigned it to one of the above rubrics. (9) Estimation of longer intervals, *i. e.*, from 5 min. to an hour. (10) Experiments with intervals of sight.

Results: "For all categories of time from seconds to years, the same law holds good, *i. e.*, the relatively short intervals are lengthened by judgment and the relatively long intervals are shortened." Vierordt holds his experiments sufficient to determine the law definitely, though the constant error may vary for different persons, times of experiment, senses, and other conditions. He tested intervals usually ranging from .25 to about 8. The indifference point for himself was: ear, 3 — 3.5; eye, 2.2 — 2.5, for H. (ear) 1.4; for N. 1.5. The indifference point fell on a longer interval when a pause was made between norm and reproduction. Morning hours, and good physical and mental condition were favorable to more accurate estimates of longer intervals; intense mental strain led to under-valuation. Sensibility was found greatest at about 1 to 1.5, and was more exact when as in (1) no pause was made between norm and judgment. Judgment was more accurate after 8 beats as in (3), than when the norm was heard but once. Weber's law does not hold. Vierordt suggests that contrasts affect judgment; that after several short beats, a longer interval seems unduly long.

Comment: Only three persons were experimented upon; most of the results are from two individuals; 2147 single judgments were made in all; these spread over the large number of intervals tested, under several different methods, and upon two men, leaves far too few trials on any one interval, for conclusive results. The same criticism of metronomes applies here as to Höring. The results are valuable as far as they go, but must be deemed inconclusive even on the points taken up.

WILHELM WUNDT. *Ueber psychologische Methoden.* Wundt's Phil. Studien. Bd. I. 1882; S. 1.

Wundt here complains that Vierordt's experiments unwarrantably complicate the time judgments with voluntary muscular movements; that is those used in reproduction; also that the indefinite pause introduced between the norm and the reproduction in many of the experiments causes an indefinite break in the rhythm, which must disturb judgment with great irregularity. Wundt claims that the time-sense is so extremely delicate that the apparatus used by Vierordt as well as his method of Right and Wrong Cases, can give no reliable results. Wundt recommends his own method of Least Perceivable Difference.

JULIUS KOLLERT. *Untersuchungen über den Zeitsinn.* Wundt's Phil. Studien. Bd. I. 1882; S. 78.

This work was done under the direction of Prof. Wundt at Leipzig. *Purpose:* To reinvestigate the Constant Error and Sensibility, with more accurate apparatus and method, and particularly without involving the time-reaction of reproduction. *Apparatus:* Two finely adjusted metronomes, governed by electric current and magnets. *Experiment:* In all cases the norm was given by two beats from one metronome, then, after a pause invariably equal to the norm, another interval was given by two beats from the other metronome; these two intervals to be judged according to Wundt's method of Least Perceivable Difference, that is, the compared interval was first made equal to the norm, then gradually lengthened till it was just perceived to be longer than the norm; next the compared interval was made markedly longer then the norm, then gradually shorter till just indistinguishable from the norm; the average was then taken of these two judgments just perceivably longer than the norm. An average is similarly determined for the two judgments just perceivably shorter than the norm. The Constant Error is then calculated by averaging the just perceivable shorter and longer judgments so determined. The norms used were .4, .5, .7, .8, 1.0, 1.2, and 1.836. Seven men were experimented on, and a total of 175 single determinations of the Constant Error made.

Results: 42 or about 25% of the 175 determinations were classed apart as "anomalies" because in these the Constant Error appeared a maximum at the point where in the "regular" cases it appeared a minimum. The remaining 133 "regular" trials confirmed Vierordt's Law that for relatively long intervals the Constant Error is negative, and for relatively short ones positive; but the Indifference Point as averaged from the seven persons was .755 in place of 3. — 3.5 as given by that experimenter. The 42 anomalous trials were mostly overjudged. Sensibility was greatest at the Indifference Point, diminished rapidly with shortening intervals, and more slowly with lengthening intervals. No explanation was found for the "anomalies."

Comment: Metronomes have never proved sufficiently accurate or reliable for time experiments; to use two metronomes together is objectionable as the difference of their sound disturbs judgment. It is doubtful if Wundt's method of Least Perceivable Difference as used by Kollert is free from objections, since the judgment of the subject is always biased; he knows beforehand the direction and nearly the degree in which his judgment is to be made, *i. e.* which way the pendulum weight is to be moved and about how much, and soon *expects* to perceive no difference or the reverse. There seems no good reason for having culled out the 42 anomalies; that they were different from what was expected is no ground for classifying them apart. The remaining 133 trials, when divided among seven persons, and again among the seven intervals used, leaves but an average of about 3 trials for each interval per man, which, in view of the great variation the time-problem is now known to be susceptible to, is altogether insufficient to prove the results to be more than mathematically fortuitous. Kollert lumps his results leaving us entirely in the dark as to just how the trials were divided among men and intervals with reference to specific results. This is inexcusable and, besides detracting largely from the value of his own conclusions, renders impossible any revision of them by a closer analysis of the facts. Care does not seem to have been taken that the subject should remain ignorant both of the course and of the purpose of the experiments; this is important, as otherwise subjective influences are inevitable to a degree that renders the results comparatively worthless. On the whole Kollert's determinations are unsatisfactory and of doubtful value. They show intervals between .755 and 1.836 to be shortened while Vierordt found the same to be lengthened.

KARL VIERORDT. *Psychophysiche Bemerkungen.* Zeitschrift für Biologie, Bd. 18, 1882; S. 397.

Vierordt here briefly defends his work against the attacks of Wundt and Kollert; shows the reaction-time of reproduction is too short to vitiate his results, and that in most of his experiments it was neutralized and not included at all. The pause between norm and reproduction made in some of the rubrics, he thinks most accurately adjusts itself when left to the inclination of the subject. In turn he criticises rather bitterly the method of Wundt, raising many of the objections we have stated above against Kollert.

VOLKMAR ESTEL. *Neue Versuche über den Zeitsinn.* Wundt's Phil. Studien, II. 1884; 37.

This work was also from Prof. Wundt's Laboratory. *Purpose:* To extend the investigations of Kollert, to the longest intervals that can be judged as a whole, and to settle the dispute with Vierordt as to the effect of a pause between norm and comparison. *Apparatus:* New electric machine designed by Prof. Wundt; has horizontal metal wheel graduated on the edge; revolved by weight. Electric connections made at proper arcs of the revolving wheel regulate the desired lengths of norm, pause and comparison intervals; the stroke was made by electric hammer, during some of the experiments, on a bell, during others on an iron anvil. *Method:* Least Perceivable Difference as described of Kollert. *Experiments:* Divided into two sets, one without and the other with a pause, equal to norm, between norm and comparison interval. The intervals investigated were about the same for both sets and ranged from 1.5 to 8. The longer intervals were practised over several times, till they seemed familiar, and then judged; the shorter intervals, as with all of Kollert's, were judged, each after a single hearing. Ten persons were experimented on, through a range of 18 intervals, with a total of 96 trials in the first set, and 293 trials in the second set.

Results: No time difference appeared between use of stroke of bell and stroke of anvil. Twenty-seven of the ninety-six trials in the first set, and 182 of the 293 in the second set, were culled out as anomalous, on the ground that "purely psychic" phenomena betrayed themselves in these; claimed by Estel to be due to "contrast," that is—all these anomalies were asserted to have occurred in the later experiments of each day, and to vary according as the intervals used during the first part of the day were longer or shorter than those of the later part. Estel stated the Law of Contrasts to be that the hearing of any interval makes a subsequent shorter or longer interval to be judged respectively longer or shorter than it really is. The other important result claimed by Estel was, that while all intervals longer than Kollert's indifference point of .755 "were under-estimated, yet the increase of the Constant Error was not regularly progressive with the lengthening of the interval, but rhythmic; relatively minimal values were asserted to appear at all multiples of the said indifference interval, *i.e* nearly at 1.5, 2.25, 3, 3.75, and 4.5." Sensibility also was rhythmically inverse to the constant error. Weber's Law was declared not to hold. Wundt and Estel incline to the belief that the multiple indifference point is governed by the pendulum-swing of the leg.

Comment: After carefully studying the tables of Estel, we agree with the strictures of Fechner (below) upon the demonstrations of a periodic course of the Constant Error. From the nature of the case irregularities are to be expected, and the assertion that these variations were in any sense rhythmic multiples of the indifference point seems to us entirely unfounded and forced. Also the Law of Contrasts, though perhaps true under very different conditions of quite other significance, seems quite unsupported by the data presented; at least, sufficient of the protocol should have been given to establish the order of the length of intervals used for each day's work. As it is, nothing appears upon which a revision of the facts can be based definitely to disprove Estel's claim—much less to support it.

As a whole the work of Estel appears not only inconclusive, but unscientific; too few trials were made in proportion to the great variability of the results; only 389 tests were made in all, these divided among ten persons and eighteen intervals each, leave an average of but about two trials for each interval per individual; this is insufficient, particularly when as in the major rubric 209 out of 389 tests are classed apart as "anomalous." Again the "subjective" conditions were not sufficiently guarded. The controversy with Vierordt, under which the work was undertaken was spirited and unfortunate for unbiased psychological judgments; yet no care seems to have been taken to provide subjects undoubtedly free from the subtle involuntary prepossessions, which are so difficult to exclude in all psychological investigations. For such results to be of any definite value, a sufficient number of persons must be experimented upon who know neither the purpose nor the results of their judgments—this in order to establish the testimony beyond even any possible involuntary prejudice. Finally it seems almost incredible in the face of the contradictory evidence of Mach, Höring and Vierordt, and solely upon the meagre and much criticised results of Kollert, reinforced alone by the yet entirely problematical "leg-swing" theory,[1] that Estel should have *assumed* the fundamental Indifference Point upon which he based his entire periodic deductions, without adequate experiment for any of his ten subjects and absolutely with none at all covering that important interval for seven out of the total ten persons. Such neglect can be more easily explained by subjective prepossessions for theories than the results can be admitted to the rank of scientific facts.

G. THEO. FECHNER. *Ueber die Frage des Weber'schen Gesetzes und Periodicitätsgesetzes im Gebiet des Zeitsinns.* Ab. d. k. S. G. d. Wis. XIII, S. 3.

This paper subjects Estel's work to long and minute criticism, finally characterizing it as unreliable and false. The variations claimed by Estel as rhythmic, Fechner shows to lie entirely within the probabilities of accidental irregularity. Fechner also considers that nothing is to be dis-

[1] Martin Trautscholdt, in W. and E. Weber, Mechanik d. Mensch. Gewerkzeuge, pp. 77–254; Wundt's Phil. Studien I, 213 (249); Ibid. II, 286, 250.

covered irreconcilable with Weber's Law. Such high authority would have greater weight were the spirit displayed here less controversial, and less enthusiastic for the support of Weber's Law.

VOLKMAR ESTEL. *Ueber die Frage des Weber'schen Gesetzes und Periodicitätsgesetzes im Gebiet des Zeitsinns.* In Wundt's Phil. Studien, II, 1884; S. 475.

Estel makes a weak reply to Fechner's attack. In answer to a request for the precise order of each day's experiments, Estel says the results were unexpected, and the protocol had been designed for other ends, and therefore data could not be given. He excuses the small number of his tests by declaring that he had looked upon them only as indicative, and needing confirmation—that he made as many and on as many persons as "he had time for." As to the charge that he had brought out his results to suit his own preconceptions, he declares they were entirely unsuspected until after the experiments had been performed. His counter criticism against Fechner's deductions from his (Estel's) work in support of Weber's Law is effective.

MAX. MEHNER. *Zur Lehre vom Zeitsinn.* Wundt's Studien, II, 1884, 546.

Purpose: The severe criticisms of Fechner compel a reinvestigation of the work of Kollert and Estel. *Apparatus* and *Method:* The same as Estel's. *Experiments:* The order of each day's work was arranged to be free of all influences of contrasts. No pause was ever permitted between norm and comparison intervals. Judgment was always made after each hearing of the two intervals. Ten determinations were made for each length of interval used; twenty-eight intervals were tested ranging from .7 to 12.1. Mehner was himself subject for all experiments made.

Results: Four Indifference Points were found, namely, .71, 2.15, 3.55 and 5. All the *odd* multiples of the lowest Indifference Point, .71, were shown to be points of minimal worth of constant error, while *even* multiples showed maximal worth. All intervals between .71 and 5 were declared to be under-estimated; all from 5 to 12.1 and "probably far above" to be over-estimated. Sensibility was also a function of the odd multiples of the Indifference Point .71, (though inversely to the constant error) up to 7.1 above which it remained approximately constant; it was greatest at 2.15. Weber's Law did not hold below 7.1, *i. e.* so long as sensibility is rhythmic, but was approximately valid above 7.1, *i. e.* where sensibility is constant. He attributes individual differences and the great disparity of results obtained by different experimenters mainly to the insufficient and varying amounts of practice which they had in estimating time intervals; he thinks the effect of practice is to lessen the constant error. Straining of the attention makes the interval seem longer; the experienced subject judges with less strain, therefore makes a smaller error; also familiar intervals being judged without a strain are shortened, while the longer ones, requiring great attention, are lengthened. Fatigue and low condition, mental or physical, require greater attention and therefore lengthen the interval; all this accords with and explains his results. Upon these grounds he thinks the results of Estel and others may be reconciled with his own work and with his theory of odd multiple periods, or expressed differently he thinks most of the results previous to his own to be of comparatively little worth, as their experimenters had not attained sufficient experience and skill to bring their judgments up to a non-fortuitous or non-variable standard. Mehner found 12.1 to be the longest interval he could judge without division, instead of the limit of 5—6 determined by Estel; he also attributes this to his greater experience. Mehner determined, contrary to the expectations of Fechner, that it made no difference in the result whether, in comparing the intervals, the long or the short interval preceded the other. He found Estel's Law of Contrasts was without validity for his judgments, where the norm was always heard only once, or at most only a few times; and he even inclines to think that were the norm heard many times and deeply impressed upon the subject, the results would be opposite to Estel's Law, for example, were the norm a short interval, a tendency to preserve this accustomed length would hold over and tend to make a new, subsequent, longer interval seem unduly short. He inclines to favor the method of Right and Wrong Cases as the most accurate and direct. Mehner attributes the alleged phenomenon of Periodicity to a universal rhythmic law, towards which the membering or compounding of all our presentations and mental content tends in general.

Comment: Mehner's experiments were conducted upon a single subject, and that person himself; they could not therefore be held to be general, or even valid for most individuals, until corroborated by many other experiments; also, for this reason they suffer greatly from the liability of subjective prepossessions, as we have explained in the case of Estel. Otherwise his work seems to have been conducted with particular care, and the number of his tests to have been sufficient for establishing the general tendencies peculiar to a single individual. His deductions from these results regarding Periodicity seem, however, as forced and far-fetched as those of Estel, with which they conflict, and which have been severely criticized by Fechner. Re-examining Mehner's tables we believe his Law of Periodicity to be unwarranted by his own figures; there are few columns of figures in which a prepossessed imagination cannot discover some sort of approximate periodicity of equal validity as a "law" with that of Estel or Mehner. Regarding Mehner's opinion that experience, practice and attention explain all the discrepancies in the results of time-experiments, there is so far no adequate information as to what the tendencies of any of these influences are; several investigations regarding mental fatigue, as those of Glass, Cattell, and others in the Physiological Laboratory of this University, fail to support Mehner's view.

G. Theo. Fechner. *In Sachen des Zeitsinnes und der Methode der richtigen und falschen Fälle, gegen Estel und Lorenz.* Wundt's Studien, III, (1884), 1.

Still further criticism is here raised against Estel and Mehner; though Fechner devotes more space to Estel, he seems to hold even weightier objection to the results of Mehner; he thinks the probability of any Law of Periodicity to be negatived by the fact that the law claimed by one contradicts that of the other.

Richard Glass. *Kritisches und Experimentelles über den Zeitsinn.* Wundt's Studien, IV, (1887), 423.

Purpose: Glass assisted Mehner in most of his experiments; his testimony regarding them is therefore of value; he subjects Mehner's figures to a searching scrutiny, and comes to a like conclusion with Fechner; he thinks a proper interpretation of the tables of Mehner even contradicts the Law of Periodicity deduced from them by their author. Glass, therefore, proposes to give the entire matter experimental revision. *Method:* The Method of Average Error is now chosen for the first time in Wundt's Laboratory. *Apparatus:* same as that used by Estel and Mehner, so modified as to be instantly stopped by the operator. *Experiments:* All were made with single norm and single reproductions, and without pause between norm and reproduction. The subject recorded his reproductions or judgments directly by pressing a lever which stopped the revolution of the wheel; the interval thus recorded was then read from the graduated arc of the wheel. One hundred trials were made on each interval tested; the Constant Error was averaged from these; the intervals asserted by Mehner to be periodic, were those chiefly investigated. Glass was the sole subject for all his work.

Results: Table I comprises 100 trials each, upon twenty-three intervals ranging from .7 to 15.; for all these the Constant Error was negative, with the exception of .7, for which it was slightly positive. Neither Estel's nor Mehner's Periodicity held good, but a new law, based upon multiples of 1.25 was thought to be observed. Therefore, a greater number of intervals, 42 in all, differing less from each other, but covering the same range as the others, was next tested, with 100 trials each. These form Table II, which shows the Constant Error positive for 1.8 and under; negative for 5.4 and over, and variable between 1.8 and 5.4. Periodicity was again thought to be observed on intervals still 1.25 *apart*, but not falling on the *same* intervals as previously. Hence, the experiments given in Table III were undertaken, comprising 100 trials each, on intervals regularly .25 different in length, through the range .75—9, making 34 intervals in all. These showed Constant Error positive for 2 and under, negative for 4 and over; inconstant from 2 to 4. If for Table III, however, a reaction-time of .05 be deducted for the time occupied in stopping the instrument, the Constant Error would be negative throughout except for the lowest interval, .75. Glass concludes that the Constant Error is normally negative for all intervals. Again, all multiples of 1.25 appear as points of relatively minimum values for the Constant Error. The experiments of Table IV were then undertaken to discover the variations in judgment of the same interval from day to day. Only *one* interval and *two* successive days were tested. Glass claims the results "agree pretty well" with each other, and with those for the same interval in Table III. [According to his figures, however, the value from Table I is about 300 per cent. longer; from Table II about 200 per cent. longer; and from Table III about 60 per cent. shorter than those of Table IV.] He, therefore, concludes that in general the variations in his three main tables are not greater than those to be expected from day to day; and in view of their general agreement, so demonstrated, he asserts a new Law of Periodicity striking the multiples of 1.25, though the interval of 1.25 is not itself a point of least value of the Constant Error.

Comment: All the objections which have been made against Mehner for testing his experiments solely upon himself are applicable with greater force against Glass; for, having assisted Mehner in the previous experiments, he was more liable to have formed prepossessing conceptions. Regarding this third Law of Periodicity, which contradicts the two previously published, a close examination of the tables seems to confirm the views of Fechner, twice maintained by him against the probability of such a law. The insufficiency of the evidence with the fact that each experimenter found a different law entirely irreconcilable with the others, and coupled with the tendency already mentioned, for all columns of figures to present variations more or less delusively or fortuitously rhythmic, ought to dispose of this subject until some very conclusive results shall newly establish such a Periodicity as a fact.

LEWIS T. STEVENS. *On the Time-Sense.* Mind. Vol. XI. No. 43.

These experiments were chiefly performed under the direction of Pres. G. Stanley Hall, at Johns Hopkins University, and were confirmed by other experiments under Prof. Henry P. Bowditch of the Harvard Medical School. *Purpose:* To investigate the Constant Error with both norm and reproduction many times successively repeated. *Apparatus:* Beats were given by a metronome, and recorded by electric circuit on a Marey kymograph; the key of the circuit was extremely delicate, and worked by the finger with scarcely perceptible exertion; the intervals were measured on the drum by a tuning-fork of known vibration rate. *Method:* Average Error. *Experiments:* "The individual under experiment tapped the lever synchronously with the beats of a metronome. When he had become perfectly familiar with the given interval, the drum of the kymograph was set in motion, and the first round of the tracing (the drum worked continuously on a spiral) was taken with the metronome still beating; the latter was then stopped, while the person kept on tapping the lever at the same rate for a period of one minute." The tables show the averaged reproductions for each five seconds. The total number of experiments is uncertainly stated; only one result "showing an average amount of variation" is published for each interval of each individual; tests were made upon seven persons.

Results: One hundred and fourteen out of 135 trials "point to the fundamental principle: That there is an interval of time, the value of which varies between .53 and .87, which can be reproduced with considerable accuracy; but with all other intervals an error is made, which is plus for those above and minus for those below the so-called indifference point." The average Indifference Point was .71. The Constant Error was found gradually to increase as the Indifference Point was moved away from, in either direction. Twenty-one out of the 135 experiments were classed apart as irregular. "The irregularities consist in reproducing accurately long, in shortening long, and in lengthening short intervals." "The examination of such experiments, however, revealed the fact that the effect of fatigue is to make the error for short intervals *plus* instead of minus, and to increase the amount of variation made in the reproduction of long intervals; and that individuals under experiment are apt, when inattentive, to shorten long and prolong short intervals." "Diversion of attention and small experience are regarded as the cause of the great irregularities" shown in all the experiments.

As to the Law of Periodicity, "two remarkable points are revealed in the manner of variation of the curves. (1) The constant zig-zag of individual records; only in nineteen cases out of 140 were two sequent variations in the same direction. This would seem to indicate that an interval is judged more correctly after it is completed than before, and that correction is made for its error in the next reproduction, according to a standard which the mind carries, but to which the hand (or perhaps the will during the interval) cannot be accurately true. The origin of this peculiarity, therefore, appears to lie not in the judgment, but in the execution. (2) In all of the curves plotted, there were observed more or less distinctly, still larger and more primary waves. The prominence of these varied greatly; in some of the curves they were apparently absent, in others they were decidedly marked. These waves were no more prominent for one interval than for another—their length varies in the majority of cases between .6 and .9 min. and averages .73 min. This rhythmical variation seems not to be in the execution, but rather to have its origin in a rhythmical variation of the standard carried in the mind. That this is connected with the rhythmical changes in the nutritive condition of the cerebral centres, or produced by the vaso-motor rhythmical constriction of arterioles, it would be rash to deny or affirm or perhaps even to suppose."

Mr. Stevens refrains from any opinion as to the contradictions between his own and nearly all previous results, but suggest that these may be due to fundamental differences between single and successive reproductions.

Comment: As published, the number of experiments seems too few to establish conclusive results, as individual differences and variations from general physical conditions are now known to be great. Also it is doubtful if the metronome used preserved alternate beats of equal lengths through the entire running down of its spring. On the whole, however, this paper is of marked value and reliability.

MICHAEL EJNER. *Experimentelle Studien über den Zeitsinn.* Inaugural Dissertation No. 137, Dorpat, April 18, 1889, under Prof. Kraepelin.

Purpose: To investigate (1) how we judge filled intervals of time. (2) What is the influence of fatigue and practice; (3) pathological disturbances. *Apparatus:* Stop-watch measuring .2 sec. *Method:* Average Error. *Experiments:* Both single and multiple reproductions were investigated; the norm was never heard but once; the assistant called "now" at the beginning and at the end of the norm; the subject announced his judgment by a signal; the length of the norm and reproductions were read from the watch by the assistant; reaction times of both subject and assistant were involved with other slight inaccuracies, but these compensated each other to a degree, and their sum was small in proportion to the unusually long intervals worked with. These were five in number, as follows: 30, 60, 120, 180, 240 seconds. The experiments were extended from Aug. 29th to December 13th, 1889, lasting one hour each day; the single reproduction was always at the same hour of the day. Ejner was the sole subject for his chief tables. For the class of multiple reproductions the judgment was always repeated twenty-five successive times; then the same norm was given again and another set of twenty-five reproductions made; for very long intervals a rest of about a half-hour was made between these two sets. Ten double sets of twenty-five reproductions each, were made by Ejner for each of the five intervals; these multiple reproductions were confined to no particular hour daily. To test individual differences, ten double sets like the above were tested upon two *commilitionen* for the interval 5, and six double sets for 240. For the pathological experiments three patients were selected from the clinique, all of them students. To investigate the effects of attention, 200 single trials each were made upon Ejner for the intervals 30 and 240, under each of the following conditions: (1) Same as his single reproductions above, except that he listened closely to an extra metronome (beating 200 strokes per minute) at the same time that he listened to the norm and made his judgments; (2) While performing mathematical problems.

Results: The tables are admirably arranged, particularly those which compare with each other the average progress of the double sets, for the purpose of showing the effects of fatigue and practice manifested between the two. The main results are as follows. (1) For single reproductions the Constant Error is always negative; for the multiple reproductions it is positive; in both cases it is a maximum at about 120. (2) The Average Error is less for single than for multiple reproductions, in the proportion of 2 : 3. (3). The increase of the Average Error follows Weber's Law approximately. (4) Practice decreases the Average Error. (5) Fatigue shortens the judgments; the effect of practice is to lengthen them. (6) The feeling of inner tension (*Anstrengung*) or attention is proportionally indicative of the accuracy of the judgment. (7) Pathological individuals show diminished sensibility and great irregularity of judgment, especially for long intervals, the Constant Error reaching wider extremes in both directions. (8) Distraction of attention by the metronome and arithmetical problems caused decrease of sensibility for long intervals and shortening of judgments, the latter especially for short intervals.

Comment: The objections repeatedly raised against results chiefly obtained upon a single experimenter, apply here again. The manner in which the results are combined and mathematically analyzed with reference to the influences of practice and fatigue offers great opportunity for merely fortuitous results, when based on such limited investigations; it may be doubted as of the similar calculations for the Law of Periodicity whether the same methods would again show like results with other experimenters. Otherwise the work is careful, thoughtful, and valuable.

HUGO MÜNSTERBERG. *Beiträge zur Experimentellen Psychologie.* Heft, 2, Freiburg, 1889.

This paper presents theoretical explanations, rather than experimental results. It aims to found all time phenomena on physiological processes; unless experimental results are correlated with their physiological causes, Münsterberg estimates such as "mere heaps of pedantic figures," and he is inclined to look upon all previous time experiments from this point of view. Münsterberg traces attention to feelings of muscular tension, and finds in our various rhythmic bodily processes, the indispensable measures and foundations of all time judgments. For short intervals, he thinks the rhythmic tensions of the sense organs themselves, are the basis of their respective judgments, but the processes of respiration preponderatingly determine our time measurements, though unconsciously. A gradual rise and fall of tension-feeling accompanies each corresponding rise and fall of the equal inhalation and exhalation phases; according as impressions fall into like or unlike phases of respiration tension, or endure through like or unlike periods or multiples of such, so are they associated with, that is, measured by these familiar and judgment-determining processes.

The paper is one of the most thoughtful and suggestive yet contributed to the time problem, and a step in the right direction whether we give full acceptance to the particular theories announced or to his experimental results. His manner of presenting the latter is unfortunate; he tells us that "in cold blood" he suppresses the full figures until he "can prove what each period in the process means;" yet he gives his main results, if we understand him, as confirmation of his explanations regarding these same "periods."

Experiments: Wundt's time-sense apparatus as used by Glass, was arranged so that by an electric circuit, and a delicate key held in the hand, the subject could record his judgments while assuming any comfortable position, whether sitting or lying. Both the norm and reproduction were beat by the same electric hammer, enabling both the judgment of the norm and of the reproduction to be formed under the same conditions. The judgments were not, however, always fixedly recorded, but the position of the index each time the hammer fell was noted by two assistants, and averaged; with single reproductions, the assistant stopped the wheel when he heard the hammer fall; Münsterberg thinks the reaction-times involved do not exceed .05 to .08, and are too small to need correction. The experiments were of two classes — with and without a pause between norm and reproduction. The subject was never informed as to the character of the judgments he was making. The intervals tested ranged from 1 to 60 seconds. The method of average error was used. The only experiments for which definite results are given were 400 trials made upon Münsterberg himself with intervals from 6 to 60 seconds. The chief feature of these was, that two parallel series of tests were made; in the first, no regard was paid to phases of breathing; the second set was arranged so that the reproduction should begin in the like phase of breathing to that in which the norm had begun. This was accomplished, when the reproduction followed the norm without pause, by the assistant ending the norm (and thus beginning the judgment) upon the same phase of the subject's breathing as it had begun in; it will be noted that this always confined the length of the norm to the length of the breathing or multiples thereof. Where a pause was made between norm and judgment, the assistant gave the signal for the judgment to begin, in the same phase as that in which the norm had begun, thus making the pause of variable length.

Results: No details are given. It is stated for experiments made without pause that when no regard was paid to breathing, the average error was 10% of the normal, and but 2.9% when the judgment and norm began in the like phase. For experiments with pause, the error was 13.3% when breathing was neglected, and 5.3% when like phases were maintained. When voluntary violent interruptions and variations were made by the subject during the tests, "judgment was entirely upset, 4 seconds appearing like 12, and 9 like 3." Münsterberg looks upon these results as evidence that there is no special function of *consciousness* to be called the time-sense, but that psycho-physically conditioned changes, which constitute the rise and fall of our bodily or muscular tensions, and chiefly those of breathing are the measures of our time presentations. "It is not the physically unconditioned transcendental apperception which functionates in time perception, but our time perceptions are the results of those physiological excitations which underlie our periodic changes." No constant error appeared in Münsterberg's work ; the judgments were for all lengths about as frequently positive as negative.

Comment: If Münsterberg had asserted that one *may* measure off certain intervals of time by his breathings, no one would object; but that our functional rhythms unconsciously govern our time judgments, there is grave reason to doubt; if several such functions simultaneously formed our time measures, what confusion would result; yet what reason is there according to Münsterberg that one function should influence, and another not? Why the breathing and not the heart? The latter expending more energy, why should its rhythms not predominate over those of breathing? Why may not the peristaltic movements of the intestines disturb the influences of both heart and lungs, if such unconscious functions may influence judgments at all? Again, were breathing the chief measure, we should expect that the ordinary person could more accurately indicate the length of the usual breathing interval than any other, whereas this is not at all the case. I incline to believe that the interval most fixedly impressed upon the conscious memory is the one that may be most exactly reproduced. The workman who has closely tended a particular trip-hammer for a course of years, would be more able to judge the time-beat of that hammer than the length of his breathing. Most of us are more definitely familiar with the tick of our clock than with our respiration rhythms which constantly vary; I could not tell if my ordinary breathing was faster or slower than usual; while having had unusual practice in second beats of a pendulum, I could instantly tell to a very small fraction, if a beat, newly heard, were longer or shorter than a second. I should judge correctly, it seems to me not by my breathing, but because the reproductive process of the higher centres constituting memory had acquired a fixed periodic habit of its own. Sufficient explanation of Münsterberg's experimental results may be found in the fact that his methods confined his tests to intervals of about one given length, or to the multiples of that length, namely, that of breathing. If the same number of experiments had been equally confined to any other interval, it may be suspected that a similar phenomenon, due to the practice or habit being thus limited while forming, would have been observed. Yet beside this, inasmuch as the published figures were only those tested upon Münsterberg himself, we must again re-iterate the great liability to the unconscious influence of prepossessing theories and conceptions.

F. SCHUMANN. *Ueber Contrast-Erscheinungen in Folge von Einstellung.* Preliminary communication to Philos. Seminary, University of Göttingen, Dec. 3, 1889. Nachrichten v. d. könig. Gesell. d. Wiss. No. 20.

In certain memory experiments similar to those of Ebbinghaus, letters were pasted at regular intervals upon a revolving drum and observed through a slit; Schumann noticed, that when the eye or the attention had for a considerable time become adjusted to, or familiar with a definite rate, *a*, of presentation of the letters, any immediate change to some other rate, *b*, caused the latter to be differently estimated than if the previous adjustment upon *a* had not occurred; if *a* were shorter or longer than *b*, the judgment of the latter in consequence appeared respectively shortened or lengthened. When the physical and mental condition was good the attention was better, and rapid intervals seemed shorter than when reverse conditions obtained. Similar results were observed when metronome beats were presented under like conditions to the ear; when the attention had been adjusted to an interval of .7, one of .9 was judged longer than previously to such adjustment. Dr. Schumann thinks the sensory centres are the seat of these phenomena; that they adjust themselves to a given rhythm, and thus prepare themselves, as it were, to expect excitation at a given time. If the rate of excitation is changed, the expectation is unfulfilled, and the subject is surprised into a judgment longer or shorter by contrast. Experiments of a like nature were also made in measuring given distances; by drawing the finger along a scale by motion of the arm, similar results were obtained.

Comment: The explanation offered by Dr. Schumann for the phenomena discovered by him seems, at least, inadequate; to say that the sensory centre, after adjustment "expects" a certain rate of excitation is vague in the extreme; but as this point is to be spoken of presently in detail the subject will be deferred.[1]

GEORG DIETZE. *Untersuchungen über den Umfang des Bewusstseins bei regelmässig aufeinander folgenden Schalleindrucken.* Wundt's Philos. Studien, II, 362. cf. also, Wundt's Phys. Psych. 3te Auf., II, 248.

Another line of experiments begun by Georg Dietze in Wundt's laboratory with reference to the so called Compass of Consciousness, was brought by Dr. Schumann into correlation with his above theories in a later paper.[2] The experiments of Dietze were to determine the greatest number of metronome beats, that, given in a series, and then repeated, could be determined to be the same in the repeated series as in the original; it was found that the larger series tended to group themselves into rhythmic multiples; it was claimed that these rhythms could never be entirely suppressed; the largest number of beats was found to be 40, and these were obtained by five groups of eight beats each.

Wundt contended that these 40 beats were in consciousness

[1] Owing to the resemblance between the phenomena reported by the above author, and those forming the chief part of my own work, to be presented later in this paper, this is perhaps the place to state that Dr. Schumann's Preliminary Communication of Dec. 3, 1889, reached my notice Jan. 10, 1890, at which date my own experiments had been under way about three months, and the method already established according to which they were carried out to the end.

[2] F. Schumann. Ueber das Gedächtnis für Komplexe regelmässig aufeinander folgender, gleicher Schalleindrücke, Zeitschrift für Psychol. Band I, Heft I, S. 75.

simultaneously; that they expressed the limit compass of consciousness, and that the addition of another beat to the end of the series, drove out the first of the series; Wundt explained this phenomenon by his well-known theory of Apperception. Dr. Schumann contends against this view, and believes that the hearing centres are capable of adjusting themselves to the reproducing of certain series which they had received with sufficient frequency; that they can repeat these series with more or less accuracy according as the habit has been formed with more or less fixity, and also in proportion to the favorable or unfavorable length of the interval and of the series; thus the 40 beats of Dietze express the extent of the habit-capacity of the hearing or memory centres, rather than any simultaneous compass of Consciousness or Apperception.

G. Stanley Hall and Joseph Jastrow: *Studies in Rhythm.* Mind. Vol. XI, No. 41, p. 55.

A work which approaches closely to many of the most fundamental processes of the time problem is the eight-page contribution of these experimenters. Two disks were fixed to the drum-shaft of a Ludwig kymograph; and cogs were fitted in their periphery in such a manner that, the disks revolving, and a quill pressing on the cogs, adjustable at various distances apart, intervals of different lengths and arrangment could be given as desired.

Three sets of investigations were made: to determine (A) for given intervals, what is the largest number of beats that can be accurately counted? The two intervals for which tables are given were .0895 and .0523. Of this set the authors say: "Counting objects and impressions is a very complex process, and slow, and hard to teach or learn. (1) The impressions in a series must of course be distinguished from each other. The ear, which does this most acutely of all the senses, unless it be touch, can discriminate $\frac{1}{132}$ (Helmholtz) or even $\frac{1}{500}$ (Exner) of a sec. under exceptionally favorable conditions. These of course are extreme limits, but from 24 to 40 beats per sec. can be distinguished by the average ear without fusing into a tone. The actual number of beats is also a function; that is in order that their discontinuity may be clearly perceived, four or even three clicks or beats must be further apart than two need be. When two are easily distinguished, three or four separated by the same interval approach nearer to the above limit and are often confidently pronounced to be two or three respectively. . . . (2) Counting requires a series of innervations, if not of actual muscular contractions. . . . The most rapid contraction of antagonistic muscles in trilling by pianists who have given us their record, or the rapid lingual movements involved in aspirating the sounds *t*, *k*, recorded by a Marey tambour, we have never found to exceed and rarely to reach six double or twelve single contractions per sec., while few can make more than 4 or 5 double movements in that time. There is thus at any rate a wide interval between the most rapid innervations and the limit of discriminative audibility for successive sounds. Attention, in other words, discriminates sensation, more rapidly than the will can generate impulses How the fact is reconciled with any extreme form of the hypothesis of the identity of apperceptive and volitional processes is not easy to see. None would venture to assume that, because we can volitionally cut short the otherwise normal duration of a single innervation-impulse, by innervating an antagonistic muscle, the extreme limit of distinguishing elements in a series of noises marks really the limit of this abbreviation. (3) Counting involves the matching, pairing or approximative synchronization of the terms in two series of events in consciousness. However familiar both series may be, this is difficult. Many school children find it hard to keep step with others or to keep time with a drum or piano in marching; and savages have been reported to sight across each stick, used as a counter for animals they were selling, to keep the correct tale. . . . What now becomes of the lost clicks when we are constantly behind in counting, yet with great subjective assurance that we are right? It will hardly be sufficient to say that, when counting with great energy and concentration, we cease to attend to the auditory series, stretching the interval we caught the *tempo* of at the beginning of the series, as all short intervals are expanded when we come to perceive only our innervations. We may, however, conceive the earliest announcement of the impression of the first click in consciousness and the exit therefrom of the registry-innervation involved in counting it, as separated in time by some not inconsiderable proportion of the simple reaction time between ear and tongue. If the interval between the clicks is greater than or equal to this reduced reaction-interval, consciousness is done with the first click when the second arrives, and there is no error. If, however, the second click begins to be recognized in the focus of consciousness before this has completely initiated the act of tallying the first, and if the fastest rate of doing so has already been attained, then the third click will come a little earlier in the process, until at length a click in the later afferent stage will cease to be distinguishable from the perhaps more widely irradiated process of the earlier efferent stage of tallying, and will drop out of consciousness and be lost, possibly after the analogy of the second of two sub-maximal stimuli in myological work, which produces no summation if extremely near the first in time. . . . We do not realize how far the fastest counting falls short of the fastest hearing. In judging of small divisions of time, we seem, as Vierordt thought, to take relatively large periods, perhaps as great as our psychic constant (or the time we reproduce with least change)—so large at least that we can overlook it readily, and then pair or otherwise group the subdivisions which do not get into the field of direct time-sensibility themselves. The focus of apperception is perhaps dominated by the rhythm of the largest and more slowly loading and discharging motor cells. Although we can discriminate a finer intermittency by means of the smaller sensory cells, this is prone to be done more in the direct field of consciousness, and these smaller movements of time speedily fall out of sense-memory into oblivion like knowledge or impressions not directly reacted on. If immediately known time be discrete, and temporal continuity be an inference, as seems likely, these finer temporal signs are somewhat analogous to the finer local signs discriminating motion and even its direction considerably within the ordinary limits of discriminative sensibility for stationary compass points."

The (B) set of experiments investigated, "Just-observable Differences of Duration." Subjects D. and S. made each 20 judgments when the middle interval was varied $\frac{1}{60}$ of the 4.27 secs. of the extremes, viz., ten times each way with no error. G. S. H. judged 90 times under the same conditions with no error, while J. J. made only 12 errors in 90 judgments. When the variation of the mean was $\frac{1}{120}$ of the same time of the extremes, D. and S. made no errors in 10 judgments, J. J. made 3 errors in 40 judgments, and G. S. H. made 2 errors in 30 judgments."

The (C) experiments concerned "Full and Vacant Intervals." "It is well known that if a horizontal line be bisected in the middle and one half untouched and the other half crossed by short regular perpendicular lines, the latter half will seem the longer. It was found that under certain conditions the same illusion held for the time-sense. . . . Full tables were constructed for four individuals. With 10 clicks the following vacant interval to be judged equal to it must be extended to the time of 14 to 18 clicks; 15 clicks seemed equal to the time of from 16 to 19. Preliminary experiments upon other individuals indicate that these differences are extreme. If the absolute length of interval is increased beyond from 1 to 3 secs., the illusion is less. It is also less if the clicks are very near together. The illusion still holds, but is diminished if, instead of comparing clicks and a vacant time, more or less frequent series of clicks are compared. In these observations, also, the time between the two intervals became quite important. In general the illusion was less if this time was short; but if less than about $\frac{3}{4}$ of a sec. the illusion again became greater. Indeed, in a few cases an indifference time was found in which little or no illusion took place. This entire illusion, however, is reduced to a minimum, and with some persons vanishes, if the order of the terms be reversed, viz., if the vacant or less-filled interval precedes."

A. BINET. *La concurrence des ětats psychologiques.* Revue Philosophique, Fév., 1890.

This paper deserves mention as an interesting study of the effects of attention upon time judgments.

Many investigations have been made upon such questions as, The Least Perceivable Duration throughout the various senses; The Least Perceivable Difference of Change for the same; Complicated results from several like or disparate sensations received simultaneously or in series. But as these are not sufficiently pertinent to our main problem the reader is referred to a good review of them in Wundt's Phys. Psychol. 3te Auf., II, pp. 330–364.

Casting an eye back over the experimental field of Time Psychology, the results are found scarcely more satisfactory or conclusive than were those of the preceding chapter on the theories of time perception. Most experimenters have confined themselves to the determination of the Constant Error, Sensibility and Weber's Law, yet with difficulty, if indeed at all, can the results of any two of such determinations be harmonized, as the following table shows :

Investigator.	Year.	Constant Error.			Periodicity falls on Multiples of.	No. of Reproductions.	No. of Persons Tested.	Average No. of trials per interval per man tested.	Method used.	Weber's Law.	Sensibility.
		+	0	—							
Höring, . . .	1864	.306–.365	.365–.454	.454–1.428	. . . . .	8	1	10	R.&W.C.	. . . .	Inverse to length of interval.
Mach, ...	1865	. . . .	. . . .	. . . .	. . . . .	. . . .	6	. .	L. P. D.	Does not hold.	Max. at .375 sec. thence both ways.
Vierordt, . .	1868	.25 (3.–3.5)	3. –3.5 2.2–2.5 Eye 1.4 (for H) 1.5 (for N)	(3.–3.5)–8.	. . . . .	{ 8 1 }	3	. .	Chiefly R.&W.C.	" " "	" 1.–1.5 " "
Kollert, . . .	1882	.4–.755	.755	.755–1.836	. . . . .	1	7	3	L. P. D.	" " "	" .755 " "
Estel, ...	1884	. . . .	. . . .	1.5–8.	(all) .75	1	10	2	L. P. D.	" " "	Follows inversely Periodicity .75 (all)
Mehner, . . .	1884	5.–12.1	{ .71 and 5. }	.71–5.	(odd ones) .71	1	1	10	L. P. D.	Does not hold below .71; Holds Appx. above 7.1.	" " " .71 (odd) (Up to 7.1 above this is constant)
Glass, 1st set,	1887	.7	.7	.7–15.	(all) 1.25	1	1	100	A. E.	Held Appx. throughout.	" " " 1.25 (all)
" 2nd set,		.7–1.8	1.8–5.4	5.4–15.	do.	1	1	100	do.	. . . .	" " " " "
" 3rd set,		.75–2.	2. –4.	4.–9.	do.	1	1	100	do.	. . . .	" " " " "
Stevens, . . .		.71–2.85	.71	.26–.71	. . . . .	Through 1 min.	7	20	do.	do.	. . . .
Ejner,	1889	30.–240.	Least at 120.	. . . .	. . . . .	25	Nearly all on 1	100	do.	. . . .	Greatest at 120. Decreases thence both ways.
"		. . . .	do.	30.–240.	. . . . .	1	6	100	do.	. . . .	. . . .
Münsterberg,	1889	No Constant Error was found.			. . . . .	1	3	. .	do.	. . . .	Greatest in Equal Phases of Breath'g.

As a summary of these experiments the most conclusive results may be said to be as follows:

Nearly all persons, under nearly all conditions, find a particular length of interval more easily and accurately to be judged than any other.

This Indifference Point or interval of best judgment is very variable for different individuals and for different times and conditions.

The sign of the Constant Error is usually constant in both directions from the Indifference Point.

Where norm and reproduction are single the Constant Error is minus for intervals longer, and plus for intervals shorter than the Indifference Interval.

Where norm and reproductions are multiple, the Constant Error is plus for intervals longer, and minus for those shorter than the Indifference Interval.

The majority of evidence is strongly against the validity of Weber's Law; also against any fixed or constant Periodicity.

Later investigators look to physiological processes for explanation of time-judgments, and particularly to rhythmic habits of nerve centres. Whether such processes as breathing, pulse, leg-swing, etc., govern our perceptions, or whether the more general rhythmic functions of the higher cephalic centres are in themselves the basis of time-judgment is now the important question. The discussion of this question, together with the author's experimental results, will occupy the following sections of this study.

THE PROCESS OF RECOVERY FROM THE FATIGUE OCCASIONED BY THE ELECTRICAL STIMULATION OF CELLS OF THE SPINAL GANGLIA.

By C. F. Hodge, Ph. D.

Experiments Upon Cats.

The two preceding chapters, of which the following is a continuation, appeared in this Journal in May, 1888, and May, 1889. In the first it was shown that stimulation of a nerve going to a spinal ganglion produced a marked change in the appearance of the ganglion cells, as seen under the microscope. This change was most pronounced in the nuclei, which might, upon stimulation of seven hours, lose forty per cent. of their bulk. The cells themselves, further, decreased little in size, but in many cases the cell protoplasm became extremely vacuolated, and as a third difference the nuclei of the cell capsule shrunk to a noticeable degree.

In the second paper the attempt was made by a series of experiments, in each case the nerve being stimulated in the same way but for a different length of time, to ascertain whether the amount of change in the cells was directly proportioned to the length of time the work was continued. In a general way this was found to be true. In all cases the nerve upon the right side of the animal was stimulated, while that upon the left was at rest. After the experiment the stimulated ganglion was examined, using its resting mate of the left side as a normal to compare with.

By this method it was found that the nuclei lost respectively upon stimulation of 1 hour, 2½ hours, 5 hours and 10 hours, 22%, 21%, 24.3% and 43.9% of their bulk.

The series of experiments which I propose now to describe had for its object a study of the recovery of spinal ganglion cells after fatigue. If the changes seen in the specimens, the shrunken nucleus, vacuolation of protoplasm, shrinkage of the capsular nuclei, are, in truth, evidences of normal or physiological fatigue, a period of rest being allowed, recovery should take place. Accordingly, a series of cats were worked in exactly the same manner for the same length of time and allowed to rest, before excision of the ganglia, different lengths of time, in order to observe the process of recovery, if it took place, at different stages.

Method.

I find that in previous descriptions I did not devote enough space to the method employed. And as this has been still further perfected by experience and by the use of the best available apparatus, I wish, before considering the experiments, to describe the method in some detail.

In the first place, in order to compare one experiment with another, we must know that the stimulation used in both is the same. We must, therefore, have in the primary circuit, first, a galvanometer to give us the strength of current; second, a resistance box or rheocord of some sort to control any irregularities in the strength of the battery; third, an arrangement of some kind to make and break the primary circuit at regular intervals, since continuous stimulation is not employed; fourth, a signal to record the beats of the interrupter; and fifth, an ordinary induction coil. For the battery I have used in the last series of experiments three grove cells. A Weston's direct reading am-meter, reading from 0 to 15 ampères, was placed next the battery. From this it was possible to read off the strength of current at any time. Next this in the circuit was placed an ordinary resistance box with rheocord attached. This is quite necessary for exact work, as the battery was set fresh at the beginning of each experiment and increased in power for the first hour or so and then gradually weakened until the end of the five hours, during which the stimulation lasted. These variations could generally be compensated for by merely sliding the bridge of the rheocord. The interval of rest and stimulation was the same as that adopted for the last series of experiments, viz., 45 seconds rest alternating with 15 seconds stimulation. In my first experiments a key was placed in the circuit and the circuit was made and broken by hand.

I am glad to acknowledge to Dr. Lombard my indebtedness for a most serviceable little device which removes this irksome feature of the experiment. A small nickel clock forms the basis of the contrivance. It must be provided with a second hand. The glass face-cover and all the hands are removed, and upon the shaft of the second hand is fastened an eccentric zinc disc $2\frac{1}{2} \times 3$ cm. in diameter. In front of the clock is held by a post, properly placed, a lever of hard rubber 15 cm. in length; the longer arm of the lever, 8 cm., is between the post and the clock, so that this end, which is tipped with a small gutta-percha wheel, to reduce friction, will tilt back lightly upon the eccentric. The other arm of the lever carries two light copper wires tipped with platinum. The platinum tips, extending downward at right angles from the lever, dip into a glass mercury cup. Thus the motion of the eccentric upon the second shaft is made to tilt the lever in and out of the mercury cup every minute. By placing the cup upon the head of a screw, so that it can be raised or lowered at will, and by proper shaping of the eccentric disc, it is very easy to arrange it so that the circuit is made through the mercury in the cup 15 seconds and broken 45 seconds, which is the spacing of intervals desired. The whole is arranged upon a small board, into which are screwed two binding screws for convenience in joining up with the circuits. It is only necessary to connect this automatic make and break key with the circuit.

It was decided to use 20 stimuli per second, and this rate was obtained by loading the interrupting hammer attached to the induction coil. As this was apt to jar out of adjustment, I was compelled to take the record of the interruption by placing a signal in the circuit which should write its vibrations upon a smoked drum, under the tracing of a signal in circuit with a seconds clock.

By these means it was possible to control the stimulation apparatus very accurately. A half ampère, as read from the galvanometer, was used throughout the series. The automatic key gave regular intervals of 15 seconds stimulation, with 45 seconds rest. The beat of the interrupter was kept at 20 per second. The secondary coil was of course kept at the same place in each experiment.

The animals used were kittens six to eight weeks old, and a word as to their preparation may not be out of place. Nothing was fed after the commencement of the experiment, but up to that time they were so well fed that it was thought a fast of even twenty-nine or thirty hours would not complicate matters seriously, if at all. In operating, the kitten is laid on a holder and gently brought under the influence of ether. When fully anæsthetized the skull is trephined at about the parietal eminence, and a slit is made through the *dura mater*. The trephine should be the smallest size, 5 to 7.5 mm. in diameter. With kittens it is possible to lift out a small piece of the bone at this place with the point of a knife blade, with generally less loss of blood than is occasioned by trephining. Now, holding the head with the left hand, with the thumb upon the vertex, the tip of the first finger upon the angle of the right jaw, the tip of the third upon that of the left jaw, introduce, with the right hand, through the opening in the skull, the blunt end of a 3 mm. glass rod, and aim it directly at the angle of the right lower jaw, the opening being invariably made in the left parietal bone. The probe will then strike the floor of the skull, having pierced the right optic *thalamus*, and the right *crus*. Work the probe across the floor of the skull about three mm., to either side of its first position, toward the right and also toward the middle line and withdraw it. Introducing the probe again, direct it forward as before, but down, aiming to pierce the left optic *thalamus* and the left *crus*. Take about one 3 mm. step with the end of the probe to right and left, withdraw the probe and close the skin over the wound. The aim of the operation is, of course, to destroy the sensory and motor tracts in the *crura*. Remove the ether and allow the animal to recover. If the operation has been successful the animal will evince no signs of pain or distress, but will remain as though quietly sleeping during the rest of the experiment. In some cases, however, the animal does show signs of restlessness for a few minutes after it recovers from the ether. These generally pass off very soon and give place to the condition of quiet desired.

The next step is to get the electrodes over the desired nerves, in this case the nerves of the right brachial plexus. Turning the animal upon its back, expose the external pectoral muscles by an incision in the skin about two inches long midway between the *sturnum* and *axilla*. Cutting through the external and internal pectoral muscles will now expose the subclavian artery and vein, and just underneath these can be plainly seen the nerves of the brachial plexus. In order to prevent hemorrage, I always take the muscles up with a double row of ligatures and make the cut between them. Free the plexus of fat for a short distance and separate it from the subclavian vessels, and, not including these, slip over it from behind a two tined platinum electrode.[1] Thus the current is made to pass through the nerves obliquely.

The stimulation may now begin. The nerves are not divided, and every muscle of the right fore limb should contract. This, in fact, is an important test of the proper working of the apparatus. If all the motor nerves are stimulated, and are conducting the impulses properly to the muscles, there is every reason to think that the sensory nerves are also conducting their impulses centrally to the cells of the spinal ganglia.

The animal is now carefully tended while the stimulation proceeds. The temperature is frequently taken, and heat applied or removed as the case demands. Respiration and pulse are watched. Lymph is apt to collect in the *axilla* about the electrodes, and should be frequently wiped up with absorbent cotton. The skin is drawn together over the wound and held with a clamp, and the wound is further protected with an ample pad of cotton.

In this series of experiments, the stimulation was continued for five hours in each case. At the end of this time the animal

[1] The electrode first used was an ordinary platinum electrode such as was used to stimulate a muscle-nerve preparation. Thinking that it would be better to have the platinum tips guarded, I made an electrode by letting heavy copper wires into deep grooves in a strip of gutta-percha. Platinum wires were soldered to these, and lie half-exposed in shallow grooves upon the inner side of each of two fork-like prolongations of the gutta-percha.

is gently removed from the board, wrapped up and laid in a warm place, where it is left to sleep the desired length of time. When this has expired, the work of removing the ganglia is begun. This is done as quickly as possible. A single cut with a scalpel severs the medulla at the *foramen magnum*. The skin is opened along the dorsal median line, some of the muscles cut away, and, with a pair of slender pointed bone forceps, the arches of the *vertebræ*, from the fifth cervical to the second thoracic, are removed, care being taken not to injure the cord or spinal nerves. A preparation is thus obtained which should resemble, so far as the brachial region is concerned, the plate upon page 374 in Wilder and Gage's *Anatomical Technology*. I have always taken the additional precaution before removing the electrodes of tying a ligature around the nerves included by the tines of the electrode, so that I may be sure to note the fact, if any important branch of the plexus has escaped stimulation.

In this series I have used for study only the ganglia of the first thoracic and eighth cervical pairs, and of these the first thoracic pair is dropped into about 5 cc. of 1% solution of osmic acid, the eighth cervical into saturated mercuric chloride solution at 40° c. The ganglia should be in their respective killing solutions within five minutes from the time the animal is killed. My own practice has been to leave them in both of these fluids for four hours, after which they are carried through the remaining processes in the usual manner. Minor points of technique are, however, not essential, so long as this one point is observed, viz.: *that the two ganglia to be compared are carried through all processes of preparation absolutely together, from the body of the animal to the microscope slide.* We then have under the microscope, side by side, sections of both ganglia of the same pair, one of which has been experimented with, while the other remains as a normal with which to compare it.

The method of investigation from this point on is the same as that employed in the former series of experiments. The nuclei and cells are measured microscopically, the longest and shortest diameter of each being taken. The mean of all the measurements for the worked or normal nuclei is taken as the diameter of a sphere. As the nuclei are very nearly spherical, this sphere may be conceived to represent the average bulk of the nuclei in the set, from which the average diameter is obtained. And a comparison of the average sphere of one set with that of the mate to the set gives in a crude, but in the most exact way yet attained, an idea of the quantity of change produced by the conditions of the experiment.

As there is often reason to distrust averages, I will give the actual measurements as they occur in my notes for Cat 17. The measurements were made with a Zeiss eyepiece micrometer ruled to $\frac{1}{1}$ micron. divisions (eyepiece, 8; objective 4.0 mm. $\times$ 500), hence each division equals $2\frac{2}{5}$ μ. They are given as they were read, in units of the micrometer eyepiece.

CAT 17.

Measurement of the diameter of the Nuclei.

After 5 hrs. Stimulation and 0 hrs. Rest.		Normal.	
Diameter.	Number of Measurements.	Diameter.	Number of Measurements.
8.5	3	9.	3
8.	1	8.5	6
7.5	4	8.	28
7.	17	7.5	17
6.5	17	7.	61
6.	48	6.5	29
5.5	30	6.	33
5.	44	5.5	12
4.5	14	5.	11
4.	17		200
3.5	4		
3.	1		
	200		
200 cells measured, average diameter for the set, 5.39.		200 cells measured, average diameter for the set, 6.83.	

The above is sufficient to show that the mean in these diameters is a fair average. The measurements stand in about equal numbers above and below it in both cases. The diameters of the normal nuclei are throughout larger. The largest nuclei being found among the normal cells, and the smallest among the stimulated cells.

The results of this whole series of experiments may be seen at a glance from the following table:

Series to show the Influence of Rest.

Right brachial plexus of each stimulated in the same manner for five hours.

	Nuclei.			Cells.
	Rest.	Mean diameter of Nucleus in μ.	Shrinkage in per cent.	Mean diam. in μ.
Cat 17.	0 hrs.	16.40 Left, normal. 12.93 Right, stimulated.	48.8	57 52
Cat 16.	6.5 hrs.	16.70 Left, normal. 15.09 Right, stimulated.	26.	56 54
Cat 21.	12 hrs.	16.34 Left, normal. 14.73 Right, stimulated.	26.	55 51
Cat 19.	18 hrs.	17.08 Left, normal. 16.03 Right, stimulated.	18.	56 55
Cat 18.	24 hrs.	17.01 Left, normal. 17.11 Right, stimulated.	+ 2.	58 58
From another series.[1]				
Cat 7.	Normal.	14.20 Left. 14.54 Right.	+ 6.9	

[1] Am. Jour. Psy. May, 1889, p. 395.

In this series the stimulation was severe. It must be remembered that during the period of work, so-called, the stimulation is applied for only 15 seconds each minute. Five hours, therefore, of stimulation represents only one hour and a quarter actual working of the cells. But in this short time the change is marked, as is shown by a shrinkage of 48.8 per cent. in the nuclei of the side stimulated. The cells, as before, shrink little, and the cell protoplasm exhibits considerable vacuolation.

The quantities expressed in the above table, while they show that the nerve cells do gradually recover from the effects of fatigue, tell nothing concerning the process of recovery. The table is, in fact, but a poor expression of even the amount of change. In the first place it is impossible to measure accurately the irregular and jagged outline of the worked nucleus. Our practice has been to measure to the tips of the jagged points into which the nucleus is prolonged; and this would evidently tend to make the computed bulk larger than the actual volume. In the second place, the quantities in the table are averages, whereas for our purpose extremes are most interesting. In a study of the cells of a worked ganglion, we see some nuclei which are not affected at all; and this we should expect because it is impossible to stimulate all the nerve fibres going to a ganglion without disturbing its blood supply. We next find nuclei which are slightly worked. In their even outline there may be here and there only a slight indentation, with here and there a vacuole in the cell protoplasm. These nuclei may have shrunken 5 or 10 per cent. And so we pass, by all degrees of difference, to the cells which show extreme changes. And here the cell protoplasm is riddled with vacuoles and the nucleus has skrunken to a densely staining speck, which must have lost 75 to 80 per cent. of its original volume.[1]

To trace the process of recovery in a nerve cell from its condition in fatigue to that in the resting state, the ideal thing would be to watch a living nerve cell continuously for the required length of time. For the present, however, we have only the prepared specimens taken so as to give us presumably five steps in the process. The chief interest for us at present attaches to the nucleus.

To begin with, we find the normal nucleus a round or oval body with an average diameter, in the cat, of about 16μ. The outline is even and sharply defined. In the nucleus, generally near the center, is a single (for the spinal ganglion cells of the cat) round nucleolus. Beside the nucleolus, the normal nucleus, as seen in a section, has generally from one to four or five rather coarse granules or agregations of smaller granules, and is spun through with a fine reticulum. On the whole it appears clearer than the protoplasm of the cell; as though the greater part of its contents were unstained. This appearance it was that gave rise at first to the idea that the nucleus was a large vescicle or vacuole in the midst of the densely granular protoplasm.

[1] See plate Am. Jour. Psychology for May, 1889, p. 402.

As the cell is worked, the nucleus gradually loses its sharp outline and at the same time becomes clouded and filled with darkly staining granules. Two opinions are possible here: either that the granules already present in the nucleus and its reticulum, being drawn closer together in shrinking, give it a darker appearance, or that new granules are formed in the nucleus. My own observations incline me toward the latter view. The stimulation is continued, and the nucleus shrinks smaller and smaller, and becomes so dark in osmic acid specimens as to be hardly distinguishable from the almost black nucleolus. Whether the extreme limit of fatigue has been reached in any of the cells examined, is of course impossible to say; but if recovery can be taken as a sign of normal action, then the fatigue occasioned by working for five hours, as above described, is not abnormal or pathological.

The process of recovery is in general the reverse of that of fatigue. The nucleus and cell gradually return to the normal appearance. At the end of six and a half hours the cell protoplasm has apparently almost or quite recovered. Vocuolation is not observable in the specimen which has rested this length of time, or in any specimens which have rested for a longer period. The nuclei, however, although they have gained much in size, retain, to a marked degree, their dense stain. The process of recovery in this respect is not entirely completed in all the nuclei which have rested for 24 hours; it is still possible to find a few large but densely stained nuclei.

A study of the ganglion cells after long periods of complete rest has brought out a point of interest to the general histology of the nervous system as well as to the special subject in hand. An appearance, often noted in nerve histology, has hitherto complicated all our experiments. This is the fact that individual cells in the same ganglion present such great histological differences. Ranvier[1] calls attention to this fact

[1] Ranvier, Traité d' Histologie, Paris, 1889, p. 802. "How is it that a little spinal ganglion, placed in a solution of ammonium bichromate, all the elements of which are therefore submitted to the same influences, contains side by side cells modified in a manner so widely different? This is a fact which we cannot yet explain; but, upon which we must insist, because we see it repeated in the spinal cord, the cerebrum, the cerebellum, etc.; that is to say, in all organs containing ganglion cells."

and shows that it cannot be due to the action of the reagents, but must be attributed to some differences between the cells themselves. So in my own experiments, even in sections of normal ganglia, I invariably find a few cells which have all the appearances of being worked. The number of these in the normal ganglia varies, but may reach 5 to 10 per cent., while in the stimulated ganglia they often exceed 90 per cent. My supposition in such cases was that some of the ganglion cells had been more or less fatigued by the normal activity of the animal. But this was merely supposition. It might also have been supposed that these cells were in process of degeneration. After we have wrapped an animal up in cotton batting, however, and laid it in a warm chamber at constant temperature for twenty-four hours, its brain having previously been destroyed so that it makes no voluntary movements, after scarcely a sensory impulse has disturbed the cells for that length of time, we find, as we might naturally expect, all the cells in the most perfect resting state. The cells appear uniformly full, and not a single shrunken nucleus can be found. The nuclei, in fact, appear larger, rounder, and clearer than in any specimen I have hitherto examined. It would seem quite possible, then, that the differences between ganglion cells, seen in sections from the same specimen, may be due to the phase of nutrition or of functional activity in which each of the cells happened to be when it died or was killed by the reagent.

We have, in the foregoing, materials from which to construct a curve that may provisionally, at least, be taken to represent the process of fatigue and recovery in the cells of the spinal ganglia. Whether these results are applicable to the fatigue of nerve cells in general does not concern us at present. And whether the action of the nucleus may be fairly considered as an index of the whole process is open to question. But we have shown that this shrinkage of the nucleus is directly proportional to the duration and also to the strength of stimulation, and in general inversely proportional to the length of the period of rest. It is the only index we have at present, and we may be permitted to use it with the understanding that the curve obtained is entirely provisional.

The curve of fatigue for a muscle is generally described as a straight line, which falls more or less rapidly according to its load and the strength and frequency of the stimuli applied to it. That of a nerve fibre has been shown, for short intervals at least, to be a straight line which remains parallel to its base line; *i. e.*, within physiological limits a nerve fibre is not susceptible of fatigue.[1]

No curve representing the fatigue of the nerve cell, drawn directly from observation of the cell itself has hitherto been obtained. The nearest approach to this is perhaps to be found in such work as Mosso has done for the fatigue which manifests itself in voluntary muscular contractions.[2] If the curve which Mosso obtains can be taken to express the fatigue of the brain cells; we may say that the nerve cell tires rapidly at first, then very slowly, or possibly holds its own for some time, and finally falls quite rapidly again to a condition of complete exhaustion. If now we plot the percentages given in the table for a fatigue series (this JOURNAL, II, May, 1889, p. 395), we find a curve quite similar to some of the curves obtained by Mosso.

We have from the table above referred to, slight stimulation, for 1 hour, 2½ hours, 5 hours, and 10 hours, causing a shrinkage in the volume of the cell nucleus of respectively 22 per cent.; 21 per cent.; 24.3 per cent., and 43.9 per cent. This is represented to the eye by the dotted line in Fig. 1.

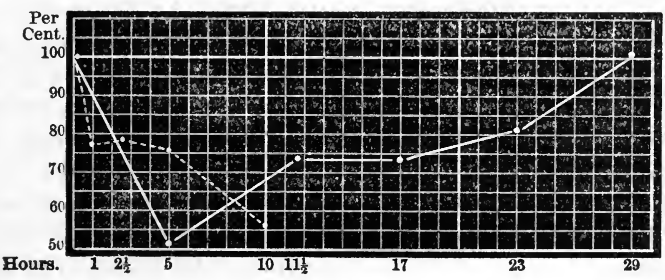

FIG. 1.

[1] H. P. Bowditch. On the Nature of Nerve-force. Jour. of Physiol., Vol. VI, p. 133.

[2] A. Mosso, Les lois de la fatigue, étudiées dans les muscles de l'homme. Travaux de Lab. de Physiol., de l'université de Turin, 1889. See plates, pp. 178, 185, 186.

By the continuous line of the figure is represented the process in the series of rest experiments, in which five hours of severe work has caused a shrinkage in the nucleus of 48.8 per cent.; recovery taking place as indicated by the second part of the curve. The curve of recovery in this instance is seen to rise quite rapidly at first, then more slowly, and again more rapidly to the normal.

I have already said that these curves are only provisional. In fact, they are introduced with the purpose of showing that in some degree they cannot be relied upon, rather than of attaching any permanent value to them. A most important factor in the shaping of these curves has hitherto been entirely ignored.

We have been endeavoring from the first to demonstrate the changes which occur in the normal functional activity of the nerve cell. That the changes already described do relate to the normal and not to the pathological action of the cells is proved by the facts that no pathological condition, which can affect the cells of the spinal ganglia, has been introduced into the experiments; that the changes in the cells are proportional to the severity and duration of their stimulation; and that the changes accompanying recovery are so far as we can see the natural reverse of those occasioned by fatigue. If, then, these changes are normal, why should there not be a rhythmic curve of rest and activity demonstrable in the normal activity of the animal. No more fundamental rhythm exists, in either physiology or psychology, than that of activity and rest, sleep and waking. And this rhythm, if not entirely dependent up on the condition of the nervous system, is, to say the least, very intimately connected with it. And if, as we know, marked changes are demonstrable in the normal activity of the cells of glands during hunger and digestion, (again rest and activity) why should not changes capable of demonstration occur in the rhythm of normal activity and rest in the cells of the nervous system?

If such a rhythm exists in the cells of the spinal ganglia, it is evident that such curves as we have obtained may be profoundly influenced by it. A stimulation of five or ten hours is physiologically a trivial matter compared with a fundamental rhythm which has become through generations an established fact in the economy of an animal species, and if the changes in such a rhythm are similar to those which we have demonstrated by means of artificial stimulation, then clearly our results in each case have been *resultants* between the influence of our stimulation and the tendency of the rhythm at the time. Such considerations necessitate a study of the normal rhythm of sleep and activity in the animal employed. To this end I have kept under constant observation for a week a half-grown kitten similar to the ones used in my experiments. The sleep of such a kitten depends largely upon the amount of food given to it. When fed to repletion, it would sleep as much as eighteen hours a day; and even when sparingly fed, slept twelve and one-half or thirteen hours. It seemed to be able to sleep equally well day or night. In fact it will probably be necessary to study the next phase of our subject in some animal which has a more pronounced daily rhythm than that found in the cat.[1]

In no animal is this daily rhythm more constant or better developed than in our day birds. I have already made sections of the spinal ganglia of pigeons and English sparrows, taken at morning and night, and so far have found that the ganglion cells of these birds killed at night do show changes exactly similar to those produced in the cells of cats and frogs by artificial stimulation. The differences, further, between the morning and night cells are much more marked in English sparrows upon a cold and snowy day, for example, than I have been able to produce by the most severe electrical stimulation. The results of these experiments are, however, reserved for the present.

To conclude, then, we have as the result of the above series of experiments the following facts :

First, that spinal ganglion cells of kittens do recover from the effects of electrically stimulating the nerve going to them.

Second, that this recovery is a slow process. It is not complete after a rest of 18 hours ; but is found to be about complete after a rest of 24 hours.[2]

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[1] It will be noted that if the cat has no marked daily rhythm of rest and activity, then our curves are more probably correct.

[2] I have purposely omitted any attempt to discuss in this place the literature bearing upon the subject. This I hope to do in some more appropriate place; a general discussion of the literature touching the similar stimulation of gland and muscle cells, it has seemed, would necessitate the introduction of minute details of remote interest to psychology.

PSYCHOLOGICAL LITERATURE.

I.—NERVOUS SYSTEM.

Histogenese und Zusammenhang der Nervenelemente. W. HIS. Archiv für Anatomie und Physiologie. Anat. Abthl. Supplement-Band, 1890.

This paper contains the substance of an address made on August 7, 1890, before the Anatomical Section of the International Medical Congress at Berlin. His begins with the question of histogenesis. At the time of separation, the medullary plate consists of a single layer of epithelial cells forming when cut across a nucleated middle zone, and two non-nucleated zones, one above and one below the former. The part of the cell body above the nucleus soon forms a striated pillar or stem with an expanded base, and the bases fuse to form a limiting membrane. The part below is also striated, but soon breaks up into short branches on a more or less divided stem which form among themselves a meshwork. By the formation of the medullary tube, the part above comes to be the wall of the enclosed canal, while the part below becomes the more excentric portion of the surrounding substance. The former, which thus represents the wall of the ventricular cavities and the central canal is designated as the columnar layer (*Säulenschicht*), the latter, as the limiting mantle (*Randschleier*). It is the limiting mantle which grows extensively both by enlargement of existing elements and formation of new cells. The entire tissue thus formed is designated as the myelo- or neuro-spongium, and the individual cells as spongioblasts. In the adult it is the innermost layer of spongioblasts which form the ventricular epithelium. His has always held the view that the branches formed a net-work in the limiting mantle. The investigations of Ramon y Cajal lead to the view that the branches of the cells are not morphologically continuous, though they may be closely apposed.

Almost from the first there are to be found among these epithelial elements another group of cells, the germinal cells (*Keimzellen*). These cells lie mainly in the columnar layer of the neurospongium, are variable in number according to the age of the embryo and the location in the nervous axis, undergo rapid division, and are amœboid in their early stages. In human embryos the last germinal cells are visible at the end of the second month. The protoplasm becomes accumulated at one side of the nucleus in a conical striated mass, and in this form they are designated neuroblasts, the conical prolongation being the beginning of the axis-cylinder prolongation. The tendency to wander leads to the early formation of a layer of neuroblasts in the limiting mantle, where they constitute the so-called mantle layer (*Mantelschicht*). While the cells themselves remain for the most part within the limiting mantle, sending their axis-cylinder prolongations beyond it in various directions, it sometimes happens that the cell body passes more or less beyond the limits of the neurospongium. For the most part these exceptional cells are overtaken in turn by the limiting mantle and finally buried in it, but there seem to be cases where this does not occur. This wandering tendency is strongly developed in parts of the *medulla oblongata*, and the olivary bodies are formed from cells which have travelled a long course. The medullary plate is thus composed at the start of epithelial and germinal cells. At the time of first multiplication of the neuroblasts, blood vessels enter the medullary plate from without, but no other elements appear. About the end of the second month in the human embryo, there appear amœboid connective tissue cells with dark nuclei. They are first seen on the outside of the neurospongium, but gradually become scattered through it. These form one constituent of the neuroglia. The neuroglia then of the adult is of mixed origin, being the neurospongium plus the connective tissue cells just mentioned. Deiter's cells he therefore considers as genuine connective tissue cells.

The neuroblasts of the medullary plate develop nerve fibres which either pass out as centrifugal fibres or remain as intra-medullary. The sensory roots come from the spinal ganglia. Here the cells are at first bipolar, but gradually change to the form where they give rise to a T-process. Passing by the description of the origin of the cells of the spinal ganglia, we come to the discussion of the origin of the sympathetic ganglia. The arrangement here is remarkable. That the sympathetic ganglia are not simply constricted off from the spinal ganglia is indicated by the following facts: The spinal ganglion cells are fully formed before the sympathetic ganglia appear, and the cells of the latter are unlike those of the former. The *rami communicantes* are formed before the sympathetic ganglia. It appears that the *rami* lead the way, and that undeveloped germinal cells, which appear in the spinal ganglia, then follow to the point of the future sympathetic ganglion. From the chain of the lateral ganglia the other orders of ganglia are developed in a similar manner.

The sensory nerves belonging to the organs of special sense appear to develop after the manner of the spinal sensory nerves, save in the case of the optic. Here he recognizes that the optic nerve may contain fibres that develop and conduct in reverse directions, as demonstrated by Ramon y Cajal. In all sense-organs the distinction between the spongioblasts and the functional germinal cells reappears.

Passing to the second part of the paper, the connection between the nervous elements, the conclusions may be more briefly stated. Within the central nervous system each cell gives out only one axis-cylinder process. The cells of the spinal ganglion give out two. The arrangement in the sympathetic nerve-cells must be left open until the fate of the spiral process can be determined. The axis-cylinder prolongation is first to appear in the nerve-cells and for a long time is the only prolongation they have. As at a very early period embryos have a nervous system without nerves, so there is a period when the nervous system consists only of cells and single long fibres running from them and when the felt-work of fibres due to protoplasmic prolongations and branches of the axis-cylinders is wanting; yet this kind of a nervous system is capable of complicated physiological activity, as can be seen in young larvæ of frogs and fish. Only at a later period are the protoplasmic prolongations developed. In man this occurs in the embryo about the end of the second month. In the cerebral hemispheres their development is subsequent to that in the spinal cord. As there is no evidence for continuity between any of the prolongations of any two nerves or nerves and cells, but in the central system all prolongations are closely matted together in a diffuse intermediate substance, it must be this latter which in some way establishes the final connection between the various elements. On the growth of the axis-cylinder His makes the point that a long time may elapse before it reaches its destination, but having reached it, it ceases to grow. The power to grow is not lost, since on cutting the end from the fibre it grows again. Why it normally stops growing then, has yet to be explained. Concerning the cells of Golgi's second type, the central cells, they appear to be of later origin in the nervous system than the others, and it is suggested that perhaps the resistance to development with which they meet in the more completely formed tissues may account for the diffuse character of their axis-cylinder prolongations. One interesting deduction from the laws of growth can be applied to the completed nervous system. Since the nerve-cells and fibres start from fixed points, those that appear first in development will be more or less overgrown and covered by those which appear later. This is illustrated by the relations of the nuclei of the *hypoglossus*, lateral column, the ascending root of the *glosso-pharyngeus* and *vagus*, etc., in a cross-section of the *medulla*. No one can read this paper of His without assenting to his final statement that embryology stands foremost among the means which we have at our command for unraveling the organization of the central nervous system.

Zur feineren Anatomie des centralen Nerven-systems. Erster Beitrag. Das Kleinhirn. A. KÖLLIKER. Zeitschrift f. Wissen. Zool., B. 49, H. 1. Mai, 1890. Taf. XXX—XXXIII.

Under this title Kölliker has reviewed the results obtained by Golgi, Ramon y Cajal, and himself, laying of course the principal emphasis on the method of silver impregnation introduced by Golgi. The lower mammals, cat, dog, etc., are largely used in these studies, and it is not always clear how far the several points have been made out for man, but I will endeavor to give a description of the elements in the human cerebellar cortex as they are now regarded by Kölliker.

The *Molecular Layer:* The cells of Purkinje are somewhat flattened and their enormously developed protoplasmic prolongations lie in a plane at right angles to the long axis of the cerebellar folia. These prolongations end free. The axis-cylinder prolongation gives off lateral branches, some of which at least turn back towards the molecular layer, while the main stem passes on to become a medullated fibre. The small cells of the Molecular Layer: (*a*) The peripheral small cells lie in the outer half of the molecular layer and have well-developed protoplasmic prolongations. The axis-cylinder prolongation is present, but its character and distribution have not been determined. (*b*) The central small cells belong to the most remarkable elements yet described for the nervous system, and from the peculiar terminations of the axis-cylinder prolongations have been termed "basket-cells." They lie just ectad of the bodies of Purkinje's cells, are more numerous where these latter are more abundant, have their long axis in the plane of the cortical surface, and give rise to numerous and complicated protoplasmic prolongations, some of which may run almost to the surface of the cortex. The axis-cylinder prolongation is very long, runs in the plane of the surface, just above the bodies of the cells of Purkinje and in the neighborhood of each cell sends down a branch, which dividing into a bunch of terminals forms a net or "basket" about the cells. Of this very remarkable arrangement Kölliker expresses himself as perfectly satisfied.

This exhausts the classes of nerve-cells in the molecular layer, and we pass next to the *Granular Layer*. There are here distinguished large and small nerve-cells. (*a*) Large nerve-cells: These are characterized by being few in number, situated just below the molecular layer, having their protoplasmic prolongations distributed in both molecular and granular layers, and having the axis-cylinder prolongations of the second type, which have thus far been found, distributed in the granular layer alone. (*b*) Far more numerous than the foregoing are the small nerve-cells of this layer. These are furnished with short protoplasmic processes which end in bunches of terminals, suggesting in a distant way the terminations of the axis-cylinder branches in the "basket cells." The axis-cylinder prolongations on the other hand are slender, long, arise as a rule from a protoplasmic prolongation at their base and pass without exception to the molecular layer, within which they divide into two branches running longitudinally and parallel to the surface; so abundant are these T-terminations in this region that a longitudinal vertical section of a folium shows a distinct longitudinal striation due to them.

Turning now to the *Nerve Fibres:* (*a*) The medullated fibres form a thick net-work in the granular layer, a thick band just below the cells of Purkinje, and bundles passing to the molecular layer between these cells. In the molecular layer they are abundant in the central portions and decrease towards the periphery. In this layer also they sometimes divide. (*b*) A portion of the fibres from the medullary layer are non-medullated, and end in part in the granular and in part in the molecular layer, and owing to the fewness of them in the latter locality they may be associated with the small peripheral nerve-cells of that region.

If the matter is looked at from the other side and we attempt to account for the nerve prolongations of the several groups of cells just described, we have the following:

Molecular Layer.—Cells of Purkinje, nerve prolongations medullated; (*a*) small peripheral cells, nerve prolongations not known; (*b*) basket-cells, nerve prolongations non-medullated. *Granular Layer.*—(*a*) Large nerve-cells, nerve prolongations non-medullated; (*b*) small nerve-cells, nerve prolongations medullated, giving rise to the bundles of nerve-fibres which pass between the cells of Purkinje and finally form the longitudinal striation of the molecular layer mentioned above(?) No-where is there seen anastomosis between the termini of cells or fibres either with themselves or with one-another, and the physiological relation remains therefore as much of a riddle as ever.

Zur feineren Anatomie des centralen Nerven-systems. Zweite Beitrag. Das Rücken-Mark. Taf. I—VI. A. KÖLLIKER. Zeitschr. f. Wissen. Zool., 51 Band, 1 Heft. Dec., 1890.

In this second communication Kölliker has formulated the new facts concerning the spinal cord much in the same manner as he has those for the cerebellum in the first communication just reviewed. The discoveries are the result of the application of Golgi's method to the nervous system of fœtuses or very young animals and the chief authorities, as before, are Golgi and Ramon y Cajal. In the material from immature animals the nerve-fibres are non-medullated to a greater or less extent, and appear therefore to be more easily brought out by the silver method. The fact that many of the results thus far obtained have not been verified on the adult by this same method may be urged against the validity of the conclusion, but other methods used on the adult give so much confirmation to the results here described that there is great reason for considering them as generally true.

In the light of these investigations the spinal cord in man may be described as follows:

The *dorsal nerve roots* all arise from the spinal ganglia, enter the dorsal column of the same side and there sooner or later divide into two branches one of which runs cephalad, the other caudad. In some cases these longitudinally coursing fibres run for a distance in the fœtus which would be equivalent to 4—6 cm. in the adult. In other cases they soon bend at right angles to the long axis and run into the gray matter, where they terminate. The criterion of termination is the formation of one or more finest branches, which in certain cases may amount to a bunch of terminals suggesting the "baskets of the baskets cells" in the cerebellum. In addition to these terminals there are those of an entirely new sort, formed by so-called "collateral fibres." These are very fine, arise more or less at right angles to the course of the main fibre, and appear too, constantly abundant for these dorsal root fibres at least, and thus form a most important addition to the possible paths for incoming impulses. As many as nine of these collaterals have been counted running from a single fibre. The exact point in the fibre at which these collaterals arise in the adult is a matter of speculation. In the specimens described there appears to be a thickening of the fibre just at the point of origin, but the silver method does not offer any explanation of this appearance.

The dorsal roots pass to the dorsal columns and the gray substance of the same side, and to a small extent to the gray substance of the opposite, the crossing taking place mainly in the ventral commissure. The *efferent nerve roots* arise from the nerve prolongations of large and small cells in all parts of the ventral *cornua*, and in some cases give off at their origin a few branches. In many other cases no lateral branches are found, but the negative evidence in this case has little value. The ventral and lateral columns contain fibres which in part arise from cells situated at all levels in the cord. The great majority of fibres in these columns, if not all, give rise to collateral branches, which end freely in the ventral *cornua* and the ventral portion of the dorsal *cornua*. In many cases the fibres themselves of these columns bend at right angles and terminate as free fibres in the gray substance. The *ventral commissure* is composed, (*a*) of the nervous prolongations from cells in all parts of the gray matter which after crossing distribute themselves to the ventral and ventro-lateral columns, (*b*) of decussating collateral branches from the same columns, and (*c*) of decussating protoplasmic prolongations of some cells which lie close to the commissure. The *dorsal commissure* consists of (*a*) decussating collaterals of the dorsal root-fibres, (*b*) of possible decussation of collaterals from the dorsal portions of the lateral columns, and (*c*) doubtfully, of the decussation of the protoplasmic and nerve prolongations of a few cells lying near the central canal.

When the nerve-cells are classified on the basis of their nerve prolongations they fall into two groups: (*a*) Those whose nerve prolongation forms a fine net-work in the terminals of which it ends; and (*b*) those whose nerve prolongation maintains its identity, *i. e.* is directly continued into a nerve-fibre. Here again (*b*) a subdivision can be made into those that have nerve prolongations richly branched and those in which they are sparsely branched or not branched at all(?). When the cells are grouped according to the destination of the axis-cylinder they fall into: (*a*) Motor-cells where the nerve prolongation passes into motor nerve fibres and has the fewest lateral branches. (*b*) Those whose nerve prolongation passes into one of the columns of the cord and which may present almost any degree of branching. (*c*) Those whose axis-cylinder is much branched but in which the terminals are strictly confined to the gray matter of the cord. It will be noticed therefore that sensory cells in the older sense, are excluded from this list.

Passing by what may be said concerning the connective tissue elements we come to the physiological considerations connected with them. Those cells which directly give rise to nerve-fibres through their nerve prolongation alone act by continuity. In all other cases the relation between the nervous elements is that of contact simply, and constitutes an *actio in distans*. It was Golgi's view that the nerve prolongations ultimately formed a fine net work in which it was not so easy to see how an impulse should pick its way. The general outcome of Kölliker's discussion is that despite the great complication here present, there is a high degree of organization in this region and he rather swings back again to anatomical reasons for the reactions of the cord.

Striæ acusticæ und untere Schleife. DR. C. v. MONAKOW. Archiv für Psychiatrie. Bd. XXII, H. I. Taf. I and II.

The author opens this paper, which is written with his usual care and precision, by a historical sketch of the views held regarding the *striæ acusticæ*, in which he specially dwells on those results which associate the *striæ* with the *lemniscus*. Passing to his own previous experiments he brings forward the following as bearing on the discussion. Removal of the entire temporal lobe, including the auditory centre of Munk, gave (in dogs?) degeneration of both cells and fibres in the *corpus geniculatum int.* of the operated side. This observation has been recently verified on two human brains where there was a defect in the temporal lobe. Moreover, following this operation, there was an evident degeneration of fibres in the arm of the posterior *corpora bigemina* on the operated side. If the lenticular nucleus and the *amygdala* were not also injured by the operation, then the degeneration could not be followed further caudad. In cats and rabbits, at least, the *inferior lemniscus* (*untere Schleife*) remains quite normal, after removal of the temporal lobe. If, in a rabbit, the caudal portion of the internal capsule be cut through, the atrophy in the *corpus geniculatum internum* and the arm of the posterior *corpora bigemina* is even more extensive than after removal of the temporal lobe, and in addition the nucleus of the posterior *corpora bigemina* is somewhat reduced in size. Neither the *inferior lemniscus* nor the so-called auditory nuclei are at all affected by this operation. In one instance, v. Monakow removed the posterior *corpus bigeminum* of one side, from a rabbit, and found as a result atrophy in the arm of the *corpus* and the *inferior lemniscus*, and also some loss of fibres in the ventral decussation of the *tegmentum*. When, however, the *inferior lemniscus* is sectioned in a new-born cat, there degenerate among other things the *striæ acusticæ* and the *tuberculum acusticum* of the side opposite that of the lesion. This result on the cat was obtained some time since, but the author has delayed publication until he could verify his results in some other case. Recently, a repetition of the same operation on a dog has given him similar results and he now publishes the account of both together.

The operation consisted in both cases of cutting the *inferior lemniscus* on the right side and observing the degenerations which followed. The details of the results must be omitted here, but the general outcome may be stated as follows: In a section just caudad of the posterior *corpora bigemina* are to be seen nearly all the bundles of fibres belonging to the *lemniscus*. This last—the *lemniscus* of Forel—occupies that region between the *pons* and *formatio reticularis*, which lies laterad to the *raphe*. The lateral portion of the region so bounded consists of fibres which in a cross-section are cut through squarely or obliquely, and is called the *inferior lemniscus*, lying for the most part laterad to the *formatio reticularis*. In the cat, v. Monakow divides the *lemniscus* of Forel into a lateral and mesal portion, the dividing line running parallel to the *raphe*, and cutting the *lemniscus* midway between the *raphe* and the mesal edge of the middle peduncle of the cerebellum. In each of these subdivisions he further distinguishes a dorsal and a ventral portion, which latter, however, are only separable in animals that have been operated upon. Of this area about two thirds belong to the so-called cortical *lemniscus*—*i. e.*, the fibres which degenerate upon removal of the parietal cortex, and they occupy the dorsal portion of both the mesal and lateral areas just mentioned. By "*inferior lemniscus*" v. Monakow designates the region between the ventral end of the superior cerebellar peduncle (*Bindearme*) and the gray matter of the *pons* and laterad to the *formatio reticularis*. In this region he marks off four areas, which he designates by *A*, *B*, *C* and *D* respectively: *A*, the central area, is the group of fibres which passes through and immediately surrounds the lateral nucleus (Obersteiner) of the *lemniscus*. *B* is the ventral area which passes mesad into the so-called *lateral lemniscus* (v. Monakow's lateral division of the *lemniscus* of Forel). *C* is the dorsal area which occupies the space between the superior cerebellar peduncle and *A*. *D* is the mesal area of fibres, cut obliquely, which lies mesad of *A* and *B*, and is separated from them by a thin layer of gray matter.

Turning now to the results of the examination of the two animals experimented upon, they show that the dorsal area (*C*) when sectioned causes a degeneration of the dorsal fibres of the superior olive on the operated side, and of the arcuate fibres passing from this part of the superior olive to the dorsal surface of the other side. Since the fibres that take this course go directly to form the *striæ acusticæ*, it is, therefore, the *striæ acusticæ* which degenerate and in connection with them the large spindle-shaped cells lying in the dorsal portion of the *tuberculum acusticum*, so that this group of structures may be considered as physiologically associated. To this area (*C*) of the *inferior lemniscus* v. Monakow gives the designation of "Path of the *striæ acusticæ*" (*Antheil der Striæ Acusticæ*). It does not, however, contain *all* the fibres of the *striæ*, since some escape degeneration. Cephalad of the point of the initial lesion there occurs a degeneration in the gray substance of the posterior *bigemina*. Since, therefore, there are two sets of cells involved, in the *tuberculum acusticum* at one end, and the *corpora bigemina* at the other, v. Monakow assumes that two sets of fibres, conducting in opposite directions, have here been sectioned. Considering further the reactions of the posterior *corpora bigemina* to lesions lying cephalad to them, as given in the first part of this review, and now the reaction to a lesion lying caudad, the author suggests that there may be in their gray matter predominantly cells of the second or central type (Golgi), and that they may thus form an intermediate centre between the *medulla* and the cortex.

Dependent on the *inferior lemniscus*, according to these experiments, are the lateral nucleus of the *lemniscus*, and in part the superior olive, both on the same side as the lesion — further, the fibres passing ventromesad from the side of the lesion, and taking part in the ventral decussation of the *tegmentum* and the dorsal fibres (H_2) in the *regio subthalamica*, on the side opposite to the lesion. For the relations of these several degenerations to the areas of the *inferior lemniscus*, as above described, the reader is referred to the original.

V. Monakow's final statement with regard to the "Path of the *striæ acusticæ*" is that he considers these fibres as a secondary tract of the *acusticus* passing cephalad from the *tuberculum acusticum*, and at least once interrupted on its way to the cortex, the point of interruption being probably the gray matter of the posterior *corpora bigemina*; but what the connection between this intermediate centre and the cortex may be, is by no means clear from the experimental evidence at present available. The paper closes with a condensed statement of the relation of the author's views on the subject of the *striæ acusticæ* to those of Flechsig and Baginsky. [It will be remembered that in his study of the path of the optic impressions (see AM. JOURN. PSYCHOL., Vol. II, p. 625), v. Monakow suggested the same arrangements of double sets of fibres conducting in opposite directions, which he here believes to exist in the "Path of the *striæ acusticæ*."—REV.]

La psicologia in rapporto alle ultime nozioni di fisiologia del cervello. L. BIANCHI. Estratto dagli Atti del IV Congresso tenutosi in Novara dall' 8 al 14 Septembre, 1889. Milano, 1890.

This paper is the report of an address given by Bianchi at the congress above mentioned, and is an example of the efforts now being made on many sides better to utilize the results of experimentation on the brain for the benefit of psychology. The author urges the study of those phenomena in animals which may be grouped under the general term "changes of character." According to the observations most generally received, the ideational processes are dependent on the integrity of the sensory and motor cortical areas. The question is then asked whether the sense perceptions are due to a simple and elementary reaction of a cortical area, or are complex and based on the association of two or more cortical areas? The instances which the author then adduces from his own experiments and those of others favor the later view. Bianchi finds vision affected by lesions in the cephalic half of the cerebral hemisphere, in the dog, and the intensity of the disturbance increased as the lesion is carried further caudad. If the place of the excision affects only the amount of the disturbance, it is otherwise with stimulation, where the character of the reaction depends on the point stimulated. For example, the stimulation of the most cephalic portion of his (Bianchi's) cortical area produces closure of the eyelid; of the middle portion, movements of the eyeball; and of the most caudal portion, no movement. When this cephalic area is excised, there are no changes visible in the conjunctiva; yet, stimulation of the conjunctiva in dogs thus operated produces closure of the eyelid, as it would in a normal dog. He, therefore, infers, since the reaction can be gotten as described, after removal of the cortical centre, that when the reaction followed its stimulation it was not direct but due to the indirect excitation of the sensory cells of the visual area. Other instances are given where sensory disturbances follow the lesion of so-called motor areas, and it is concluded that the interruption of associative paths may explain these results. The author's next question is whether there may not be something over and above the sensory and motor centres which controls their action and gives capability for attention. From this point of view he finds, as others have done, dogs from which the extreme frontal cortex has been removed, very instructive. In such a case the animal appears intact, so far as sensation and motion are concerned, but in conduct he is highly deficient. This leads him to the tentative opinion that there is some relation between the completeness of the associative processes and attention and the lack of the latter in the animals in question is explained by the disturbance of the former. His final observation is on the variations in the character of different dogs from which the same amount of cortex has been removed from different regions, and here he obtains the classic results as described by Goltz in his earlier experiments.

The Principles of Psychology. WILLIAM JAMES. 2 Vols. New York, 1890. Henry Holt & Co.

The standpoint of any psychological treatise toward the anatomy and physiology of the nervous system is certainly of interest to those working along the latter lines. In these volumes there is almost no anatomy in the stricter sense of the term. The author's interests are on the physiological side, and certainly what he gives is most admirable. The nerve centres in the encephalon of the frog furnish the introduction to the whole subject, and the reactions of the animal, from the case where it is possessed of nothing but the spinal cord, through the intermediate cases up to the normal individual, are followed and described in accordance with the best results. The well-known scheme of Meynert, representing the child and the candle, and showing the nerve connection in the inexperienced child, who did burn his finger, as compared with the connections established in the same child when experience has acted on it, is used to lead up to the discussion of the education of the hemispheres. A brief allusion to phrenology furnishes here a useful preface, and is followed by as well proportioned a sketch of the history of cerebral localization as is to be anywhere found. Naturally in such a book the latest results on some points, as for example, the recent observations on motor reactions from sensory areas (the visual and auditory centres), are overlooked; also the increasing evidence for a decidedly detailed projection of the retina in the visual area in dogs and monkeys, is not brought out. Neither these nor other minor omissions would seriously alter the general conclusions, however, and these latter are certainly drawn with due appreciation of the development and migration of function within the encephalon and the possibilities which that conception brings with it. Motion and sensation represented in the cerebrum; consciousness as the companion of nervous currents in the higher nerve centres, and associations between these centres themselves and the lower centres, furnish the background for the subsequent discussions. Since this conception is comprehensive, simple and highly plastic, it is easily handled in the more or less speculative chapters which follow, and it would be uncharitable to find fault with it. At the same time, there are those who long to get the problems discussed into the laboratory. For their purpose hypotheses must be rigid and anatomy detailed, so that while they will find these pages full of suggestion, they will not find the relations of brain function and brain form developed in a manner which permits of experimentation until both are more narrowly formulated.

The Origin of the Cerebral Cortex and the Homologies of the Optic-lobe Layers in the Lower Vertebrates. ISAAC NAKAGAWA. Journ. of Morphology. Vol. IV, No. I. July, 1890.

It was natural that Edinger's statement that the homolog of the cortex in the higher vertebrates could not be traced further down the scale than the reptiles, should stimulate a more careful study of the cerebral mantel in the amphibia. We have recently reviewed a paper by Oyarzun (AMER. JOUR. PSY., III, p. 377), coming from Edinger's laboratory, which shows that undoubted nerve cells are found in the mantels of several amphibia which were examined. Quite independently and in another way Nakagawa, working under the direction of H. F. Osborn, has compared the cells in the cerebral mantel in the Amphibia (*Rana, Menobranchus and Spelerpes)*, the Reptilia (*Tropidonotus* and *Emys*), the Aves (*Columba*), and the Mammalia (*Didelphys*), and concludes that, though poorly developed, there is a layer of cells in the cerebral mantel of the Amphibia which must be considered the homolog of the cortex in the higher forms. In the first three classes the same method of comparison is applied to the several layers of the optic lobes, and from them a provisional scheme of the functional value of the various layers of this region is constructed.

Ueber früh erworbene Grosshirndefecte. Dr. v. MONAKOW. Correspondenz-Blatt für schweiz. Aerzte, Jahrg. XX, 1890.

Under this title v. Monakow briefly describes the brain of two young children in whom during the first month and first year respectively, a porencephalous condition developed which involved the region supplied by the *arteria fossæ Sylvii.* In both cases the lesion was on the left side of the brain. This area is that of the inferior frontal gyrus, the *operculum*, *insula*, and the first temporal gyrus, and the general point of his discussion is the relation which these portions of the hemispheres bear to the nuclei of the thalamus. Of special interest is the comparatively circumscribed degeneration of the *geniculatum internum*, which has not been described before for man and which the author associates with the defect in the temporal lobe, thus bringing his results here into harmony with those obtained by his experiments on animals. Whether the *geniculatum internum* is associated with the sense of hearing, must still be further investigated.

The Cerebral Cortex and its Work. HENRY MAUDSLEY. Mind. No. 58, April, 1890.

Those who may be interested in this line of thought will find a suggestive discussion in the above-mentioned paper, wherein the entire central nervous system is considered as an elaborate reflex apparatus. Sensory nerves are adapted for special stimuli, fit motor adjustment in response "is the fundamental quality of a perfect reflex action." Complexity of reaction is the criterion of a highly developed nervous system. The highest nerve centres are the store-houses of "adjustments and fit acts." Coming to the question of the motor centres of the cortex Maudsley asks "what actual relation of function the definite motor areas of the cortex have to the classes of movements which take place in consequence of their stimulation." He concludes, that it may be that no part of the so-called motor-region is really directly motor, but that it represents specialized movements, "abstracts of movement or motor abstracts, which are the efferent aspects of the cortical reflexes called thoughts." One corallary from this would be, no thought without movement.

Proceedings of the Physiological Society, 1890, No. IV, Journ. of Physiology, Vol. IX, No. 6.

Dr. Beevor gave a demonstration of the *cingulum*,—the longitudinal fibres of the *gyrus fornicatus*, and *gyrus hippocampi*—in the marmoset monkey. The most important general result was that the fibres forming the *cingulum* are not continuous from one end to the other, but are internuncial, running a short course in the *cingulum* and then turning out into the neighboring white matter. In that portion of the *cingulum* which lies dorsad of the *callosum* they thus appear to put the *gyrus fornicatus* in connection with the *centrum ovale*—an anatomical relation which is interesting in view of the observations of Schäfer and Horsley that removal of the *gyrus fornicatus* produces in monkeys tactile anæsthesia on the opposite side of the body.

Complete Sclerosis of Goll's Columns and Chronic Spinal Leptomeningitis with Degenerative Changes in the Fibres of the Anterior and Posterior Roots. F. W. MOTT, M. D. The Am. Journ. of the Medical Sciences. Vol. CI., No. I, Jan., 1891.

The case which the author describes was a male 46 years of age. His occupation exposed him to all weathers, and he drank rather heavily. History negative. He was admitted to Charing Cross Hospital on account of illness which had commenced some two years previously. He died, about twenty days after admission, of general tuberculosis of the lungs. The symptoms which are of interest in this connection were sudden failure of power in the legs, which increased until he lost completely the use of them, accompanied by pain, the legs becoming flexed and rigid. Weakness and wasting of the upper limbs developed later, but he did not completely lose the use of them. The reflexes were generally absent though a very faint knee-jerk was obtained on the right side. Sexual power was lost at the outset of the disease, but there was no difficulty in micturition or defecation. For the upper extremities the dermal sensations were normal. The only note on these sensations for the lower extremities is that tickling the soles of the feet was painful. The special senses and the movements of the muscles of the head and face were normal.

No note was made of the macroscopic appearance of the fresh cord. On sectioning the hardened cord the lumbar region was found free from degeneration up to the level of the first lumbar segment, but from this point to the cephalic portions of the cervical region the dorso-median columns were degenerated. The *dura* appeared normal but the *pia* was the seat of a chronic *leptomeningitis* which caused a thickening and an encroachment of inflamed tissue on the periphery of the cord. Both dorsal and ventral nerve roots were extensively but irregularly degenerated, while the cells in the ventral *cornua*, in the column of Clarke, and in the spinal ganglia remained unaffected. The only other fibres found degenerated in the cord were scattered in the lower thoracic region in the dorso-lateral columns and in the mid-cervical region, located in the two wing-like masses, in the same columns. Inasmuch as the dorso-median column is sclerosed throughout and the initial lesion is assumed to be in the nerve roots between the cord and spinal ganglia, it is necessary to explain why this column alone is affected. The arteries of the sclerosed region have their walls enormously thickened, and the author suggests that it is possible to connect the sclerosis with the disturbance of nutrition thus indicated. He then quotes three cases of degeneration of the dorso-median columns in which the symptoms were somewhat similar to his own case and in two of which the muscular wasting was also observed. Before passing to the general conclusion it will be well to state what he assumes in the discussion, as expressed at the beginning of the paper. The fibres of the postero-median columns are formed from prolongations of the cells in the spinal ganglia and pass through the dorso-lateral columns on the way to their destination, but do not cross the middle line. It is probable that the fibres from the lumbar region become smaller in diameter as they ascend, for if a measured area of fibres in the lumbar region of this column be counted and a similar area, assumed to contain also fibres from the lumbar region, be counted in the cervical region, more fibres will be found in the second than in the first case. The fibres end in the post-pyramidal nucleus and, through the connections of this nucleus, in the cerebellum. The connection favors the idea that these fibres are paths for the muscle-sense, and the cases cited show that they do not conduct impulses connected with the sensations of touch, heat, cold or pain. Turning next to the conclusions which are based on the above statements and the cases given. They are in brief: 1. The dorso-median column may be connected with the transmission of impressions relating to the muscular sense or have some other function not yet determined. 2. The several cases given are similar in symptoms and reputed lesions. 3. The absence of knee-jerk, inability to stand, and wasting of the limbs, might be explained by lesion of the motor nerves which were more or less involved at their origin from the cord. Further, the disturbance might first express itself at the periphery in the motor end-plates, for though the nutritional disturbance might be too weak to affect the entire fibre it might show itself at the terminals which are furthest from the seat of nutrition. In the same way the complete destruction of the dorso-median column in the cervical region, while it is incompletely destroyed in the thoracic and lumbar regions (the fibres being considered continuous), is regarded as showing that the portions of the fibre most distant from the nutritive centre are most affected by the disturbance of nutrition. Further to support this view, idiopathic lateral sclerosis is mentioned.

[That the dorso-median column is connected with the cerebellum is a view far less well-supported than the current one, that its physiological continuation is in the arcuate fibres of the medulla. As regards their relation to the muscle-sense — in the author's case and two of those which he has cited, it is not stated that tests of the muscle-sense were made, and in the third case cited it is distinctly stated that the muscle-sense was normal. The motor phenomena can certainly be attributed to lesion of the motor elements and the view that nerves tend to degenerate at the point furthest removed from the nutritive centre, when the latter is affected, is, I believe, without experimental foundation.—Rev.]

A Study of the Paths of Secondary Degeneration in a Case of Injury of the Cervical Spine. A. V. MEIGS, M. D. The Am. Journ. of the Med. Sciences. Aug. 1890. III Plates.

A blow on the back of the head and neck of a sailor caused loss of sensation and motion below the level of the clavicles. The patient died twenty-six days after admission to the hospital. The autopsy showed neither luxation nor fracture of the spine, but a small extra-dural hemorrhage into the spinal canal at the level of the seventh cervical vertebra. Specimens of the cord were taken from a little above this point and as far down as the lumbar region. The hardening was in Müller's fluid, and the staining, by carmine, Weigert's hæmatoxylin and Schultze's palladium and carmine method. This last was found to bring out an incipient stage of degeneration which the Weigert's hæmatoxylin did not reveal. At the level of greatest destruction (about the seventh cervical) the transverse myelitis appeared to involve the entire section, except the dorsal portion of the dorsal columns, and some peripheral parts of the ventro-lateral column on the right side. On completion of the hardening, the cord was examined macroscopically and the color markings used to locate the paths of degeneration. When, however, the paths thus located are compared with the indications from the microscopical examination, so much discrepancy is found that any direct inference from the one to the other is plainly unreliable at present. The macroscopic color changes are significant, but according to this account the possibilities of that significance have yet to be elaborated. The author calls attention to the distribution of the degeneration above and below the level of greatest disturbance. For example, above the level the dorsal columns are involved, whereas they appear normal at the point of the initial lesion. Below this level a region which appears to be that of the crossed pyramidal fibres is involved throughout the extent of the cord, but appears to have a less area in the mid-thoracic than at the levels above and below this. The peculiarity of this result is contrasted with the usual observation that as we pass from above downwards a lesion of this bundle gradually decreases until it fades out. For this appearance the author is inclined to fall back on some explanation other than the usual one, but for this and the several stages of degeneration in which the fibres were found, the reader is referred to the original.

The Presence of Ranvier's Constrictions in the Spinal Cord of Vertebrates Dr. WM. T. PORTER, Quart. Journ. Micros. Sci., Feb. 1890, 1 pl.

The author worked at Kiel in the laboratory of Prof. Flemming. The problem of the presence of the nodes of Ranvier in the fibres of the spinal cord was tested by him with silver, osmic, using the method of teasing and sections, on the cords of the rabbit, guinea-pig and ox, and nodes were satisfactorily demonstrated in all these animals, as his drawings show. The technical difficulties are apparently considerable and neither the distribution in the cord of any one animal nor in any large series of vertebrates was followed out, the author showing simply that the constrictions do exist in that locality in the animals named and that, as these fibres have no sheath of Schwann, the formation of these constrictions must be independent of that structure. Here and there since 1875 the existence of these constrictions in the spinal cord has been maintained, but the evidence here given appears to be the strongest that has yet been advanced. (The existence of these constrictions would harmonize with the "collateral" nerve branches of Ramon y Cajal, since they would give points at which these collaterals might leave the main fibre, thus bringing this new case under the law of branching as observed in the peripheral nerves. REV.

On the Progressive Paralysis of the Different Classes of Nerve-cells in the Superior Cervical Ganglion. J. N. LANGLEY and W. LEE DICKINSON, Proc. Roy. Soc., Vol. 47, March, 1890.

Pursuing their previous studies on the paralysis of the nerve-cells in the superior cervical ganglion by nicotin, (see review in AMERICAN JOURNAL OF PSYCHOLOGY, Vol. III. p. 372), the authors present in this paper evidence to show that the various effects of stimulation of the cervical sympathetic nerve are unequally influenced by the action of this drug, and therefore conclude that the different classes of nerve cells concerned, are not affected to the same extent at the same time. They worked with rabbits, cats and dogs, and the induction current was applied to the sympathetic nerve on the distal side of the ganglion so that the impulse must pass the ganglion to produce its effect. They recognize the following reactions upon stimulation of the nerve: (1), Retraction of the nictitating membrane; (2), Protrusion of the eyeball and opening of the eye; (3), Turning the eye (under certain conditions); (4), Dilation of the pupil; (5), Constriction of the small arteries of the ear, conjunctiva, and of various other parts of the head; (6), In the dog, dilation of the small arteries of the gums, lips and some other parts of the head; (7), Secretion of saliva. In making these experiments, the nicotin was given by intravenous injection, either in doses sufficient to abolish all the reactions from the sympathetic and then the order in which the various reactions returned upon recovery from the drug was noted; or the reverse process was pursued. Smaller doses being given, and the order in which the reactions were abolished, noted. The order of recovery was found to be the reverse of the order of paralysis. As bearing on the immediate question it may be repeated that Langley had previously found that in the cat the secretory cells on the course of the cervical sympathetic were more easily paralyzed than the secretory cells on the course of the *chorda tympani*; that in the dog the reverse was the case; finally that on the course of the *chorda tympani*, the cells associated with the secretory fibers were paralyzed before those associated with the vaso-dilator fibers. In the final tables the effects of stimulating the sympathetic are arranged for each animal,—rabbit, cat, dog,—in the order in which they disappear under nicotin. The absolute time intervals are short, not more than a few minutes as a rule, and many of the effects disappear apparently at the same time, but some of the effects are regularly abolished sooner than others. In the rabbit for example the withdrawal of the nictitating membrane disappears first and the constriction of the blood vessels of the ear last. In the cat the first is the secretion from the submaxillary gland, and the last, the withdrawal of the nictitating membrane. In the dog the dilation of the arteries of the bucco-facial region is first, and the last the constriction of the blood-vessels of the submaxillary gland. While the authors admit that tonic stimuli reaching the several regions by nerve fibers other than the sympathetic may influence their results, they nevertheless consider the differences in reaction just mentioned to be due to an unequal paralysing action of nicotin upon the nerve cells of the superior cervical ganglion.

Ueber den Nachweis der Unermüdlichkeit des Säugethiernerven. H. P. BOWDITCH. Archiv f. Anatomie und Physiologie, Physiol. Abthl. 1890.

In a previous investigation the author showed that prolonged stimulation of a motor nerve did not cause fatigue in it. The strength of stimulus was such as to tetanize the normal muscle with which the nerve was connected, and the muscle was then kept quiet by the action of curare while the stimulus was continuously acting on the nerve. On recovery from the curare the final tetanus was preceded by single contractions of the muscle and then an imperfect tetanus. This paper bears on the question whether these first reactions of the recovering muscle are due to changes in the muscle or in the nerve during the experiment. The work was done on dogs and the simple method was used of comparing the reaction of the muscles on recovery from curare first, when the nerve was continuously stimulated during the interval preceding recovery and next when it was not so stimulated. Under both conditions the muscle reacted in the same way, and it was therefore concluded that the peculiar reactions were independent of any changes in the nerve due to stimulation, and were muscle phenomena only.

Twelve Lectures on the Structure of the Central Nervous System, for Physicians and Students. By DR. LUDWIG EDINGER. Second revised edition, with 133 illustrations, pp. 230. Translated by W. H. Vittum, M. D., edited by C. Eugene Riggs, M. D. Philadelphia and London. F. A. Davis, 1890.

It has long been felt among those interested in these matters that a translation of the "*Zehn Vorlesungen*," or as it was rechristened in the second edition "*Zwölf Vorlesungen*," of Edinger would facilitate instruction in the finer anatomy of the nervous system in this country. The gentlemen who have made the English version have been conservative in all matters. The nomenclature is that of the English anatomies. No notes are added to the original, and the same illustrations appear in the English that are to be found in the German edition. The English book has more pages owing to the use of larger type and a somewhat smaller page. The contents of Edinger's original book is already familiar and it needs only to be added that the second edition contains some results of the author's studies in the comparative anatomy of the brain, especially that of the fibre tracts; these results have on several occasions been reviewed in this JOURNAL. This translation forms probably as compact, consecutive and practically useful a treatment of the subject as we have in English.

Macroscopic Vocabulary of the Brain with Synonyms and References. Prof. B. G. WILDER.

This pamphlet, which appears so far as we can judge *sumptibus auctoris*, was presented at the last meeting of the Association of American Anatomists held in Boston, Dec. 29, 1890. It contains something over 200 terms which the author recommends for use in the macroscopic description of the brain. They are for the most part mononymic paronyms (*i. e.* words adopted into a modern language without essential change) arranged in alphabetical order and followed by references to standard publications where they are defined by use.

II.—PSYCHIATRY.

RECENT LITERATURE OF GENERAL PARALYSIS.

BY WILLIAM NOYES, M. D.

PRODROMAL STAGE AND EARLY DIAGNOSIS.

The Early Stage of General Paralysis. CHARLES F. FOLSOM, M. D. Transactions of the Association of American Physicians, September, 1889, and the Boston Medical and Surgical Journal, 1889, CXXI, p. 349.

Dr. Folsom's article deals with a stage of general paralysis that has been very little touched on in the books; and the asylum physician rarely, if ever, sees cases presenting the symptoms here described. The body of the article is a most careful and painstaking analysis of seventeen cases selected with reference to giving the most important points in diagnosis, in which the symptoms preceded by varying periods the time that is usually looked on as the beginning of the disease. A careful study of the cases themselves is necessary for a full appreciation of the obscure and insidious character of the first symptoms, but Folsom's description of the general mental condition in this early stage furnishes an excellent clinical picture of this state. It cannot well be summarized, and its importance warrants giving it in full.

"The question whether the diagnosis of general paralysis can be made in its actual incipiency is still under judgment; I do not know an instance where it has been successful. Indeed it is not within my experience that a physician has been consulted so early. The absence of subjective symptoms and the lack of those naturally observed by others, as compared with the various forms of neurasthenia, for instance, are quite deceptive. But the change in personal traits or character, and the peculiar apathetic, indifferent, unconscious quality of the mental impairment, in uncomplicated cases, are unlike anything else. There is not the slightest doubt, however, that general paralysis can be diagnosticated with certainty far oftener than not, for a considerable length of time before what is usual now. It is quite true that the signs of mental impairment may be ascertained only by a painstaking examination, that the patient may bear cross-questioning without manifesting any degree of loss of those finer qualities of brain, psychic and motor, coming last in a highly organized and developed civilization, although it may at the same time be detected by the methods which I have suggested. The very essence and nature of general paralysis imply and involve mental symptoms in some degree, and some motor impairment, however slight, even if only judged by the test of a minute examination of what the patient can do and how well or how ill he does it. The symptoms may thus be recognized in a large proportion of cases, and at least suspected in most, certainly in those persons whose brains are so highly organized, who are so trained and cultivated that slight changes in the highest brain-centres produce distinct, although difficultly appreciated, departure from their normal character and quality of mind. In an orchestral leader, for instance, the mental and fine mechanical operations are so complex and of such high order that the least fault is detected; in professional and business men a less degree of impairment is recognizable than in mechanics; in routine employments without much thought or nice muscular effort, a large degree of deterioration may be unnoticed. In day laborers an early diagnosis is simply impossible.

"The earliest signs of general paralysis are of the slightest possible brain failure; if, for example, a strong healthy man, in or near the prime of life, distinctly not of the "nervous," neurotic or neurasthenic type, shows some loss of interest in his affairs, or impaired faculty of attending to them; if he becomes varyingly absent-minded, heedless, indifferent, negligent, apathetic, inconsiderate, and although able to follow his routine duties, his ability to take up new work is, no matter how little, diminished; if he can less well command mental attention and concentration, conception, perception, reflection, judgment; if there is an unwonted lack of initiative, and if exertion causes unwonted mental and physical fatigue; if the emotions are intensified and easily change, or are excited easily from trifling causes; if the sexual instinct is not reasonably controlled; if the finer feelings are even slightly blunted; if the person in question regards with a placid apathy his own acts of indifference and irritability and their consequences, and especially if at times he sees himself in his true light and suddenly again fails to do so; if any symptoms of cerebral vaso-motor disturbance are noticed, however vague or variable. Naturally there may be many or few of these indications in a given person. This group of symptoms seems very striking, but may be compatible with the performance of usual duties. They require careful and prolonged observations of the patient, and painstaking interrogation of his family and friends for their detection. They are recognized perhaps as much from the peculiar mental quality of the mental impairment, difficult to describe, as from its degree, and often ante-date, at least in the time of their recognition, perhaps not absolutely, any physical symptoms, which when they appear, may be so slight as not to be appreciated for a long time, except as an unusual sense of weariness on exertion, and perhaps attributed to malaria or rheumatism. Commonly there is loss of flesh, slight, moderate, or excessive. A very great or disproportionate loss of physical power, especially in the legs, I have found to be due to a complicating peripheral neuritis. We must not overlook the facts that there are elements of uncertainty in the early diagnosis of general paralysis, that there are few forms of mental disease in adult life that it may not simulate in obscure cases, and that it may be confounded with Bright's disease, epilepsy, hysteria, lead or malarial poisoning, cerebral syphilis, or the long-continued abuse of opium, alcohol, chloral, and the bromides, so that not seldom an absolute early diagnosis is impossible. But there is a peculiar, indescribable form of mental impairment which, with the vague physical deterioration, if not obscured by other conditions, may be sufficient to decide the diagnosis. Even the expression of the face and the general appearance of the patient are often characteristic. There may or may not be slight confusion, a sense of fullness in the head, headache, insomnia. Except for unusual physical as well as mental fatigue following effort, the patient may feel entirely well and not complain of anything. There is no indication from the eyes or reflexes so early; the muscular tremor is, as a rule, less than in functional nervous disorders; the speech may be not noticeably affected to the family, and may be only like that of a person with lips chilled by frost or slightly under the influence of wine. It may be necessary to have the patient read or copy several pages or even be under close observation for several days before any defect is observed in the use of the muscles, or it may be necessary to test him in a new place or occupy him in unaccustomed ways. Finally, perhaps the distinguishing feature of this stage of general paralysis is the fact that the change observed consists in a symmetrical mental and physical deterioration which, like all diseases in which a vaso-motor element is prominent, varies very much from time to time. It begins, or is first noticed, in those acts requiring the most complicated and highly coördinated effort, in the functions and powers coming last in development of the highly organized and trained brain. As the mind becomes decidedly less able and the muscles less responsive, with less coördinating power, and finally weaker, the heavy and then staggering gait, the hesitating, stuttering and finally unintelligible speech, and the progressive dementia, may be slow or rapid in their advance.

"The prognosis of the pronounced general paralysis of the books is so unfavorable that there are only exceptional remissions of the symptoms, which last so long as to justify a few writers in calling them cures. Early symptoms, however, which in men of forty years of age, so far as we now know, almost certainly mean death, when occurring in men of sixty are not incompatible with a fair recovery. In the stage of general paralysis that I have attempted to describe, it is true that there have been thus far only partial recoveries. But the indications are that a certain proportion of cures may be expected with more satisfactory treatment. The treatment of general paralysis has thus far been most unsatisfactory from the fact that it is begun only very late; because a rest of a few months often brings such relief that further treatment is abandoned; because a remission which may naturally come in the course of the malady is too apt to satisfy the patient or the friends that the disease is at an end; and because our therapeutic measures have thus far proved, as a rule, so ineffective that we cannot often get our patients to consent to a great sacrifice of time and money, and all that goes with it, for a cure that at best may mean only comfortable uselessness for many years. The travelling or stimulating life usually suggested ends in aggravation of symptoms. Entire mental rest in a quiet place in a sedative climate, with simple food, abundance of sleep and moderate exercise, results in such improvement that there is every reason to suppose that such measures, if fully carried out, might do more."

PATHOLOGY.

Die pathologische Anatomie der Dementia paralytica. E. MENDEL. Neurologisches Centralblatt, 1890, No. 17, p. 519.

In the section for Neurology and Psychiatry of the Tenth International Congress Prof. Mendel gave a review of the present condition of the pathology of *Dementia paralytica.* The extended and careful researches of the last ten years lead him to think that further light on this subject cannot be expected, at least from the methods of investigation at present at command. He passes over without consideration all the changes in the skull, dura and pia about which there is no dispute, as well as the gross anatomical relations, such as atrophy of the convolutions and diminution in brain weight, and considers only the results of the microscopical examination of the brain.

The Neuroglia. Increase of the nuclei is a very common occurrence. The spider-cells also frequently show a great increase and extension. In this connection Golgi's staining has given especially beautiful results. Nuclei as well as spider-cells are present in normal brains, but in smaller numbers, and the last only of very small dimensions, while in general paralysis they exceed the normal size three or four times, or even more. In the normal brain spider-cells are mostly clearly seen only under the surface of the brain, while in general paralysis they are scattered throughout the entire thickness of the cortex. This last condition is also sometimes found in the neighborhood of encephalitic deposits and syphilitic neoplasms, but in these cases only in circumscribed places, while in paralysis it is more extended in the frontal and parietal lobes, especially in the central convolutions, and also in the basal portions of the frontal lobes. It is this spider-cell development which, pushing its way through the white substance, finally comes out on the exposure of ventricles as ependyma proliferation. The brain substance in long continued cases finally falls away in a confusion of fibres: sclerosis; if this process is strongly developed in the medullary laminæ, especially if the autopsy is made somewhat long after death, and the cortex has undergone a slight post mortem softening, the cortex can be separated from the medullary substance with the back of the scalpel, as Baillarger, Rey and Tuczek have pointed out. The separation as a rule takes place in the cortex itself, so that pieces of this remain attached to the medullary substance.

The Vessels. The larger brain vessels in general paralysis are more frequently intact, or show only a trifling amount of change, at times being more or less atheromatous. With the present methods of investigation it is in many cases difficult to say anything accurate and trustworthy of the condition of the small arteries and capillaries which lie in the ground substance. Notwithstanding this, however, it has been possible hitherto in most cases of paralysis to point out certain morbid changes in the vessels: increase of the nuclei in the vessel walls and perivascular spaces, which Weidl observed as far back as 1859, miliary aneurisms, widened spindle-form adventitial spaces, etc. Here belongs also, as a widening of the lymph spaces, the cystoid degeneration so often found in general paralysis. Further changes in the vessel walls are the colloid and hyaloid degenerations described by Grieff and lately by Dagonet. All these changes occur also in other forms of brain disease, they have nothing characteristic of general paralysis, but it seems clear that with better means of investigation their *regular occurrence* in general paralysis can be shown.

The Ganglion Cells. At the session of the society of German Alienists in Berlin in 1883, Mendel took the ground, against strong opposition, that changes in the ganglion cells were an almost regular occurrence in general paralysis, and now the views of authors are almost unanimous that changes in the ganglion cells may always, or at least almost always be observed. Nissl's staining has materially advanced knowledge in this direction. A description of these changes was given by Mendel in 1884 (*Neurolog. Centralbl.*, 1884, p. 487). Widening of the pericellular spaces, changes in the protoplasm such as fatty pigment degeneration, sclerosis and atrophy of the cells (hyaline degeneration of Liebmann), changes in the nuclei such as shrinking or enlargement, are the usually reported findings. These changes are especially marked in the frontal lobes, on their lateral and medial surfaces, as well as on their lower; also in the parietal lobes, and least in the occipital lobes. Normal cells often lie between the altered ones. Similarly altered cells are also observed in other pathological processes of the brain.

The Nerve Fibres. To Tuczek belongs the credit of first calling attention in 1883 to the atrophy of medullated nerve-fibres in the cortex of paralytics. A large series of observations has been made in this direction with the following results: 1. The shrinking of the nerve-fibres in general paralysis is not confined to the cortex alone, but takes place throughout the entire brain. The nerve atrophy in the cortex is thus only one part of a process affecting the entire medulla of the brain and cerebellum. 2. This fibre-atrophy, especially the cortical, occurs not simply in progressive paralysis, but also in epilepsy, senile dementia, alcoholic paranoia, etc. Finally, reference may be made to the alteration of the nuclei of the brain nerves and to the degeneration of the peripheral nerves. With regard to the cord, this is normal in a number of cases of general paralysis, but in the great majority of cases it also is diseased. The changes that show themselves are: 1. Isolated gray degeneration of the posterior columns. 2. Isolated degeneration of the pyramidal tracts. 3. Disease of the pyramidal and cerebellar tracts with intact posterior columns. 4. Various combinations of diseases in different tracts.

From the anatomical findings described it is evident that no individual one of these morbid changes, either in the neuroglia, in the vessels, in the ganglion cells, or in the nerve fibres, is in and by itself characteristic of general paralysis; its essential difference from all other brain diseases lies not in the special changes, but in the diffuseness of the process, which appears spread over a great part of the cortex—sometimes over its whole extent, and even over the cerebellum, and taking all these facts into consideration we are justified in looking on general paralysis as a disease *sui generis.* In this it is self-evident that the clinical picture must vary according as the development is acute or chronic, according to the greater or less extension and according to the complications with other affections. The more closely and carefully the examination is made, the more are the frequent early negative reports of the microscopic examination invalidated, and now it can only rarely be asserted that in a well-marked case of general paralysis that has lasted a long time there are not the characteristic findings in the neuroglia, the vessels, the ganglion cells, and the nerve fibres.

Up to this point Mendel's views are in essential accord with those of most alienists, but there is a dispute as soon as the question arises as to where the starting point of the morbid changes is to be sought. Regarding this there are two views directly opposed to one another. The first is that the starting point is a primary degeneration of the nerve fibres, and that the disease of the vessels, the neuroglia and the ganglion cells is secondary; the second view is that the process starts in the vessels, and that an inflammatory process proceeds from these to the neuroglia, the inflammatory products leading to the destruction of the nerve fibres and to changes in the ganglion cells. If it were oftener possible to study very rapidly developing cases of general paralysis—the diagnosis, however, must be absolutely certain—a decision might possibly soon be reached. There is, however, only a small number of such observations. In one case in which there was an early autopsy Greppin found no atrophy of the nerve fibres, while Friedmann, in a case of a little over two months duration, found pronounced changes in the vessels. Mendel is able to report a second such case. These cases, therefore, tell against primary degeneration.

Mendel's assistant, Kronthal, by a special procedure was able to isolate the capillaries in the fresh brain, and in all the cases of general paralysis studied by this method there is shown a great degree of widening of the capillaries, thickening of their walls, and a marked increase of nuclei in these. This speaks still farther for the primary involvement of the vessels. Where all the different elements have been changed by disease, the relation between the atrophy of the nerve fibres and the changes in the vessels is a very varying one; sometimes the changes are relatively proportional, while again one and then another predominates. Under these circumstances it would seem that we could not come to a fixed conclusion with regard to the starting point in men. For this reason Mendel in 1883 undertook experiments to produce in dogs a disease similar to *dementia paralytica* in men. The experiments were repeated with similar results by Lemos, Kusznezow and Fürstner; the last makes the similarity to human paralysis more evident since he finds also in the paralytic dogs disease of the cord and optic nerve atrophy. At the time of Mendel's first experiments the finer methods for the recognition of nerve fibres did not exist, but he has recently gone over the experiments again, directing special attention to how in beginning disease the morbid process first showed itself in the brain; the dogs were therefore killed when they showed the first sure signs of disease. The following are the results of the microscopic examination: Changes in the vessel walls through numerous scattered nuclei, widening of the adventitial spaces, in which numerous nuclei are visible, but *no changes in the medulated fibres and no changes in the ganglion cells.* In dogs, therefore, the disease certainly acts not as a primary degeneration, but as an inflammatory process proceeding from the vessels. To carry a physiological experiment directly over to man, especially in mental diseases, certainly has something misleading, yet we cannot abstain from doing this in doubtful cases. One point from the symptomatology of general paralysis is of importance with regard to this question. In a great number of cases fainting attacks precede the outbreak of the mental disease, and also apoplectiform attacks, conditions which are referred to stagnation in the vascular system. Here then are some changes present at a time when there is absolutely no reason for assuming an atrophy of the fibres. Finally, the conclusion that appears to Mendel justified at this time, even if it cannot be proved with absolute certainty, is that in general paralysis there is first present disease of the vessel walls through hyperæmic stasis in the vessels; exodus of blood corpuscles and inflammation of the neuroglia follows, leading secondarily to destruction of the nerve elements. General paralysis, then, may be designated as *a diffuse interstitial encephalitis, terminating in brain atrophy.*

Zur pathologischen Anatomie der Dementia paralytica. LUDWIG MEYER. Neurologisches Centralbl., 1890, No. 20, p. 610.

This is a criticism of certain points in the preceding article by Mendel, citing the conclusions that general paralysis is a diffuse interstitial encephalitis, and the conclusions on the microscopic examination of the brain of the dogs. Meyer claims that essentially the same findings have been shown by him to exist in a considerable number of cases, and since Mendel casts doubt on the significance of these observations, either through doubt as to the diagnosis or because of the small number of cases, Meyer reviews his own contributions to the subject of *dementia paralytica* extending over a number of years. In 1858 he claims to have advanced proof that in typical cases the disease takes its course in febrile exacerbations, and may therefore be classed with the chronic febrile diseases as a meningo-encephalitis. The anatomical proof of this was published in the *Centralbl. für med. Wiss.*, 1867, Nos. 8 and 9. The accumulation of the nuclei and cells in the walls of vessels was described, and the change of the ganglion cells in atrophic brains was described as a result of vascular degeneration. Meyer agrees with Mendel that the question of the primary changes can only be settled by a study of those cases with a very rapid development; but this rapidity must without doubt be looked on suspiciously, for since "the diagnosis must be absolutely certain" it is necessary that the time of development as well as of the existence of the typical symptoms should not be too short. Meyer claims that with the limitations just mentioned he has given the essential anatomical changes of the disease in his work on the Pathological Anatomy of Dementia Paralytica (*Virchow's Archiv*, 1873, pp. 270–303.) As far back as then he said "only those changes in the brain can be looked on as pathological which appear and are constantly observed with the first distinct symptoms of disease," and "cases of very short course must serve exclusively as the basis for investigation." "Brains with appearances of atrophy must be excluded, or must be admitted only with great reservation." Meyer found 20 cases answering these conditions; and among other things, the normal brain weights went to indicate that the cases fulfilled the required conditions; and these were further strengthened by some of the phenomena of the course which resembled a severe meningitis, or there were headaches in the beginning, maniacal outbreaks resembling febile delirium, convulsions, paralytic attacks, etc. In all the cases there were early autopsies. There was cell-proliferation of the vessel walls. Meyer's conclusion at that time was that, apart from the chronic meningitis which was not always present, the changes at the beginning of the disease were confined to these vascular changes, which were claimed to be inflammatory. Examination of the substance of the brain gave an entirely negative result.

MANNER OF DEATH.

De la mort dans la paralysie générale. JEAN L. BARAZER. Thèse de Paris, 1890, No. 179.

Barazer considers that the question of the mode of death in general paralysis may be reduced to simpler proportions than in Jamin's thesis of 1887. If it is true that the causes of death may be innumerable, it is also incontestable that the patients always die, or at least almost always, in the same manner, and that all the cases of death, with almost no exceptions, may come under the general primary disease.

The forms of death are as follows:

a. By the direct manner.	Apoplectiform attacks.	
	Epileptiform "	
	Maniacal excitement.	
	Vices of nutrition and trophic troubles.	Paralytic Marasmus and Bed-sores.
b. By the indirect manner.	But intimately related to the cerebral lesion.	
c. By accidental causes.		

The natural form of death is by marasmus or paralytic wasting. This is the natural termination of the disease and also the most frequent, other forms of death being only complications. Christian and Ritti found this manner of death in 52 out of 119 men, and in 9 out of 20 women. The author adopts Charcot's theory of the central origin of *decubitus acutus.*

COMPLICATIONS.

Contribution à l'étude du mal perforant dans la paralysie générale. HILDEVERT BERTHÉLEMY. Thèse de Paris, 1890, No. 126.

The author considers historically the question of the origin of perforating ulcer of the foot, and of the three theories as to its origin, the mechanical, the vascular, and the nervous theories, he favors the latter, claiming that the nervous lesion is always present, while the vascular changes may be absent. Perforating ulcer is usually considered a rare complication in general paralysis, but Berthélemy claims that it is not so rare as is supposed, and that published observations are so few because attention has not been sufficiently called to the condition, and he is able to present eighteen observations, all from French sources, four being personal. In two cases the patients had suffered from a preceding locomotor ataxia, and the combined action of the tabes and the general paralysis producing the ulcer is admitted, while in two other cases alcoholism was doubtless a similar causal factor, but in the remaining fourteen there was no complication, and the general paralysis was looked on as the direct cause of the ulcer. A striking fact brought out in the study of the cases was that in eight of the eighteen cases it was noticed that under the evident influence of the ulcer undoubted remission occurred in the course of the general paralysis. The same fact was noted by Christian in publishing his observations on *mal perforant* in 1882, and he claimed that almost all remissions in general paralysis came as a sequel of prolonged suppurations. Berthélemy suggests that such remissions following suppurations give a basis for the therapeutic employment of revulsive measures such as setons in the neck or the actual cautery. The author reaches the same general conclusions as Marandon de Montyel in his thesis of 1888:—1. Progressive general paralysis is as justly a cause of perforating ulcer as other diseases of the nervous system. 2. The infrequency of published observations on perforating ulcer point to the fact that the complication should be carefully looked for to be discovered, and that attention has not been sufficiently called to it. 3. Perforating ulcer shows itself by preference in those general paralytics who have been alcoholics, or who have at least had some excess in drinking. 4. Perforating ulcer, judging by those cases which we have at command at present, favors remissions in general paralysis in those paralytics who have it.

The Pulmonitis of Paralytics and Degeneration of the Vagi Nerves. Dr. BIANCHI. Translated and abstracted by Joseph Workman, M. D. Montreal Medical Journal, 1889-90, XVIII, p. 481.

Bianchi is unable to attach any very great importance to the forms of pneumonia studied by him in the insane, accompanied by more or less advanced degeneration of the pneumogastrics. As slight compression, from which the tissues in their normal condition feel nothing, produces a bed-sore when a neuritis or an inflammatory process exists in the spinal cord, so a degenerative neuritis changes the conditions of nutrition in the pulmonary parenchyma, and in these altered conditions stimuli which were previously harmless may become pathogenic, reaching the lungs through the larynx, the mouth or the tracheal tube in the inspired air. Hyperæmia, if it is present, the disturbed respiratory mechanism, increased endoalveolar pressure, paralysis of the muscular fibres of the bronchi, insensibility of the mucosa of the deep respiratory passages, are but so many factors concurring to disturb the process of nutrition. Even gangrene, which is so common a finding in the pulmonitis of paralytics, simply indicates the frail vitality of the tissue, and preceding lesions in the vessel walls may have contributed in determining the easy and prompt death of the tissue, however slightly more intense may have been the stimulus which it has been unable to resist.

Case of General Paralysis Complicated by Aphasia. C. P. TANNER, M. D. Brain, 1890, XIII, p. 111.

Male, aged 33. A typical case of general paralysis with a sudden onset, beginning to talk "jargon" while reading; shortly afterwards right arm and leg were paralyzed; unconscious for four days; on recovery his language was entirely incomprehensible. Disease began at least a year before. A month after admission could not understand spoken words, except his name; could not read printing aloud; could not repeat spoken words, write at dictation, or copy printed matter. Could understand written words to a fair extent, and read them aloud, but made mistakes in pronunciation of letters, *e. g.* called *name*, *tame*. In copying, frequently transposed letters, but put them all in. Further history was the ordinary one of general paralysis. Examination of brain, besides the usual symptoms of general paralysis showed whole of left insula destroyed, apparently result of hemorrhage, its place being occupied by a broken down blood-clot, apparently encysted. Hemorrhage had invaded first tempero-sphenoidal lobe near its tip, and also part of the inferior parietal lobe, adjacent to fissure of Sylvius. Claustrum destroyed, external capsule, lenticular nucleus and internal capsule flattened in direction of lateral ventricle. Source of hemorrhage not found.

OCULAR SYMPTOMS.

The Analysis of the Motor Symptoms and Conditions of the Ocular Apparatus, as observed in Imbecility, Epilepsy, and the Second Stage of General Paralysis. C. A. OLIVER, M. D. American Journal of the Medical Sciences, 1890, c, p. 486.

Conclusions: 1. In idiopathic epilepsy of the male adult, even when the stage of dementia has been reached, both the intra-ocular and the extra-ocular motor groupings seemingly, as a rule, remain unimpaired, both as to innervation and to active impulse, although in some instances curious enervations and limitations of action seem to exist. 2. In the lower grades of imbecility, as seen in the male adult, which have resulted from malformation or disease of a minor degree than that producing so called idiocy, that have supervened in infancy or occurred before birth, both the intra-ocular and the extra-ocular muscle-groupings, as a rule, remain unaffected both as to innervation and as to proper action; in fact they seem ordinarily to retain their original condition without any pronounced indications of wear and tear; a condition that most probably evidences very little abuse of a delicately poised muscular apparatus. 3. In the second stage of paresis, as seen in the male, both the intra-ocular and the extra-ocular motor-groupings are in all instances more or less paretic, as evidenced by great inequalities and irregularities of pupillary areas, with peculiarities in iritic movement and loss in ciliary tone and power, as well as by extra-ocular insufficiencies and ataxic nystagmic motions, all indicative of imperfect muscle-innervation and inadequate muscle-action.

An Analysis of the Ocular Symptoms found in the Third Stage of General Paralysis of the Insane. By C. A. OLIVER, M. D. Medical News, 1890, lvii., p. 287.

Each subject was seemingly free from any gross extraneous disease or local disorder, and discretion was exercised that authoritative medical opinion had been given as to the type and stage of the general complaint; the study was limited to the male sex. In a disease of such complex symtomatology, where doubtless quite a number of pathological peculiarities exist at one time, accurate pathognomonic changes cannot be expected in each case, and for this reason a great number of seemingly similar cases were studied to obtain an idiocratic picture of the oculo-motor and retinal changes. A study of 32 cases gives the following conclusions:

1. The oculo-motor symptoms of the third stage of General Paralysis, which consist in varying, though marked, degrees of loss and enfeeblement of iris response to light stimulus, accommodative effect and converging power; lessening of ciliary muscle tone and action; weakening and inefficiency of extra-ocular muscle motion,—all show paretic and paralytic disturbances connected with the oculo-motor apparatus itself, of greater amount and more serious consequence than those seen in the second stage of the disease.

2. The sensory changes in the third stage of General Paralysis, which, though similar to those found in the second stage of the disorder, are so pronounced as to show a semi-atrophic condition of the optic nerve head, and marked reduction in the amount of both optic nerve and retinal circulation, with consequent lowering of centric and excentric vision for both form and color—all indicate a degenerate condition of the sensory portion of the ocular apparatus, with impairment of sensory nerve action.

3. The peculiar local changes seen in these cases, which consist in conditions of the choroid and retina, indicative of local disturbance and irritation of these tunics, more pronounced than those seen during the second stage of the disease—all represent the results of greater wear and tear given to a more delicate and more weakened organ.

4. Both the motor symptoms and the sensory changes of the ocular apparatus, as thus described in the advanced or third stage of General Paralysis, furnish not only evidences of a local disturbance of a more pronounced type than those shown in the second stage of the disorder, but plainly show themselves as one of the many peripheral expressions of fast approaching degeneration and dissolution of nerve elements, most probably connected with related cortex-disintegration and death.

Note on Optic Nerve Atrophy preceding the Mental Symptoms in General Paralysis of the Insane. By JOSEPH WIGGLESWORTH, M. D. Journal of Mental Science, 1890, XXXV, p. 389.

In a previous communication (*Brain*, 1884), Wigglesworth and Bickerton have shown that in 66 cases of General Paralysis the *fundus oculi* was normal in a majority of cases, but in a considerable minority there were changes in the direction of *neuritis* or atrophy; and while optic atrophy was noted as a sequel of *neuritis*, it was also not infrequently primary at the disc. In all these cases the changes in the disc had developed after the mental symptoms; but one case was quoted from Nettleship where optic nerve atrophy preceded the symptoms of the disease. Wigglesworth is now able to add a second case of this kind, where the patient had to give up work from blindness three years before any mental symptoms developed. There was well marked gray atrophy of both discs, the vessels, however, not being obviously shrunken. At the post-mortem both optic nerves were much shrunken. Making all due allowance for the fact that the mental symptoms may have existed for some time before they became apparent to the wife, it still seems clear that the optic atrophy was the primary feature. [Folsom, in the article cited at the beginning of these reviews, found in one of his cases, Case VIII, in the prodromal stage, beginning atrophy of the optic disc —the only case where he had ever found it except at a late stage.— Rev.]

Alleged Recoveries.

Fall von Dementia paralytica mit Uebergang in Genesung. Dr. Wendt. Allgem. Zeitschr. f. Psychiatrie, 1889, Bd. XLVI, H. 1, S. 77.

Dr. Wendt's case was presented before the 64th Session of the Psychiatric Union of Berlin, Dec. 14, 1888. The patient was a physician, had spent 6 1-2 years in an asylum, and on his discharge had resumed practice and had been a district surgeon for 7 years. Wendt had had him under observation for 3 1-2 years in the asylum. All the physicians who had had charge of him agreed in the diagnosis of general paralysis. When admitted to the asylum in 1872, he was 43 years old; little was known of his life, but there was no history of excesses. Two paternal uncles died in an asylum, and his only living brother was "weak-minded." The prodromal period extended back three years. Ataxic gait, immobile pupils, delusions of grandeur, and weakness of memory, were noted on admission. The history showed the usual symptoms of general paralysis, and his letters would be looked on as typical of the disease, with the customary grandiose ideas, unsteadiness of writing, and omission of words and syllables. From June 1872 to the end of 1874 the disease appears to have been at its height, and had continued without remissions and without essential increase of the characteristic symptoms, and especially of the motor symptoms. These symptoms then receded, and when Wendt took charge of the institution in July 1875, there was an entirely different clinical picture. The motor symptoms had disappeared; gait and standing were steady and firm, and the articulation undisturbed; pupils equal and reacted well. Writing was now and then unsteady, and the tongue had a slight tremor; he expressed no delusions but was considered to have them; looked on his letters as nonsense, which he had written for pastime; he had never been sick, since the insane could not manage the pen. Discharged *improved* in Dec. 1878. Letters received during next six months still showed unsteadiness in handwriting. In Feb. 1879, an unnatural self-complacency was still shown in his letters. Wendt's conclusions are eminently conservative and just; "Including the three years prodromal stage, nineteen years [preceding December 1888] have now elapsed since the beginning of the disease, the remission characteristic of paralysis came on 13 years ago, and has since then continued unbroken; for 9 years Dr. F. has been in medical practice, and for 7 years he has held the office of district surgeon. Doubts may well be entertained if he has regained his *complete* integrity, but at all events an improvement has taken place that rarely occurs in *dementia paralytica*, and which may be designated as a recovery, if the same criterion is allowed which is usual and authorized in internal diseases."

Jastrowitz appears to have coincided in Wendt's conclusions and reported a case of 17 years duration, then living and apparently well, where a diagnosis of general paralysis had been made by Westphal; a slight degree of mental weakness and apathy existed.

Müller considered Wendt's case not to be one of classical progressive general paralysis, the long course and the failure of many important symptoms usual in progressive general paralysis being opposed to it.

Zender considered it a characteristic case of general paralysis.

Mendel thought the case exceptionally interesting, and perhaps unique. The case not being *progrediens ad mortem*, they might accept Müller's criticism of the word "progressive," but they could all agree that it was a case of "cured *dementia paralytica*."

Case of General Paralysis Cured by Antisyphilitic Treatment. BYROM BRAMWELL, M. D. Studies in Clinical Medicine, 1889–90, I, p. 230. First reported in Edinb. Med. Journal, Jan. 1888, p. 630.

Dr. Bramwell's case is especially interesting in connection with the cases of alleged cure of general paralysis by surgical operation. An engineer's draughtsman, aged 32, first consulted a physician in June 1881, and was seen by Bramwell on May 1st, 1882. The history is of a typical case of general paralysis, the patient recognizing his beginning disease. The attending physician and the consultants, Drs. Bramwell and Clouston agreed in a diagnosis of general paralysis. Patient had been on specific treatment for some time, and this was continued in increasing doses. When seen six weeks later by Bramwell and Clouston, the report was as follows: "We found the patient much *in statu quo*; the vigorous antisyphilitic treatment had apparently produced very little effect; the patient had, it is true lost his delusions, but the dementia was more marked, the tremor of the lips and face, the affection of speech, and the motor weakness were quite as great, in fact apparently greater. Dr. Clouston was now definitely of the opinion, that the case was one of ordinary general paralysis of the insane, and not of cerebral syphilis—a view which he recorded some months later in his admirable clinical lectures [American Edition, 1884, p. 269]." A comatose attack preceded by rigor occurred about Aug. 1, and shortly afterwards an abscess that had formed during the attack burst, with the escape of a large quantity of pus and blood, with rupture of a blood vessel. After this, in the words of a cousin, "Mr. A. almost at once recovered his head, he continued to get better day by day until the beginning of October, when he went back to his home in Glasgow." On his return to Glasgow he was reported very much improved mentally, but still far from well. Specific treatment was continued and the head repeatedly blistered. Improvement was such that the attendant was dismissed on Dec. 18th; on Jan. 8th he returned to work; at the end of 1883 he married. On July 15, 1887, his attending physician—not the physician of 1881—stated to Bramwell that there was very little to note, as the patient has kept so well; specific treatment was being kept up; in March, 1885, the speech was so thick that the physician could scarcely understand what was said, and his manner was nervous and excited; at this time he had "fainting fits" which first came on frequently, but now (1887) only once in six weeks; fits are periodic the interval gradually lengthening; they are without warning; becomes pale, with staring eyes; if at work, becomes motionless, but does not drop his square or pencil; thinks he does not lose consciousness, but wife thinks he does; no loss of memory after a fit; speech still a little thick but quite intelligible; works regularly and is painstaking and exact; memory very good; left pupil larger than right; both contract freely, and accommodate; no disturbance of ocular muscles; fundus of both eyes normal. Regarding the knee-jerk the attending physician makes the somewhat anomalous statement, "the knee-jerk is normal, or rather exaggerated on the left side and nearly absent on the right, but there is not the slightest unsteadiness in his gait, nor any want of power of equilibration on making him stand with eyes shut and feet close together." When last seen by Bramwell in October, 1887, he stated that with occasional momentary "fits of abstraction," which were gradually becoming less and less frequent, he felt perfectly well. "His memory is, he says, quite good, his drawing is better than it was for years before his illness commenced; and for the past five years, he has had absolutely no symptoms of mental derangement whatever. Some physical evidences of disease still, however, remain. His speech is much thicker than it was before his illness; his knee-jerk, as tested through the trousers, seemed absent in both legs, and the attacks of *petit mal*, though steadily diminishing in frequency still continue. There is no longer any evidence of motor impairment. I did not on this occasion detect any twitchings or tremors in the tongue, lips or facial muscles; the pupils were equal and responded briskly to light and accommodation. The patient still has a somewhat heavy, stolid expression, which is probably natural to him; his memory and intelligence seemed active, and, so far as I could judge, in every way natural." After his recovery in January, 1883, he made frequent mistakes in writing, missing out letters and words, and using wrong letters and words; these mistakes became less frequent, and later were rarely observed. Up to the time of Bramwell's report, December 1889, he had continued well.

Dr. Bramwell's case is certainly of great interest, and its future history will be eagerly watched for. It is, however, somewhat odd that Bramwell should ascribe the improvement entirely to the anti-syphilitic treatment, and should not consider the possible effect of the shock following the bursting of the abscess with the loss of blood. Up to the time of this shock no improvement under treatment had been noticed, and indeed the patient was confessedly growing worse. The similarity to Dr. Claye Shaw's case (below) where improvement followed trephining immediately occurs to one. Neither does Dr. Bramwell suggest the possibility that the patient is only in a remission, but to him the case has been "cured" by anti-syphilitic treatment, although he admits that thickness of speech, attacks of *petit mal*, absent knee-jerk, and a heavy, stolid expression are still present. The history of the case at present extends over but eight years, and to the reviewer's mind it is to be regretted that Dr. Bramwell has not qualified somewhat his claims for a cure.

SURGICAL TREATMENT.

The Surgical Treatment of General Paralysis. T. CLAYE SHAW. British Medical Journal, 1889, II, 1090.

Is General Paralysis of the Insane a Curable Disease? GEORGE REVINGTON, M. D. Ibid, 1889, II, 1187.

The Surgical Treatment of General Paralysis. H. CRIPPS. Ibid, 1889, II, 1215.

The Surgical Treatment of Intra-Cranial Fluid Pressure. J. BATTY TUKE, M. D. Ibid, 1890, I, 8.

The Surgical Treatment of General Paralysis. R. P. SMITH, M. D. Ibid, 1890, I, 11.

The Surgical Treatment of General Paralysis of the Insane. GEORGE REVINGTON, M. D. Ibid, 1890, I, 749.

Considerable interest has been aroused by a discussion that has been carried on in the *British Medical Journal* over the question of the advisability of surgical interferance in General Paralysis, with the view to relieving the symptoms alleged to be due to increased fluid pressure.

To Dr. T. C. Shaw belongs the credit, if such there be, of making the first attempt to alter the course of the disease, (Dr. Shaw would claim much more), by surgical means. To his mind the pathological appearances in General Paralysis point to an irritative, probably inflammatory, process in the upper layers of the convolutions. The theory of the operation was that by producing an alteration in the existing state of the morbid process, a new and nutritive process might be set up. On the theory of nerve stretching he proposed to stretch the brain by giving it more space in which to expand, by allowing it to relieve itself of the increased arterial pressure, shown by the sphygmograph to be one of the early conditions of General Paralysis. Trephining, according to Shaw, must therefore relieve the later symptoms, due directly to fluid pressure, such as the paralyses, attacks of stupidity, and loss of power of swallowing. Dr. Ferrier agreed that the patient was rapidly approaching a condition of dementia, and that trephining offered the only hope of relief. Patient was in the second stage, with delusions of grandeur, affection of speech, exaggerated reflexes, unsteady gait and retention of urine. Convulsive attacks followed, with short periods of loss of sensation, increased difficulty in swallowing and talking, and rapidly approaching dementia. Trephined on right side of skull, over central sulcus, two inches outside longitudinal fissure. The operation resulted in such improvement that it was proposed to discharge the patient. Shaw states that he did not expect any improvement in the bulbar symptoms, although even here his condition was thought to be better, as he swallowed and spoke more easily; he became less optimistic, and the epileptoid attacks ceased. Shaw considers that the operation was justified by success, although the prominent bulbar symptoms remained.

Mr. Cripps, who performed the operation, speaks less positively of the pathology of the disease. Of the post-mortem conditions, diminution of brain substance and increase of fluid, there is to his mind no absolute evidence to show whether the brain atrophies from pressure of the fluid, or whether the fluid collects on account of the shrinking of the brain. The operation was performed on the former hypothesis, and the extreme manner in which the dura bulged into the wound from the tension of the fluid beneath is considered by the operator to show that the former hypothesis was the correct one. By removing a portion of the bone, with the corresponding meninges of the brain, not only would the existing fluid be let out, by opening the water-proof brain coverings, but a permanent contact would be established between the secreted fluid and the under surface of the scalp-flap, to the absorbents of which was entrusted its future removal.

On these surgical procedures, from theoretical considerations, very obvious and just criticisms are made by Revington. To justify a new and serious surgical operation three conditions should be observed: (1) The theory of the pathological process to be remedied should be unassailable; (2) the mechanical means adopted should be clearly competent to produce the result; (3) the resulting improvement should be the indubitable consequence of the procedure adopted. These conditions have not been even partially satisfied. It is extremely doubtful that the "paralyses, attacks of stupidity, loss of power of talking and swallowing," are due to fluid pressure, but the probabilities are all the other way, that the excess of fluid is a secondary and compensatory process. Further, it is not easy to see how pressure due to fluid in the convolutions could be relieved by a hole in the skull. Finally, the symptoms which Shaw regards as cured by the operation are symptoms which frequently disappear of their own accord. It is extremely probable, therefore, that the favorable symptoms were in no way the result of the treatment except in so far as an issue in the neck might have operated favorably. To Revington, curing General Paralysis, "with no marked improvement in the bulbar symptoms," is like curing paraplegia without restoring the power of walking, and the permanence of the bulbar symptoms is a curious commentary on the assertion that the loss of power of swallowing, talking, etc., are directly due to fluid pressure.

Dr. Batty Tuke's case appears to have been further advanced than Shaw's. Patient was trephined a little above and in front of the parietal eminence on both sides. No sign of bulging of the brain into the hole was observed; the buttons of bone were not returned. In the first case it was held that the bulging of the brain into the trephine hole upheld the pressure theory; the second operation was performed on the same theory, but the absence of bulging in this case is not cited as in any way militating against the theory. It was thought that for five days after the second operation the pupils reacted better to light, and the intellect of the patient was distinctly clearer, and "he was evidently more sane than previously." After five days the old symptoms returned. He was removed to Morningside, and Dr. Clouston thought the operation might possibly have modified the symptoms. When last seen by Tuke, the patient was much demented, with well marked ataxia, and showed progressive symptoms of a downward tendency. Tuke felt that the results justified the operation.

Dr. Smith's paper is a criticism of Dr. Shaw's case; he deprecates that it should not have been made to appear that it is no new thing for general paralytics to so far improve that they have to be discharged "recovered," because there are not sufficient symptoms to warrant their legal detention, though the physician may be convinced that they will eventually relapse and end fatally, and he quotes several such cases.

He does not admit that the operation was justified by success, and doubts whether the trephining had any more to do with the improvement than any other injury might have done. Smith quotes Mickle, where in several instances "recovery," or very long periods of remission have supervened on accidents, violent injuries, or diseases of such a kind as to produce revulsive effects.

Revington's criticisms in Tuke's case appear to have ended the controversy, for a time at least. Tuke's description of the case, according to Revington, shows that the disease made rapid progress, and the patient seems to be worse off than many a ten-month paralytic with a sound skull, so it is not at all sure that the operation may not have "modified symptoms" in a way not anticipated by its originators, and he must be a sanguine man who would take the improvement noticed during five days after the operation as worth much. It is, however, on the ground of the false pathological theory that the two operations are chiefly to be criticised. The pressure-theory, according to Tuke, makes it certain that obstructed lymph can make its way but imperfectly by natural channels to the pia-matral space, and becomes diffused through the tissues, injuring and displacing cell and fibre, and impairing their functional activity, while the operation, by permitting a healthy action of the lymphatics and blood vessels, stays the process of sclerosis. Revington is probably right in saying that the entire mass of pathological evidence is absolutely contradictory of such a theory as this, and that the typical cell degenerations found in General Paralysis are not such as may be expected to follow simple excess of fluid pressure, but is rather (citing Bevan Lewis) a true degeneration, due to acute interstitial anomalies, with no notable differences between the changes through which the cells pass and those in senile atrophy, and that there is no excess of fluid in the first stage, while the second stage is one of extraordinary development of the lymph connective system of the brain, with a parallel degeneration and disappearance of nerve elements, the axis cylinders of which are denuded. In the first stage, then, the only stage in which an operation would be justifiable, there is no excess of fluid, and in no stage is the excess of fluid of more than secondary importance. We may, therefore, conclude with Revington that the results in Dr. Tuke's operation are quite insignificant; that the results of Dr. Shaw's operation are most probably due to a remission; that the pathology upon which the operations were founded is opposed to all the best knowledge on the subject, and that the collation of two cases warrants nothing so clearly as the opinion that little good can be expected from the operation of trephining in General Paralysis.

III.—EXPERIMENTAL.

Ueber das Erkennen der Schallrichtung. J. VON KRIES. Zeitschrift für Psychologie. Bd. I (1890), H. 4—5, S. 235.

The ear perceives the direction and to some extent the distance from which sounds reach it; is this a judgment based upon the difference of the primary sensations reaching the two ears, or is it the more or less simple sensation of a special organ? The results of a very few rough trials will convince any one that right and left location is much more exact than location in any direction in the median plane; and this fits very well with the theory that sound is located by the difference of intensity of sensation in the two ears, because in the last case the two ears are always equally stimulated. Such recognition of direction in the median plane as is actually found has then to be explained by changes in the quality or intensity of the sound as its point of production is shifted about the head in that plane. Even this ought to fail, however, in the case of sounds with the quality and intensity of which the experimentee is unfamiliar, and this is the point which v. Kries set himself to try. The sounds of a telephone, of whistles, of bits of wood or metal snapped together — all of them variable to a certain degree in quality and intensity at will — were produced at different points in the median plane. The experimentee had to decide between but two possible locations (*e. g.* before or behind); he was kept in ignorance of the correctness of his answers, and in general every precaution was taken to prevent his learning the character of the sounds so as to be able to judge by that of their positions — as also to prevent a betrayal in any other way of their location. The experiments were made largely upon v. Kries and his assistant, but in addition some 22 students were also tested. In the first experiments (comparing forward-and-upward with backward-and-upward, telephone click as stimulus) the location was very uncertain; the next set (forward-and-upward as compared with forward-and-downward, whistle stimulus) gave much better results, as did also the next (upward compared with backward, stimulus by snapping coin). In other experiments where a continuous noise was produced by the telephone for 0.5—1 sec., the location was still more exact; *e. g.*, v. Kries, with before and behind as directions, made 39 correct judgments out of 44 trials, 4 times was in doubt, and only once answered incorrectly. On the 22 students very few trials were made, only five or six on each (comparing backward with forward) so as to exclude still further the possibility of learning the sounds. On the whole, the results of these experiments did not show exactness of location, a fact not much to be wondered at, perhaps, in so few experiments, but did show very great individual differences in this power. One student answered the first six times correctly, in an additional 30 trials was right 29 times, and showed an almost equally exceptional power in recognizing other directions.

For the detail of the experiments, as for points of incidental interest, the reader is referred to the original. Among others, however, may be mentioned the following: The occurrence of constant tendencies to say one particular direction, however the actual direction might be changed; the experiments on ability to recognize the distance of a sound, which seemed to show that it did not depend to any great extent on the loudness; also those on the simultaneous recognition of the direction of two sounds or a sound and a noise; the author's criticism of the Lotze theory of local signs for vision and the similar theory of Münsterberg for auditory localization. Von Kries concludes somewhat as follows. Two things appear from these experiments, in spite of their relatively small number: First, an approximately certain median location is possible under some circumstances (at least in case of discriminating before and behind), even when the sounds used change irregularly from experiment to experiment in intensity, quality, and distance; second, that under other circumstances the location is remarkably uncertain. [To the reviewer it seems regrettable that von Kries did not experiment with the experimentee's head fixed, (he was only instructed to keep it still); for certainly in the case of sounds which last an appreciable length of time a very slight, and possibly unconscious, motion of the head might be expected to be an immense aid in deciding between before and behind.] E. C. S.

Zur interaurealen Lokalisation diotischer Wahrnehmungen. KARL L. SCHAEFER. Zeitschrift für Psychologie, Bd. I (1890), H. 4—5, S. 300.

Equal intensity of sound in the two ears regularly gives median location, but intercranial location only under certain circumstances. Sylvanus Thompson observed that when a telephone is held against each ear a single intercranially located sound is heard, provided that the diaphragms of the two telephones vibrate at the same rate, with the same amplitude and in contrary directions, *i. e.* both at the same time toward the head or both away from it. When the last condition is not fulfilled the sound is double and located in both ears. The explanation of this is briefly as follows: Sounds are located on the side on which they are most intensely heard; if the intensity alternates slowly, they seem to shift from ear to ear; if the shifting is very rapid they may appear to be located in both ears; such an alternation of intensity and quality is given by the telephone diaphragms on their inward and outward swings. Intercranial location, as opposed to extracranial, seems to depend on the estimated nearness of the individual sounds (a stimulus to a single ear never produces it), and this in turn seems influenced by intensity. If the single sounds are located away from the ears, the location of the combined sound is extracranial; if in the ears, intercranial. For the simple and interesting experiments which support these conclusions the original should be consulted.

Urtheilstäuschungen nach Beseitigung einseitiger Harthörigkeit. W. VON BEZOLD. Zeitschrift für Psychologie. Bd. I, 1890, H. 6, S. 486-487.

Von Bezold relates the following interesting experience of his student days. At that time he suffered for a considerable time from extreme deafness in the left ear, which later proved to be due to a wad of cotton which had been driven in against the ear-drum and there become fixed. When this was removed, the resulting illusions were of striking intensity. Turning the leaves of a book under such circumstances "produces a noise that can only be compared to that of a powerful waterfall, and would rise to pain, if the sensation were not diminished by stopping the ear with cotton." Still more important were the illusions of localization due to the disproportionate sensitiveness of the left ear. Sounds were localized always too far to the left, and sometimes, even when they came from the right, were referred to that side. This illusion was so disturbing as to give considerable discomfort in crossing streets and open places. It was three weeks before the true localization of things was tolerably re-learned, and six before errors disappeared.

Eine Methode zur Beobachtung des Simultancontrastes. E. HERING. Pflüger's Archiv, Bd. XLVII, H. 4—5, 1890.

In this paper Hering describes a new method of performing his characteristic experiment for demonstrating the physiological nature of simultaneous contrast. Two sheets of even-surfaced colored paper, say blue and yellow, of complementary color-tone, are laid close together with their line of junction perpendicular to the median plane of the head. Two narrow strips of the same papers are laid at right-angles to the line of junction, but not reaching quite to it, one above the other, the blue on the yellow and the yellow on the blue. The whole is now looked at through an acromatic double refracting prism in such a way as to double the images of the strips, but not the line of junction. Each of these double images physically represents a mixture of the complimentary colors of the strip and the ground, and might be expected to look gray. As a matter of fact however, each is seen distinctly in its own color, in other words, the color complementary to the general field in which it lies. The effect is said to be very striking. In this form the experiment is not free of successive contrast, but is easily made so by furnishing the eye with a fixation point and keeping the colored fields covered till the instant when the observation is to be made. White paper may also be introduced about the color fields and the phenomenon thus be demonstrated not to be due to a changed notion of what white really is. Helmholtz has regarded it as important that the strips should seem to be a part of the general colored field in which they lie, but the modifications of this experiment, especially the binocular form of it, show that to be quite unessential. These experiments and others like them which Hering has devised should leave the "psychological" explanation of simultaneous contrast without a supporter. An instrument designed by Hering for these experiments is made by R. Rothe, Universitäts Mechaniker, deutsch. physiol. Institut, Prag.

Zur Theorie des Farbensinnes bei indirektem Sehen. A. FICK. Archiv f. d. ges. Physiol., Bd. XLVII (1890), H. 6-7-8, S. 274-285.

The points urged by Hering in the critique to which Fick here replies (see review, AMER. JOUR. PSYCHOL. III, 204), were partly dialectic and partly experimental. The first Fick seems to have little difficulty in turning, and in the second he even finds support for his own position. That a certain red and green (or rather blue-green) on moving toward the retinal periphery should lose in saturation and finally become white without changing in color-tone (Hering's central fact), he shows to be not only explained, but required by his own theory.

Ueber die Tonänderungen der Spectralfarben durch Ermüdung der Netzhaut mit homogenem Lichte. Dr. CARL HESS. Archiv für Ophthalmologie. Bd. XXXVI, 1890, H. 1, S. 1-32.

In this study, as in that upon the color sensations of the peripheral portions of the retina (Review, AMER. JOUR. PSYCH., Vol. III, p. 208), Hess subjects a set of facts, already long known, to a careful re-investigation, and brings from his more accurate results consequences of importance. When the eye has been fatigued by gazing some seconds at one color, other colors upon which it is turned do not appear as to the unfatigued eye, but are changed in a certain fixed and definite manner. What these changes are when the colors are homogeneous spectral lights (and purples mixed from spectral red and violet), and when the other conditions of the experiment are accurately fixed, was Hess's problem. The apparatus used was designed by Hering in whose laboratory the work was mostly done. The detailed statement of results can of course not be summarized, but the general nature of them can be seen in the results of a series of experiments in which the changed color was directly compared with that produced by spectral light on another unfatigued portion of the retina. 1. After fatigue from Red (between line C and the red end of the spectrum) Violet (between G and H) appeared Bluish-green, of tone about like wave-length 478 $\mu\mu$. 2. After fatigue from this Violet, spectral Red appeared Reddish-yellow of tone about line D (wave-length 589.7 $\mu\mu$), or even beyond. 3. After fatigue from Red, Green (between E and b) appeared a Greenish-blue (489–488 $\mu\mu$). 4. After fatigue from the same Green, Red appeared Bluish-red. 5. After fatigue from Blue, (wave-length 442 $\mu\mu$), spectral Red appeared like a Reddish-yellow, of less than 600 $\mu\mu$ wave-length.

Now it is possible by taking the color triangles and curves for the sensations produced by spectral lights which Fick and others (most recently König) have drawn, to predict, according to the Young-Helmholtz theory, at least for fatigue from certain colors, both the direction and the extreme limits of change to be observed in other colors. This Hess does for the typical curves of König and Fick, finding the predictions not verified by the facts. In König's curve, for example, fatigue from Yellow (wave-length 575 $\mu\mu$), which depends on the equal stimulation of the red and green fibres, should have little effect on the appearance of the colors at the red end of the spectrum in which the blue fibres are not active. The actual effect, is however, that these colors become more or less bluish. Fatigue from Red should make Violet appear a little bluish, and complete fatigue, (enough to cause temporary red-blindness) should make it only blue. As a matter of fact a fatigue of 30 seconds makes Violet appear Greenish-blue.

If, however, as Helmholtz and Fick assume, *all three kinds of fibres* are active in case of *every* color, though in differing degree, discrepancies are not avoided. Fatigue from Green should cause equal fatigue for the red and blue fibres, thus no change in their proportions; from which it follows that Violet should undergo no change in tone. Experiment shows it to become redder. The extremest fatigue for Blue should change Red but little toward Yellow (a little beyond line C). As a matter of fact it changes it nearly to line D.

These examples are sufficient to show the difficulties which these experiments offer to the supporters of the three-color theory; to the four-color theory of Hering they apparently offer no difficulties.

Zur Diagnostik der Farbenblindheit. E. HERING. Archiv für Ophthalmologie. Bd. XXXVI, H. 1, S. 217-233.

After discussing a number of the commoner methods of testing for color-blindness, and showing that, while they answer well enough for determining deficiency, they are not suited to reveal complete defect, Hering lays down as conditions to be fulfilled the following: The colors with which the test is made must be of the fullest saturation; the areas of color must be of sufficient size; they must be without spots or roughness; they must be immediately adjacent to each other in an otherwise even and colorless field. With ordinary apparatus these conditions are difficult to satisfy or make the testing a very lengthy process. In *Pflüger's Archiv*, Bd. XLII, S. 119, Hering has described an arrangement of the dark room which serves well, and now he explains and illustrates by a couple of cuts a portable and rapid instrument for the same ends. In outline the scheme of the instrument is to place in the field of view of a vertical tube, two inclined mirrors, each occupying one-half, and each reflecting colored light, one green, the other red; the first adjustable in saturation, the second in saturation and color tone.

By these means an exact matching of colors (as they appear to the color-blind eye) can be made, either between red and green, or between red or green and gray. Besides showing the presence of complete red-green blindness, it also distinguishes the "red-blind" from the "green-blind" forms of red-green blindness, in Hering's words, the "*relativ blausichtiger Rothgrünblinder*" from the "*relativ Gelbsichtiger.*" It also seems capable of adaptation to other types of visual disturbance, some description of its application to which the author may publish on another occasion.

Die Untersuchung einseitiger Störungen des Farbensinnes mittels binocularer Farbengleichungen. E. HERING. Archiv für Ophthalmologie, Bd. XXXVI, (1890), H. 3, S. 1–23.

Of great interest for the theory of color vision are those cases in which color-blindness is confined to a single eye. In order, however, to yield the most exact and valuable results, the patient must not be asked to describe the colors of things seen, for this he often does inaccurately, but to match the colors seen with his color-blind eye alone with those seen at the same time with his normal eye alone. This is possible if an area of color is so presented to each eye that the one seen by the right eye is wholly invisible to the left eye, and *vice versa*, and if the two areas lie upon disparate retinal points, (*e. g.*, on the temporal halves of the eyes), and thus escape binocular combination. Under such circumstances, very delicate comparison of colors is possible. Under the title given above, Hering describes (with one illustration) an instrument for testing such cases, and reports the result of an application of it in the case of a woman whose vision on the right side was reduced by atrophy of the optic nerve to about one-half the normal acuteness,with marked disturbance of vision for colors. The tests showed that all colors appeared more whitish or grayish to the color-blind than to the normal eye; yellow and blue did not suffer any noticeable change in their color-tone; unsaturated primary red and green (Hering's *Urroth* and *Urgrün*) appeared colorless; the intermediate colors tried, (red of spectral tone, orange, yellow-green, and unsaturated violet), lost their red or green character entirely, and appeared whitish or grayish yellow or blue; white, gray and black were for both eyes the same. The red-green vision of the patient was, therefore, nearly destroyed, the blue-yellow vision much weakened. Other tests with spectral colors gave concurrent results. Tests of the acuteness of the patient's peripheral color-vision showed the color fields reduced in size; and careful tests of the same (made later) with the color-mixer, showed that the limits of the field for the members of each color pair were the same; red and green 5°, blue and yellow 30°. Still other tests showed that colors which matched for the sound eye, also matched (*i. e.*, both suffered equal change) for the defective eye. It is hardly necessary to say that these facts speak strongly for Hering's four-color theory and against the three-color theory of Helmholtz.

Untersuchung eines Falles von halbseitiger Farbensinnsstörung am linken Auge. C. HESS. Archiv für Ophthalmologie, Bd. XXXVI, (1890), H. 3, S. 24–36.

In the case of monocular color-blindness examined by Hess, the defect was still more limited than in Hering's case, occupying, indeed, only the nasal half of one retina. The patient was a man of about thirty years and near-sighted. The sharpness of vision in the affected eye (both supplied with proper glasses) was about one-half that of the other. The colors to be matched were this time presented, one to the nasal, the other to the temporal half of the single eye. Tests with pigment colors, homogeneous spectral lights and the perimeter gave results not essentially different from those of Hering. In this case, however, the disturbance was apparently more serious, for the red and green of the perimetical tests could not be seen on any part of the diseased half-retina, and the sensitiveness to white light was a little less than normal. The case, of course, justifies the same conclusions as Hering's above. In both cases a condition of things has been brought about on the central parts of the retina by disease, which exactly corresponds with that on the more peripheral parts of the normal eye.

The Knee-jerk and its Physiological Modifications. By Prof. H. P. BOWDITCH and Dr. J. W. WARREN. Journal of Physiology, XI, 1890, 25–64.

It has been known for some time that muscular contractions and various sensory and other conditions affecting the central nervous system could considerably re-inforce the knee-jerk, also that the re-inforcing contraction must precede the stroke upon the tendon by a certain interval. To the study of this point the experiments of the present paper were directed. The apparatus was somewhat complicated, but is marked by the clever devices common to Dr. Bowditch's laboratory, and is fully described. The general results may be summarized somewhat as follows: A voluntary muscular contraction (in response, after the manner of reaction-times, to a bell-stroke) increases the knee-jerk, if the blow on the ligament falls at the time of the contraction, and in lessening degree if it follow within 0.22–0.6 sec. A larger interval than this resulted in eight cases in a decrease of the knee-jerk below its normal amount, to which, however, it returned as the interval was extended to 1.7–2.5 secs. In 2 cases there was no such negative phase. In the majority of cases, therefore, contraction of the arm muscles produces for a short time a state of increased excitability in the part of the spinal cord that mediates the knee-jerk, followed in turn by a short period of decreased excitability. Sensory re-inforcements were investigated, by the explosion of torpedoes, the flashing of light into the eyes, a blast of air on the conjunctiva, on the nasal mucous membrane, on the neck, and on the knee. These experiments were tried on fewer subjects than the motor re-inforcements (3 or less) and the individual differences are marked. With a portion of the subjects there is a positive phase but hardly any negative, while in one both phases are plainly marked. The experiments were monotonous and in some the subject fell asleep. Oncoming drowsiness decreases the extent of both normal and re-inforced knee-jerks, and sound sleep abolishes them, an effect the opposite of that produced by the same conditions upon the superficial reflexes. The authors make the interesting suggestion that the individual variations in the activities of the central nervous system which their experiments show may open the way to an understanding of those general psycho-physic modes of response vaguely known as temperaments.

Zur Messung der Reactionszeit. OTTO DUMREICHER. Inaug. Diss., Strassburg, 1889.

Twenty-one pages of this dissertation are devoted to a historical resumé of "personal equation" and reaction-time studies, in particular of those among the latter where the stimulus used was electrical and applied to the skin. Another considerable section is devoted to the description of the apparatus used, which included several ingenious devices of Ewald's — among the rest a new chronoscope, and a reaction key which is so arranged that the stimulus can be applied to the tip of the finger with which the reaction is made. The chronoscope, which is a very promising instrument, consists essentially of an electro-magnet, the armature of which works upon a toothed wheel connected with a pointer moving over a dial. If, now, a tuning-fork interrupter is introduced into the circuit with the magnet, each vibration of the tuning-fork causes an advance of the pointer one degree on the dial. The observer switches the fork into the circuit as the stimulus is applied, the subject switches it out when he feels the stimulus, and the time consumed is read off in the number of tuning-fork vibrations shown by the dial; *e. g.*, in hundredths of a second, if a tuning-fork making 100 vibrations a second is used, as in Dumreicher's experiments.

The aim of the experiments was the development of a method that should be simple enough, and at the same time give regular enough results, to make reaction-time tests readily useful in the clinique and laboratory. The recommendations are as follows: 1, Use a strong electric stimulus at the end of the finger with which the reaction is executed; 2, react by withdrawing the finger; 3, use for the warning signal a sound of short duration given 2 or 3 seconds before the stimulus; 4, take the single reactions in sets of 10, at 10-second intervals, with several minutes' rest between the sets; 5, in training the subject always tell him at the time the amount of each reaction; 6, in drawing the mean disregard the first 3 or 4 (always the same number) of the series. The reactions by withdrawing the finger are not only more regular but shorter by 0.03—0.04 sec. than those by pressing the key, probably because more nearly like the natural reflex retractions.

The Time-relations of Mental Phenomena. JOSEPH JASTROW. Fact and Theory Papers, No. VI, published by N. D. C. Hodges, N. Y., 1890, p. 60.

Those that are familiar with Prof. Jastrow's unusual skill in presenting the results of psychological experimentation in concise and intelligible form, need not be told that this little monograph is excellent in both respects. We have no hesitation in saying that it is the best general account of the subject extant, both as regards the maintenance of proper perspective and as regards the extent and freshness of the material gathered. The book provides for those that wish to consult original sources by a classified bibliography of some fifty-seven titles. It should be useful to all those that contemplate psychology from the experimental or clinical side.

IV.—MISCELLANEOUS.

The Principles of Psychology. By WILLIAM JAMES, Professor of Psychology in Harvard University. Henry Holt & Co., 1890. Two volumes, pp. 689 and 704.

This long promised, long delayed book appeared in October last. Its size and the volume of matter it contains as well as its rare vigor and acumen makes the task of the conscientious reviewer hard.

Important as are our differences *in re*, and abrupt and summary as space limits compel us to seem *in modo* let no reader forget that gratitude and admiration are predominant. Our indebtedness for stimulus and self definition to both the man and his book are very great.

The book opens with an excellent chapter on the functions of the brain[1] which is a good illustration of the way in which such subjects as speech disorders, reaction-times, the psychology of vision, the phenomena of suggestion and trance, the psycho-physic law, etc., should have been handled, instead of being broken up and treated, parts here, parts there, torn from their natural and usual connections to be brought to bear upon the speculative controversies in which the author's interest centres. Habit is then treated in a general yet chiefly hortatory way. We are told to do something every day because we do not wish to do it to keep the faculty of *effort* (one of the supremest things in this treatise) alive. We must begin early and hand over all we can to our automaton. In treating the automaton it is urged that the mind is not an epiphenomenon. If feelings cannot

[1] See page 551 in this number of the JOURNAL.

cause nerve action they cannot cause each other, but however inwardly rational they can only be juxtaposed, the brain's "hair trigger organization makes it a happy go lucky, hit or miss affair." "It is as likely to do the crazy as the sane thing." Consciousness is "an organ added for the sake of steering a nervous system grown too complex to regulate itself." Consciousness has causal agency and loads the dice or tips molecules, and this is why it is most intense where nerve processes are most hesitant.

Although metaphysics, which "spoils two good things when she injects herself into natural science," (preface, vi) is expressly and often excluded, chapter VI, is announced as "exclusively metaphysical." Fick's heat summations, tone sensations due to individual vibrations, Spencer's theoretical primordial nervous shock, etc., are all physical integrations below the threshold of consciousness. Even lemon and sugar are not present in the taste of lemoñade, but an entirely new taste. If elemental psychic units existed they could never associate or communicate. The Helmholtz-Wundt conception of unconscious inferences, somnambulism, Leibnitz *minimum visibile et audibile*, all notions of nascence or continuity between brain and mind states, material monadism or polyzoism with one arch pontifical cell, etc., are all denounced more than refuted, as either "one tissue of confusions," or "pure mythology" on which comment "seems hardly called for," a "tumbling ground of whimsies," a "bog of logical liquefactions," illustrating the "silliness of the mind-stuffists, or a temper with which the authors cannot contend and best left to its devices," "where Spencer fairly outdoes himself in vagueness" or "well illustrate the scandalous vagueness with which this sort of chromo-philosophy is carried on," or are "unintelligible and fantastical," and "it is hard to believe that intelligent men could be guilty of so patent a fallacy." Such phrases are applied not to, *e. g.* Mr. Cockayne's Leechdom, Wort-cunning and Star-craft, a strange collection of old wives' cures, but to the views now inclined to by many if not most of the best men of science, and do not suggest the philosophic temper or poise. Split-off consciousness, instant and total forgetfulness may explain much, but when we are told that psychic elements can never really combine, that atoms of feeling cannot compose higher feelings any more than atoms of matter compose physical things, that the entire brain process is not a physical fact at all, I. 178, we simply re-read but do not fully understand how the author knows.

In *the stream of thought*, Ch. IX, where the mind is first studied from within, Dr. James warms to his subject and is perhaps at his best. This is in some sense the key-chapter to all the rest. *It thinks* is the first and simplest fact for psychology. These series of unorganized impersonal thoughts are seen in trance, disaggregated and unowned, but always tend to be parts of a personal consciousness. Whether we personify the procession of thoughts, or that procession is the self, each train of them is isolated by one of "the most absolute breaches in nature" from all other selves. The thoughts in the stream are in ceaseless Heracleitic flux, and the same thought or sensation is never repeated [Hodgson]. The objects only are the same but no two psychic impressions of or brain states caused by them are the same. The successive ideas of the same thing have no identity. Their instant *esse* is *sentire*. They are as they are felt. Dimness and clearness do not pertain to states of mind but only to the objects they stand for. The minimal psychic fact which is closest to any brain state is the entire thought, for mental chemistry and psychic synthesis are denied. Contrast is invoked, and it is even said that a telephone plate thrills for years yet never reduplicates its inward state to prove the exiguous point that the notion of identical ideas or impressions which re-appear is a myth. Despite time-gaps the thought procession connected with each self is a continuum. The train is not chopped up but inwardly connected as parts of a common whole called *I* or me. Even in the greatest contrast the joint or link between the two contrasted members is a part of consciousness. The stream is "made of an alternation of flights and perchings." The perches represent sensory, images objects, and as substantive are contrasted with the transitive flights. (This happy form of statement should have been credited to Wundt.) The flights are very hard for introspection to catch or name while the perches are easy so that a sensationalism which denies feelings of relation as Hume did is easier than to ascribe it to an *actus purus* of reason. Vocal inflections, adverbs, prepositions, conjuctions, interjections, various signs of direction and grammatical tendencies abundantly prove these dumb relation-feelings. Words have both static and dynamic fringes or overtones of relationships, and these may be the same for verbal, or visual imagery [Galton]. Thought is an algebra of relations, [Berkeley], and while the assigning of values to the symbols is like the perches of thought, it is the fringes and transitive elements that make it a continuity. The reason why we come to think that our thoughts have "extra mental duplicates" or objects corresponding to them is that thoughts of many selves have the same objects. If *my* thought has the same object as *his* we believe it objective and real. Hence the great importance attached to *sameness*. In swoon there is a sense of being, or objectivity is general without any sense of self, which latter is added on awaking. Hence the sense of the object is first, and knowledge that we know it or the consciousness of self is not primordial, so that all who like Green say that to know and to know that we know are identical are wrong, and thought may or may not discriminate between the object and itself. The object is not the nucleus of a state of consciousness but all that the thought thinks just as it is thought, hence introspection can only gather up a few of the crumbs later. Again there is no Kantian *manifold* but all that is thought is in a single unitary pulse. The idea of a pack of cards is not a pack of thoughts and our notion of a large number or an army is one feeling. In the simplest sentence the states, tensions, halos, fringes, change with every word. The words are consubstantial with the idea and not over against it as Egger holds. Again some objects in the stream are emphasized and selected by attention. Our very senses are organs of selection ignoring some wave lengths and many subjective phenomena, and making what we call things out of the chaos of sensation. Reasoning, æsthetic activities, and supreme ethical choices are other forms of selective action which altogether have given us our physical, mental and moral world by filtering it out of the primordial sea of sensations and atoms, and dichotomizing and setting it over against each of the many selves whether of worm or man as its world: All this because we cannot disperse attention evenly over all objects but must inhibit, ignore, eliminate, unite series of uniform strokes to rhythm, and make and then break up totalities, etc.

We now see the author's idealism. It is the phenominalism of Hodgson and Renouvier emphasized till the very states of consciousness seem so real as to have causal force, or the realism of Herbart with his physics and mathematics and indeed all exactness taken out. Waving this, he is too eager to use abnormal experiences as yet only tentatively explained to help out both the theory of impersonal thoughts, pp. 226-9, and of object-knowledge as primordial p. 273. In recent physiological grammars the forms and acts of the "sentence sense" are explained in a simpler, more complete and exact way than by these "fringes," "relation feelings," transitive and other processes. For Hartmann these are among the strongest proofs and types of his "unconscious." Who can decide; and why force this irrelevant issue? Nor can we harmonize the contentions for the consubstantiality of idea and word with the distinction drawn between mind states and objects, or with any theory of sameness. There is no possible test to decide between Egger and James and why force facts to fit with theory? That contrast is a "joint" is good Hegelism.

Ch. X. The description of the social, spiritual and pure self, of rivalry, self-seeking and feeling are delightful and picturesque. The nuclear self of minimal primary tensions and reactions (which are very different from Wundt's apperceptions with which they seem to be identified) does not preclude a back-ground self which may become its own object. The central self of selves, the shepherd or "herder" of the thoughts, etc., is not needed to explain the facts of consciousness. Better an *anima mundi.* The self is the passing thought, differing each moment but appropriating the thought of the past moment and all it had. The thought is itself the thinker. The author declares himself "persuaded by abundant acquaintance with the trances of one medium that the 'control' may be altogether different from any possible waking self of the person. In the case I have in mind it professes to be a certain departed French doctor, and is I am convinced acquainted with facts about the circumstances, and the living and dead relatives and acquaintances of numberless sitters whom the medium never met before and of whom she has never heard the names." [I, 396.] Various facts in the Lurancy case "increased the plausibility of the spiritualistic interpretation of the phenomenon."

In this chapter the author fails to utilize the great ethical opportunities he makes so much of in treating habit. Poor Kant's "cheap and nasty editions of the soul," concerning which his "unintelligibilities became quite paroxysmal," is called "as ineffectual and windy an abortion as philosophy can show."

Chapter XI. Brain cells may be excited from within by other brain cells or perhaps by spiritual process. Attention is the nucleus of our inner life, and volition is "nothing but attention." The central question in this chapter is the "metaphysical as well as psychological one whether attention involves a principle of spiritual activity. This is pivotal, the very hinge on which our picture of the world shall swing from materialism, fatalism, monism, towards spiritualism, freedom, pluralism, or else the other way." The cause theory is held to as opposed to the effect theory. The feelings probably result dynamically upon the cell activity. Attention is an original force. He "counts himself among the believers in a spiritual force," and those who do not are "intensely reckless" and are charged with strange arrogance.

The chapters on Discrimination and Comparison, and on Conceptions need not delay us. The latter are unchangeable and nothing can be conceived of twice alike. No concept can ever change into another but remains eternally what it is. An idea neither is what it knows or knows what it is. Difference is a sensation. When we say A differs from B, we do not compare two distinct ideas but the different-sameness is one unique pulse of thought, I, 500 *et seq.* Each thought is a continuum, a plenum, needing no contributions from another. Fechner's psycho-physic law,—explained only in the most generic and summary way—is "amusing," a "patient whimsy," "dreadful literature," and its outcome is just "nothing," etc. The pregnant and far-reaching idea of the *threshold* (as irreconcilable as are "fringes" and transition states with the basal position of the "mind-stuff" chapter), the exact and patient experimentation which lifted a whole section of psychology to the plane of science by enabling it to re-identify psychic states (no two of which can be identified according to Dr. James) combine to make this field the most critical of all for his basal assumption, as its methods are most contrasted in thoroughness and exactness with his. Old

Caspar's house was on the battlefield of Blenheim as Dr. James' system is in the field of this discussion. But we should expect the latter's explanation to be more intelligent than Caspar's, because the psychophysic battle is still undecided, but it is scarcely more so.

Association is not of ideas but only of objects thought of. It is of course all on the plane of consciousness for all psychic synthesis out of ulterior simple elements was denied in Chap. VI. Here neural action is chiefly invoked, yet "possibly these will not suffice and we shall need to invoke a dynamic re-action of the form of consciousness upon its content." Even in voluntary association the order of presentation of mental material is "due to cerebral physiology alone." Contiguity and similarity of ideas can only exist after the association is done. Similarity does not exist till both things are there, so it cannot be an agent in producing anything. The object may bear any relation whatever to that which suggests it. Herbart is "repulsive, almost hideous," because each idea is regarded as an entity out of consciousness and their struggle and inhibition are too mechanically conceived. In a word the brain produces all sorts of ideas in all sorts of directions and consciousness afterwards classifies the links as best it can.

We have a unique feeling of pastness, Ch. XV, to which every feeling in turn falls a prey. This is a simple feeling or state as is the feeling of difference or of space, but of another quality. To successive feelings, a feeling of their own succession must be added and treated as another fact. The "specious present" is the few seconds that can be steadily intuited at once. This immediately-known time is the type and measure of all conceived times. An "over-lapping of brain processes" said to be related to after-images and to serve in some sense as a temporal sign is invoked to explain the feeling of duration. So primary memory, Ch. XVI, is of the nature of an after-image or after-consciousness. Secondary memory has an additional consciousness of previousness added to knowledge. There is no revival of an image, but there is a "second event, having absolutely no connection with the first save that it happens to resemble it." The tick of the oldest clock does not become aware of past ticks because these are physical and not psychic objects. It must be referred to the past and to *my* past to be memory. Both retention and recall are caused by the habit of the nervous system working by association, but even the brain states excited by an event and by its recall differ.

After inner comes outer perception and first sensations. The latter are marked by "extreme simplicity" and their natural history and classification is entirely omitted. There are no pure sensations at least after the first day of life. The infant's first sensation is the universe. The knower greets the world in the miracle of knowledge. Contrast, which shows that sensations are not immutable psychic things, is physiological as Hering says and not psychological as Helmholtz thinks. Sensations do not appear first as internal and get afterwards projected outward, but only get translated and "shoved further off." From the first they have a roomy and spatial character and that independent of other sensations. The assumption that because bodily processes cause, they must also seem to be the seat of sensation is false. Subjectivity is one of the latest notions to be acquired. Copies of sensation may re-arise—the neural processes which underly imagination, starting in the brain, may excite sense organs. So imagination differs from sensation only in intensity and not in its locality. Vague images are not general notions. "Perceptions are not inversely as sensations and differ from them by the consciousness of further facts associated with the objects of the sensation." The escort of revived sensations are integrated. Not sense but intellect accounts for most fallacies of sense. Most of what we perceive comes not from the object but from our own head. Hallucination may probably be centrally initiated. Perception is not an unconscious inference but a brain product, and both it and hallucination are elaborately explained as such. Apperception is but little more than mentioned.

The perception of space starts from a feeling of "crude extensity," involving the third as well as other dimensions. All our sensations are inexplicably extensive but do not all contribute to space perception. The hypothetical feelings arising from joints play the chief rôle in the development and discrimination of space perceptions and the muscle-feelings play no appreciable part in it. Discriminative attention subdivides the total dermal or retinal bigness by the aid of movements. The different space senses are at first incoherent and must be compared, reduced to a common standard, added etc., and very gradually the world of space as we now know it is evolved. An admirable rehearsal of many facts of visual space is made in an attempted refutation of Helmholtz' statement that the present sensation is a sign the interpretation of whose meaning is left to the understanding. This James declares is irreconcilable with all his sensationalism and insists that the understanding does nothing but recall, and produces nothing. This space chapter is one of the best in the book, but in the latter point falls short of carrying conviction.

Ch. XXI. The sense of our own bodily existence is the nucleus of all reality or belief. Any object which remains uncontradicted is *ipso facto* believed and posited as absolute reality. Real things are reductives of things judged unreal. (Taine.) There are seven orders of reality or worlds to which all gets referred. Reality coerces attention, stimulates will, is vivid, rouses emotional interest, etc. The objects to be chosen as realities are still under debate, but the perfect object of belief would be a God or soul of the world, good and explaining our experiences. This would account for all science and history in the deepest and simplest way. The primitive impulse is to affirm and doubt arises later. By acting as if a thing were real we can make it so for us. Will and belief are the same. The moral "improvements" of this chapter are interesting and impressive.

In Reasoning we pick out essential qualities first from recepts or generic ideas. An extracted character suggests a consequence more than does the whole object. Genius extracts fitting characters. The sagacity of animals is all accounted for by contiguous association while man associates by similarity. Genius does so in a great degree. This is a very inadequate chapter, abounding in animal stories, definitions of a gentleman, difference between men and women, and in view of the treatment this subject deserves, is not worthy of serious criticism. It is mainly an old paper printed under another title a dozen years ago.

A brief physiological chapter is inserted to illustrate how every feeling produces a movement with wide reverberations. Knee-jerk, sweat glands, bladder, bowels, uterus, circulation—all being affected.

The transitiveness of instincts and their inhibition by habits is shown, and this is followed by a description of a number of human instincts. Instincts conform to the reflex type, the nervous system being a preorganized bundle of such reactions. Only a mind debauched by learning can ask for the why of any instinctive human act, II, 387. It is mainly a mere excito-motor impulse due to a pre-existent reflex arc. Man has all the instincts that brutes have and many more concerning which there is much good æsthetic writing. The author is intent on contrasting rather than paralleling human and animal instincts. Instincts shade imperceptibly into emotions which are consequences not causes of bodily expression. They cannot be divorced from sensational processes. Abstract the bodily symptoms from any strong emotion and it goes with them. It seems to be even admitted that a totally anæsthetic person could have no emotions. The objections that we may act emotions and not feel them, and that expressing emotion checks it are in our judgment not at all met, and to hold that emotions are due to inhibited reflex and impulsive tendencies, would be nearer the truth. Some emotions the author holds can be explained but many, "nay the entire æsthetic life of man" is of accidental origin—love of music as well as sea-sickness, etc.

Will, Ch. XXVI, acts on the ideas of many movements left in memory by the reflex performances of our automation. It can reconstrue these elements but create no new ones. The kinæsthetic idea of what the act is to be is made of memory images of afferent sensations arising from previous motions. Feelings of out-going energy or of innervation are denied (Münsterberg), first on a priori grounds. Introspection also does not find them. We only anticipate the sensory consequences of movement and there is a fiat that these shall become actual. Thus sensationalism is made rich, not degrading, and spontaneity and choice are reserved for spirit, II, 518. Even the visual or auditory effect of a movement may be its mental cue. Sometimes the mere thought of a movement is sufficient to produce it if there is no conflicting notion, and it always tends to do so, as in mind-reading. In deliberative action there are five types of decision. Consciousness in its very nature is impulsive. Pleasure and pain are not the only springs of action, and effort of attention is the essential phenomenon of will. Will is the relation between the mind and its ideas. To these the will is always directed and the only resistance we can feel is the resistance an idea offers to being attended to at all. Consent is to fill the mind with an idea. The sense of effort, which appears in the fourth and fifth types of decision, brings us to things metaphysical and spiritual. While as a science psychology may hold to determinism and thinking as an immaterial process *goes on*, it is effort-choices that bring in the wider order on which science has no claim and which lead the author to declare for freedom. Yet free will involves only the *amount* of effort of attention.

After a chapter on hypnotism which is evidently very hastily written and is meager and inadequate, comes the long and final key chapter of the book on necessary truths and experience. Elementary feelings are innate, so it is their combination that is involved. The mind has a wealth of native forms, pre-established relations, ideal inner pure apriori rational principles, concerning which we can know nothing save that they did not originate from experience. These embrace *pure* sciences, all of which are exclusively results of comparison, such as classifications, all judging, predicating and subsuming, number relations and geometrical form, metaphysical, æsthetic and moral principles. To argue that these are in any way dependent on individual or ancestral experience is untrue, and so unintelligible that it is hard to understand how such shallow and vague accounts of them as Mill's and Spencer's could ever have been given by thinking men." The attempts of Helmholtz and others, to connect geometric axioms with experience is not here referred to, perhaps because the vocabulary of denunciation is exhausted. Experience is restricted to time and space and these are no less arbitrarily narrowed to their very lowest range and potence. All necessary truths, higher powers, and even all natural science, arise as "back-door processes" which modify the brain but give no cognition of themselves as opposed to experience, or impressions from something foreign (as natural objects to which the mind is passive and fatally servile). "Back door" is Dr. James' term for Darwin's accidental variations or Spencer's indirect equilibrations which are due to autogenous brain growth. Here belong freaks, sports, flashes of wit, and of discoveries or lucky fancies, susceptibility to music, sea-sickness, drunkenness, the temperament of genius, idiosyncrasy, as well as love, pleasure, pain and elementary sensations. All enter by the "back-door." Necessary truths are products of these accumulated spontaneities. They are as by divine fiat, or even deity could give no explanation of them; some of them are barren and abstract and verbal enough in their "pure" forms to have little interest save to a sublimated scholastic mind, and in fact are treated in extenso here in violation of the author's own worthy purpose in his preface to keep metaphysics out of psychology. But when he brings into this transcendant realm of necessary truths of which we know nothing save that they are absolutely independent of all repetitions or ancestral experience, all the choicest results of science which were attained by breaking away from mere experience, which is a chaos of fragmentary impressions of sense, which we can never know as they are to the ideal world of atoms and molecules, etc., which can be of moral and æsthetic truths which cannot be tested yet which we hold to as a creed, and which itself is finally said to have nothing to do with experience save to coerce facts of sense under its rubrics, and to be so supernally rational that even cause seems but an altar to an unknown deeper connection; we realize with sadness and regret how remote from most ideals and endeavors of empirical science in this field this vigorous and able writer has cast his anchor. If Weismann's atavism, and the mixing of sperm and germ cells early separated from somatic cells, concerning which morphologists are now about evenly divided, be true, the influence of the environment only becomes selective rather than causative. For Weismann variation is indeterminate and so far from accounting for anything necessary or eternal may conceivably give brain growth, or "back doo"r processes of a nature so entirely different that it is idle to speculate concerning any selective results. Both logically as well as historically, all schemes of necessary and eternal truths have more affinities with Lamarck or pre-evolutionary fixed types and species. It is idle to affirm whether the same truths or very different ones would issue from other lines of evolution.

Passing now to *the work as a whole* the author might be described an *impressionist* in psychology. His port-folio contains sketches old and new, ethical, literary, scientific and metaphysical, some exquisite and charming in detail and even color, others rough charcoal outlines, but all together stimulating and suggestive, and showing great industry and great versatility. The important works of art and science have usually been done by men who sink their personality in their work. These traditions of self-effacement are effete for our author, who tells us incidentally of his age, of his early school life, his daily habits, tastes, etc., and unintentionally compels the reader to imagine that he is the hero of many more of his stories and illustrations than is probably the case. His favorite theme, conscious states, also contributes to give the book in places a Rousseau like—we had almost said Bashkertsieff like—confessional flavor. Its personal frankness, which also accounts for such denunciatory epithets for divergent psychologists as we have quoted, is unequalled in the history of the subject. Indeed so saturated is the book with the author's personality even where he is not consciously recording a "personal confession," or a bare "opinion" as in I, 396, that those who do not know him will misconceive much in it, while for those who have known him it will be the key to a personality of rare accomplishments and attractions, as well as no less rare frankness.

The passing thought, feeling, or sensations or in a word *conscious states* are the basis of all. The spacial *quale* originates in a feeling of crude extensity involving all three dimensions. Time is rooted in a feeling of succession or elsewhere a feeling of duration. Imagination differs from sensation mainly in intensity. Comparison rests on difference-sensations and may involve a feeling of difference-sameness. There are also relation feelings, and these are involved in perception which is a larger sensation. The components of voluntary motion are anticipations of the sensory consequences of the movement and a feeling of effort. These cannot be analyzed or classified. They are as ultimate as necessary truths concerning which it is as idle to speculate, as concerning instinctive and reflex acts. Only a mind "debauched by learning," or as the fakir would say, II, 641, learned in the things he cares not for, would examine to these idola. Emotions rest on bodily sensations and are as unaccountable as accidents, sports, freaks, "back door" processes or sea-sickness, love of music, or the taste of lemonade which is not made of sugar or lemon, but is a new independent sensation.

States of consciousness are the warp and woof of all. No anatomist ever loved to trace tissues more than Dr. James delights to dissect these states in their ramifications. They are described from all moods and in all manners, and dilated upon as fondly as "the water that comes down at Lodore," or as a programist grasps in all directions for tropes to describe in words the nature and effect of each phrase of a sonata. He has a veritable genius for turning inward and catching these states on the wing, and for describing them graphically. Thus he makes of introspection not dogma but literature as it should be; literature not only very rarely dull (which is saying much in this field), but often highly spiced with well stored anecdotes, *bonmots* and sudden surprises, and not infrequently delightful and almost superb. In pursuit of these he is led farthest from the main line of his argument and it is novelties both of thought and expression here that are most striking and will linger longest in the reader's mind. Conscious states flow along now slowly, now rapidly, now perching, now flying. They associate themselves, summate past states, are herded, massed into an unitary object for a thought which may have become a thinker, or even a self. These are in closest apposition to brain states and to objects, mediating between these and soul *per se*. It is these that are real enough to act causatively upon brain molecules. This general standpoint sometimes called phenomenalism in Hodgson and Renouvier becomes as we said, impressionism in Dr. James. No two states can be the same, it is repeatedly said, and it is impossible to make any exact coherent statement of Dr. James positions. There are passages where these seem the only reality and not only human faculties, but soul, outer world, brain included, seem to have no reality save that which these confer, but this is by no means the dominant standpoint. His external world is not lacking in reality at least from the psychological standpoint.

In closest relation to feelings and to conscious states are brain states or neural processes. Although the usual chasm of incommensurability is emphasized, these play a rôle second only to consciousness itself. Perception is called a brain-product. So are all the "back door" spontaneities. Contrast is physiological and not psychological. Memory and recollections are the habit of the nervous system, and so is association, imagination, hallucination, instinct and spontaneous attention. The nuclear self is made up of its tensions and re-actions, and emotions are consequences not causes of bodily activities. All the movements from which the will selects are preformed in it. The combination of vibrations into musical tones is a nervous mechanism with no psychic synthesis involved. Pflüger's "spinal soul" is also due solely to mechanism. In short the "feelings" and "states" of all sorts spring out from the brain, which no physiologist would ever think of invoking so continually as a *deus ex machina*. From a description of it in chapter II and

III no one could suspect the rôle it plays later. When it is invoked to explain one group of phenomena, we are told of "currents once in which must find a way out," etc., I, 107–9; elsewhere, to explain another group, of the "cumulation of brain processes overlapping," I, 635; for yet another purpose of a "new and more violent sort of disintegration of neural matter, which now explodes at a deeper level"; or to explain the difference between sensation and imagination of an "inward molecular cohesion in our brain cells which it probably takes a sudden inrush of distructive energy to spring apart," II, 74. When a certain intensity is reached we are told that a new order of resistance arises which must be broken by a new order of force from without. We are told of "pontificial cells," of "drainage channels," "paths scooped out," "gutters," of "blocks" in the same, of "tensions" and "equalizations between any two points;" of "isomerisms" and "changes merely chemical;" of "traces," "copies" and "images;" of "glows," "tremors," "tingles," "flashes," and explosions; of "tenacity of brain substance" and "of its plasticity;" of points that "wake each other up," or how motions can become feeling, I, 146. And yet "no phrase our lips can frame is so devoid of apprehensible meaning." To use one hypothetical generic process, as Jackson uses the figure of explosions to explain epilepsies, as Meynert uses association fibres, or Spencer isomerism; or as many physiologists use electric currents, etc., or to speak in large over-all terms of neural changes, modifications and disturbances, etc., is often done in our speculative efforts to bridge the "chasm." But if we must still have tentative or provisional, physical and chemical imagery, let them be clear and consistent. Such a jumble of processes extemporized in this loose literary way are possible only in just the mental limbos physics and chemistry exist to clear up. They explain everything equally well because they explain nothing, and harmonize no better than would a random collection of choice religious imagery concerning another world and state. This is about as far from "untrameled homogeneity of terms" as can well be imagined. Such brain matter is indeed "an instrument of possibilities but no certitudes," 141. For our part we should now prefer to check this exuberance of meta-neurology, not more out of respect for the "chasm" than for recent or present morphological advances that almost inspire the hope that the beginning of the end of this degenerate interregnum is at hand.

III. Besides the many aprioi feelings or conscious states and the brain states and processes, Dr. James' psychology does not drop the soul. He says he "shall take no account of soul," I, 181–2, yet adds: "I confess, therefore, that to posit a soul influenced in some mysterious way by the brain states and responding to them by conscious affections of its own, seems to me the line of least logical resistence." On this mysterious soul the separate brain processes would combine their effects. Soul is a "much despised word," but we cannot despise the great traditional beliefs that tow us soulward. All thoughts are owned. No psychology can question the existence of personal selves. We do not personify the procession of thought, but it is already personified.—I, 226-7. The ego is felt with and connects thoughts, 242. If things are to be thought together it must be in one something, although "we will not discuss the ego just yet." "I do not wish just yet to commit myself about the existence or non-existence of the ego," although it is not needed to unite Kant's manifold," p. 177-8. The physical adjustments are not all of the self of selves, but whether the *thinker* or pure sciousness immanent in each section of the thought stream, be a logical postulate like pure matter, is a metaphysical question. This is, however. a "parenthetic digression," from which the author "reverts to the path of common sense," while the obscure feeling of some "self above the adjustments," etc., such as "subjectivity as such, of thought become its own object," or an "indivisible active soul substance" is left open.—303-5. Is the "inner nucleus of my spiritual self" the adjustments plus "a still more obscurely perceived subjectivity as such?"—319. Common sense drives us to admit an "arch ego," or at least a shepherd of past states, uniting and owning them, but perhaps itself owned in dying by another which may be the present thought vested for the nonce with synthetic power.—338-9. The popular notion of a simple, incorruptible soul is needless for explaining the phenomena "of consciousness which are all accounted for by the power of each thought in the stream to know and appropriate the others' content, and personal identity is only a perception of sameness. Of the essence of mind we know nothing. Soul is a superfluity even for forensic responsibility before God, and gives no immortality save an atom-like simplicity we do not care for. It explains nothing and guarantees nothing. The author is "free to discard the word soul from the rest of this book" save in the vaguest and most popular way, "an *anima mundi* is more promising."—I, 342-50. Yet the effort to attend may be an original force, and the auther counts himself among "the believers in a spiritual force," although his reasons are all ethical and "hardly suited for introduction into a psychological work," I, 454. [See also 499, 51]. "A presiding arbiter" seems set aloft in the mind and distinguishes good from bad thoughts as they arise, related to the latter as ethics to history. Omitting intermediate allusions, we are told later, II, 518, where to draw "the true line between passive material and the activity of the spirit." Again, II, 574-5, "what the heave of the will betokens metaphysically, and what the effort might lead us to infer about a will power distinct from motives, are not matters that concern us yet." "Questions as momentous as the very existence of spiritual causality, or vast as that of the very existence of universal predestination, or free will depend on its interpretation," *i. e.* of effort. "How thinking exists as a special immaterial process along side of material processes," the author does not fully understand, 571-1, and decides for freedom; "but since the grounds for his opinion are ethical rather than psychological, he prefers to exclude them from the present book," 573.

Such scattered references, to which must be added the one quoted, I, 696, concerning the spirit of the dead French doctor, it is impossible to co-ordinate. This outspoken writer becomes strangely timid, apologetic, self-conscious and self-contradictory here. He recurs over and over again to this in the form of "ultra cerebral conditions," "transcendental thinking agent," the "I that knows the me," the same brain subserving many conscious selves," nowhere stalwartly asserting his pneumatology, but ostentatiously refusing to ring up the transparent metaphysical curtain behind which it is usually seen,and playing bo-peep with it with if, but and perhaps. That he is even unconsciously all through the book only building a new stage and setting a fit scene in modern science-town for the old timeless, spaceless, deathless soul of eschatology, we have no right to say in view of the many unwonted, masked reserves, but every intelligent reader will see not only that there is nothing inconsistent with this view, but that this is the only possible standpoint from which the book has unity or cohesion. Deny the knowledge of passing thought, a matter left very dark by the author, and we must have a soul to mediate union between psychic elements. *Seelensucht* is the key to what is left undone as well as to what is done. His abhorrence of mind-stuffists and associationists, the slight treatment of instinct, memory, and the lower senses, the special lines of interest to which he confines himself in treating vision, hypnotism and automatism, the almost total omission of pleasure and pain, of hearing, touch, taste and smell, and of anthropological psychology, and the strange neglect of fundamental biological principles, etc., are now all explained. Some of the most lusty branches of the psychological tree are neglected or mutilated in the interest, consciously or unconsciously, of the author's strong undertow of animistic propensities. We, too, believe in soul, but not in a way which interferes with causation or the conservation of energy. As consciousness, he thinks, need only tip molecules, so soul needs, it is pleaded, only to prolong the fixation time of spontanious attention. If consciousness can tip molecules, what of the "chasm" so orthodoxly emphasized between brain and psychic state; may it not tip a table, at least if it be accurately enough balanced; and how is its force applied, or is the brain "boxed and blanketed" like a medium's cabinet to cunningly defy our peering curiosity; was it with this consciousness that physical miracles of old were wrought; can it act telepathically? There is at least nothing against any or all of these. To appeal to consciousness as a physical cause is to invoke the chaos and old night of spiritualism. Holding firmly to the views of it we expressed in the first number of this journal (see vol. 1, No. 1, p. 145), we cannot accept the smallness of this baby (I. 144), as any excuse for its illegitimacy or its depraved heredity.

This is through and through a "tendence" book. Its very inconsistencies and incoherencies not only reflect but greatly magnify all the unrest, distraction and conflicts of the present hour. The author is a veritable storm-bird, fascinated by problems most impossible of solution, and surest where specialists and experts in his own field are most in doubt, and finding it very hard to get up interest in the most important matters, if settled and agreed to, even to state them well. Open questions haunt and taunt him, and sometimes become almost neuroses. Although his partizanship sometimes lacks poise, repose and even philosophic dignity, yet in its most extreme and blinding intensity it often becomes almost magnificent, even where it is neither science nor philosophy. Assuming as the three fundamental postulates whose foundations he will not explore, brain states, conscious states and an ulterior self, and abhorring as the very powers of darkness from the pit the words unconsciousness, unknowable, if not even unknown, in all their application, his gnostic passion will not be put off with any appeal to an higher and future synthesis. All this is "spiritual chloroform," a "device for making a luxury of intellectual defeat." "Better live on the ragged edge, better gnaw the file forever," even though this be a "constitutional infirmity."—I, 179. Where can be found a better type of what Hegel's phenomenology characterizes as the stage of "unhappy consciousness?" This distraction is reflected in the form and style of the book, which is at every point in no less strange contrast with the work of the ordinary text-book maker, than it is with the patient investigations of the laboratory, which must seem both alike tedious to such an author. There are many brilliant and original pages, hundreds of pages of admirably selected quotations and translations, a large train of footnotes and afterthoughts, often most happy and helpful, and often undigested and unassimilated, representing successive stages of ripeness or information, so that occasionally errors carry their own medicine on the same page (*e. g.*, Wiesmann's corrective, not realized, of necessary truths; G. Allen's point about idiosyncrasy, 631, or Romanes, 678, the bearings of which are not fully seen or felt.) The book could have been somewhat lessened in size had the author recorded the results of private thinking instead of so often writing himself clear. The further transformations of change and growth, which are not complete, or the further adjustments between the three principles may considerably revise the present conclusions, and we shall await the author's metaphysics and ethics with interest later. The ripeness, repose and perfect mental digestion of Lotze, who abhorred every flavor of rococo, eclecticism or extravagance of expression; or of our own Charles Peirce, who burns his own smoke, and talks with the rifle rather than with the shot gun, or water hose, are most contrasted with this author, and most desired in this confused and distracting field.

For our part we do not wish to balance and foreclose accounts between brain and soul yet. Even to attempt this just now, when from the neural and also from the psychic side both change, progress and promise are greater than ever before, is worse than waste, it is philosophic and scientific precocity and lack of self-control. But to force an adjustment between mind and matter by excluding all psychic elements from the simplest forms and functions of organisms, and making a Cartesian surrender to physiological mechanism, calculated to lessen psychological interest in these fields, on the one hand, and ascribing a causative agency to conscious states in a way to interfere with the conservation of energy and the belief in the perfect reign of law and order in the brain on the other, is, we believe, bad science, bad philosophy, and bad religion. In place of this tortured and tortuous dualism, or triadism, both tendency without and temperament within incline us to repose in faith in a future monistic synthesis, in which both law and freedom, mind and matter, immanence and transcendence will lose their partial aspects and stand revealed as parts of a sublime whole. The last few years have seen great changes in the spirit and temper of scientific workers, and all the currents set in this direction. Whatever may be true of the routine professors, or of the popular writers, it may already be said (in the direction of the phrase "the undevout astonomer is mad") that scientific investigation discovers, and men of real research work, with a spirit of reverence, and a sense of unity and law at the root of things and pervading every action and corner of space, that is religious to the core, in every sense which the best philosophy of religion makes basal. They live and work, often in obscure places in the field of science, animated by belief in future syntheses, both small and great. If the ultimate synthesis be monistic, it need not be so much the monism of contemporary schools as the modern psychological and even ethical equivalent of the sublime monotheism of the Old Testament, liberally and reasonably interpreted. Psychology, we believe, is even to be the means of rescuing religious oracles from degredation and re-revealing them as sublime ethnic verbal editions of God's primative revelation in his works. It will also show what is in man, and may some day become veritable anthropology, the science of man in fact as well as in name, a gospel of love and work, where the heart is not subordinated to the head, and the emotions are not slighted, or the great ethical lesson of hereditary good and ill, psychogenesis and adolescence doubted and disparaged. Instead of the modern degenerate and exiguous forms of the originally most stimulating "theory of knowledge" now grown so scholastic and debilitating if not positively harmful in occasional teachers, pupils and institutions in ways we shall try to describe later, the new psychology of the present and future is based less upon introspection than upon observation, experiment and experience, individual and ancestral. *Sum, ergo cogito*, might have been one of its texts. The text-books it needs are illustrated by Jastrow's recent little hand-book concerning reaction times, in which the main facts and conclusions in the field are conveniently presented and not scattered among the various speculative questions on which they are thought to have bearing. This method involves more labor with details and is plainer and humbler, but it is this method of self-control and subordination, carefully adhered to also by this Journal, that has commended the scientific method in psychology to the confidence of conservative administrative boards, and by which its recent remarkable academic extension in the universities and colleges of this country have been made. It is premature speculative views that these boards justly fear. A book so individual in its style and method will inevitably invite attention more and more to the personality of the author, it is just these elements and idiosyncrasies that will be valuable material for the inductive methods of the future in psychology.

In what we have said we have been guilty, however, of looking a gift horse in the mouth. Many were too busy with enlarging the field by investigations; others lacked the range of view, or literary style, so that the advent of a good text-book maker has been longed for. Dr. James lacks the just proportion of Professor Ladd, but opens to the English reader much new ground, and his familiarity with many of the facts he does describe is greater, but they are strung on theory like Dewey (as they are not in Ladd, whose objectivity is admirable), and there is much less vituperativeness than in Bowne. Dr. James is, however, more stimulating and suggestive than any of them. His breadth and breeziness and large philosophy and comparative standpoint is now one of the chief needs in this field. Even to attempt to harmonize old and new, science and introspection is an inspiration. Those subjects that are treated *con amore* are admirably presented (as *e. g.* the optical parts), and there is a literary form that sets off everything which none of the rest can equal. The author's experience as a teacher has been long and varied; his love of his subject is deep. His acuteness and vigor of intelligence and independence are rare. From dryness and routine he is as far as it is well possibly for a professor to be and still keep in academic traces. Moreover, this is not one work among many of a worn writer, but however much he may write later, this will remain the one life book of an able, well-trained and mature man, who has gathered himself well together, re-edited all former papers, balanced accounts with the literature on his lines well up to date, and here deliberately indulges not only without reserve but with *Ausgelassenheit* in what Lotze called the supreme felicity of self-expression, which temperament, power of language, and his favorite subject of selfhood and psychic state combine to make as full and utter as self-expression can well be. Both merits and defects were never more extreme. The critic must blow hot and cold, because " where it is good it is very good and where it is bad it is horrid." The good, however, is so very largely preponderant that many if not most of the gravest errors and defects might be eliminated in a radically revised edition. It is in the earnest hope that this will be done that we have dwelt so fully upon them. There is too little claim put forth for originality in some fundamental matters, and the combination and proportion of parts could not help being new in many particulars. We are glad to give to an effort we have ourselves found so stimulating the space at least it deserves. It marks a distinct advance in the teaching and study of the subject in this country. It is on the whole and after all the best work in any language, and we earnestly advise every one with the least interest in psychology to own and study it.—[Ed.

NOTES.

THE PSYCHOLOGICAL SOCIETY OF MOSCOW.

BY PROF. NICHOLAS GROTE.

The Psychological Society of Moscow has 180 members (10 honorary members—Bain, Sidgwick, Zeller, Wundt, Helmholtz, DuBois-Reymond, Ribot, Richet, and two Russian professors, with Mr. Troitzky, the founder of the society). It was founded in 1885. The first president was Mr. Troitzky, who was succeeded in 1888 by Professor Nicholas Grote of the University of Moscow.

The society was organized for the discussion of problems in psychology, its foundation, theory, applications and history. It has also discussed problems in philosophy, logic, morals and the philosophy of law, esthetics and pedagogy. More than fifty meetings have been held, (thirty-seven of which were in the years 1888–90). Thirty members of the society have made 62 communications. Of these, 10 referred to the history of philosophy, 25 to problems in psychology, 7 to hypnotism and psycho-physics, 5 to ethical subjects—including a communication from Count Leon Tolstoi on the the problems of life,—besides papers on metaphysics, methodology, esthetics, psychiatriy, etc.

Since 1888, the society has published three volumes of its Transactions; one volume on the Philosophy of Schopenhauer; one volume of Translations of the Prolegomena of Kant, and one volume of six communications on the Liberal Arts by different members of the society. We are now engaged upon a fourth volume, Translations of Certain Philosophical Works of Leibnitz.

Since Nov. 1, 1889, I have founded, under the auspices of the society, the journal, "Problems in Philosophy and Psychology," devoted to original contributions, critical and historical, on the different questions in philosophy. From four to six numbers are published during the year, and the subscription list already contains 1400 names. It has been very favorably received, both by the members of the society and by the Russian press. The journal is edited by Mr. S. Abricosoff, a member of the society.

Each year, on the 24th of January, the society holds a meeting to which the public are admitted, when from 500 to 700 people assemble. The other meetings are sometimes open and sometimes closed to the public. The communications are discussed at length, the meetings lasting from three to four hours. The members are specialists in their lines. There are 30 each in philosophy and medicine, and 20 jurists, besides historians, philologists, mathematicians and naturalists. In addition to these, there are 30 amateurs who are associate members only.

The editors of the *Zeitshrift für Psychologie* have added to the usefulness of their already valuable periodical, by appending to it an extended bibliography of recent literature on psychology and related topics. This they propose to do annually. The present installment for the year 1889 covers with its analytical table of contents and its alphabetical index of authors some fifty-six pages and eight-hundred and ninety-nine items. Somewhat of the scope of the undertaking appears from the headings of the fourteen general sections into which the literature is divided.—1, General; 2, Anatomy of the Central Nervous System; 3, Physiology of the Central Nervous System; 4, Sensations in General; 5, Physiological and Psychological Optics; 6, Physiological and Psychological Acoustics; 7, Other Specific Sensations; 8, Perception of Space, Time and Motion; 9, Consciousness and the Unconscious, Attention, Sleep; 10 Practice (*Uebung*) and Association; 11, Ideas and Idea-complexes; 12, Emotions; 13, Motions and Actions; 14, Neuro- and Psycho-Pathology. Most of these are further divided into numerous sub-heads. Taken altogether, the bibliography is a most impressive witness to the present activity in psychology and closely related lines.

To the Editor:

May I ask your aid in making the following announcement? A grant has been made for the equipment of the laboratory for experimental psychology at the Toronto University, and I should be glad to correspond with students or investigators who are projecting researches in any branch of this subject. Apparatus which they need may be purchased from this grant, to be used by such investigators in the laboratory. The intention is to make the laboratory as useful as possible for the advancement of the Science, and it is thought that this utility may be best served by aiding a few who may be hindered in original research by lack of facilities.

The appropriateness and importance of such researches and the advisability of undertaking them under this grant will, in each case, rest with the Department of Psychology here.

If in time the results should warrant it, I assume the responsibility of saying that the expense of publishing them will be met by the Department of Education of the Provincial Government. Application should be made as early as possible.

Yours truly,

PROFESSOR J. MARK BALDWIN,
Toronto University,
Toronto, Ont.

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ORIGINAL ARTICLES.

PSYCHOLOGICAL LITERATURE.

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(The names of those who have contributed original matter are printed in SMALL CAPITALS.)