THE

AMERICAN

JOURNAL OF PSYCHOLOGY

EDITED BY

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VOL. VIII.

CLARK UNIVERSITY, WORCESTER, MASS.

J. H. ORPHA, Publisher.

1896-97.

THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

VOL. VIII. OCTOBER, 1896. No. 1.

ATTENTION AND DISTRACTION.

BY ALICE J. HAMLIN, PH. D. (Cornell).

TABLE OF CONTENTS.

CHAPTER IV.

Attention and Distraction: an experimental investigation of the effect of so-called distractions on sensible discrimination.

I. Report of experiments. Tabulated results for visual distances, light stimuli, weights and sounds. Distraction discontinuous; effect on memory; on duration of attention; on degree of attention. Disturbing factors: two methods of judging weights; experimental investigation by Prof. C. E. Parrish; different methods of addition; use of memorial images. Report of experiments by Mr. F. E. Moyer: effect of different modes of addition as distraction; effect of memorial images on overestimation of stimulus. II. Comparison of results with Prof. Münsterberg's: restriction of comparison. Results of comparing all four series; only two series. Faulty treatment of numerical results. Explanation by *expectant* attention. Analysis of expectancy in both experiments. Distinction between attention and intensity of stimulus. III. Sources of error observed and precautions suggested. Pre-adjustment of the attention. Continuity of the distraction; kinds of distraction and individual treatment of them. Methods for remembering stimuli. Results tested by other experimental methods; Patrizi's experiments. Experiments by Bertels.

Summary of the four chapters.

CHAPTER I.

Introductory.

On Certain Physiological Concepts Involved in Theories of Attention.

In our later examination of various theories of attention, we shall find certain physiological concepts introduced. The validity of their use in the maintenance of different positions will be considered in connection with the discussion of the theories in whose favor they are adduced. But the concepts themselves are neither so generally accepted nor so well established by physiological experiments as to admit of our introducing them without a preliminary definition of their significance and value in physiology itself. The two topics requiring brief notices of this sort are *cerebral localization* on the one hand, and *Bahnung* and *Hemmung*—neural reinforcement or facilitation and inhibition — on the other hand.

Cerebral Localization. The physiological controversies over localization in the cortex, carried on by Hitzig, Munk, Ferrier, Goltz, Flourens, Horsley and many others, have resulted in the establishment of a few definite principles of cerebral functioning. These are summed up by Wundt as the principles of the Indifference of Function; the Substitution of Function; and the Localization of Function.[1] The same three principles are stated less formally by Waller in

[1] *"Physiologische Psychologie,"* IV ed., Vol. I, pp. 235, 236.

the following words: "The clinical history of a dog or of a monkey having suffered a removal of some portion of the Rolandic area altogether negatives a strict localization of function, and at most suggests its local concentration. . . We thus picture the cortical organ in a semi-fluid state of differentiation, still variable by new instruction, rather than as a petrified and invariable collection of specialist organs tied down to particular functions and exclusively performing these functions."[1] In the same article Waller shows very clearly that the differences in theories of localization have been mainly due to a widely differing and even contradictory use of words for phenomena that were identical, and to the inferences drawn from these words.[2]

Neural Reinforcement (Facilitation) and Inhibition: "Bahnung" and "Hemmung."

We do not need to take any special notice of the physiological character and basis of inhibition. While there is still discussion in regard to its mechanism, the fact of inhibition, as tested, for instance, in the action of the *vagus* nerve on the heart, is well known and has frequently been demonstrated.

It is only mentioned here in connection with the opposite and more hypothetical process of neural reinforcement or facilitation. This latter idea plays a most prominent part in the theories of attention put forth by Exner and von Kries. They both refer to it as "a physiologically well established fact." I have searched the recent physiological journals and archives for confirmation of this statement, and have been unable to find mention of it. Exner, however, in his "*Entwurf zu einer physiologischen Erklärung der psychischen Erscheinungen*" gives his own physiological proof of the existence of *Bahnung*, and I quote rather fully from his report of the observations on which he bases this concept.

Exner uses *Bahnung* to mean just what we expect the word to mean—"the opening of a path."[3] It is a *facilitation* of the course of the nerve current, due either to its reinforcement by charges from the centre, or to the lowering of the limen of discharge.[4] Exner states that he first reached his conclusion that there must be *Bahnung* in connection with his experiments on reaction time. But he maintains also

[1] "On the Functional Attributes of the Cerebral Cortex," *Brain*, Parts LIX and LX, 1892.

[2] *Op. cit.*, p. 346 *seq.*

[3] "*Entwurf zu einer physiologischen Erklärung der psychischen Erscheinungen*" (1894), p. 76.

[4] *Op. cit.*, p. 82.

that he has succeeded in proving its existence experimentally by the following experiments with animals.[1]

(1) Pass an electric shock through the paw of a rabbit. Since the reflex contraction follows in an animal whose brain has been severed from the spinal cord, this reflex must be controlled by a cord centre. Now lessen the electric shock until it is too weak to produce any contraction. Apply this feeble shock to the paw, and apply to the cortex a shock also too feeble to produce any result alone. If the two are given in rapid succession, one reinforces the other, and the paw is flexed. Exner states that this is not a "summation," since in summation the reinforcing stimuli follow the same path as the reinforced. Summation, however, is one particular form of *Bahnung*.

(2) A passing reference is made to the fact that the reflex contraction following a needle prick is much stronger if we give close attention to the prick. Assuming that the cortex is in a state of excitation in attention, Exner uses the phenomenon as an instance of cortical *Bahnung* of a spinal cord centre.

(3) Sternberg has observed the *Bahnung* of other reflexes in the course of his studies on *Hemmung, Ermüdung, und Bahnung der Sehnenreflexe im Rückenmarke.*[2]

(4) *Bahnung* of the other sort, where the limen for discharge is lowered, is present in the action of the *vagus* nuclei. They lie in the *medulla oblongata*, and are connected by commissural fibres. If a section is made through these fibres, each half of the body breathes independently. If the two lungs move at the same time when the nuclei are connected, this must be because an increasing charge in either affects the other, so that it is more ready to discharge; and the actual discharge of the two must be simultaneous.

(5) The fifth case is taken from von Grossman's investigations[3] of the three nuclei concerned in the breathing of the rabbit, one controlling the facial muscles, one the *vagus* muscles, and one the thoracic muscles. If one of the three is separated from its connection with the other two, these will continue to do their work; but the limen for their release of the inspiratory impulse is raised, and the animal makes movements which we call "gasping for breath." So that in this case we find the stimulation of one aiding the function of each of the others, and all three together reaching their exci-

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[1] *Op. cit.*, pp. 76-82.

[2] *Wiener Akadem. Sitzber.*, *Bd.* C, *Abth.* III, *Juni*, 1891.

[3] "*Ueber die Athembewegungen des Kehlkopfes*," I *Theil. Wiener Akadem. Sitzber.*, *Bd.* XCVIII, *Abth.* III, *Juli*, 1889.

tation limen at a lower point than is possible for any two, or for one alone. Notice that here we plainly have *Bahnung*, not as a reinforcement of a current, but as an influence which allows currents to pass off, or to discharge, more easily; *i. e.*, as a facilitation only.

Other physiological concepts will frequently recur in the subsequent chapters; but they are either so generally recognized as to need no special notice, or so intimately associated with the psychological theories we shall discuss later that we may advantageously consider them in their psychological connection rather than in this introductory chapter.

Chapter II.

The Descriptive Theories of Attention.

Before attempting to give any account of our experimental investigation of the effect upon sensible discrimination of "free" and "distracted" attention, we shall pass in review some of the most important and typical theories of attention. The whole subject is still in a somewhat chaotic state. A summary of certain representative theories will tend to bring order out of the chaos and provide a basis for a more definite and intelligible treatment of isolated experiments. The old phrase, "*Quot homines tot sententiæ*," may well be taken to represent the number and variety of theories of attention advanced by the psychologists of this century. To indicate the importance of the problem and the incompleteness of its solution, I may quote from one of the most recent investigators of the subject, Dr. Heinrich of Zurich.

> In the series of questions which concern psychology, attention takes the first and most important place. It is regarded as the fundamental condition of every human activity. In scientific investigation and thought, in practical action, in learning and teaching, attention is always a prerequisite if anything is to be accomplished. No wonder, then, that every psychology seeks to answer the question how those phenomena arise to which we give the name of Attention. * * * Yet even now psychology has no theory, only many theories. Even now, as in the "good old times," each psychologist seeks to develop a theory of his own; and very few of these can be characterized as scientific.[1]

Yet in the general confusion two tendencies are discernible, according to which the theories may be roughly divided into two classes. One class includes the more purely "descriptive" theories, with more emphasis on the physiological aspect of attention, and less distinction between psychological

[1] "*Die Aufmerksamkeit und die Funktion der Sinnesorgane*," Ebbinghaus' *Zeitschr.*, IX, 5 and 6, Jan., 1896, pp. 342, 343.

and physiological, primary and secondary phenomena. The other class includes the "explanatory" theories, with stronger emphasis on the psychological aspect of attention. Naturally, these two principles of classification intersect, and no theory is merely descriptive or explanatory, physiological or psychological. But the distinction is a matter of convenience in the present discussion, and it also expresses a real difference in the general tendency of the theorists that largely accounts for the great dissimilarity in their treatment of the question.

The present chapter takes up the more exclusively descriptive and physiological theories of attention, recognizing as its three important types the sensory, motor, and sensori-motor theories. Any ambiguity in the meaning of these terms will be cleared away as we take up in detail the several types.

I. *Theories of attention as motor.* We turn first to the motor theory, a theory which holds that attention is primarily a term covering a group or series of motor changes; processes preceding or following these changes are not an essential part of attention itself.

As the most complete presentation of a motor theory, Ribot's volume on "The Psychology of Attention" demands careful consideration. This work, however, is so well known that we need attempt no review of the discussion as a whole. We shall merely refer briefly to passages that state Ribot's position on certain contested points. After a detailed description of the "motor mechanism" and "muscular accompaniments" of attention, he definitely affirms that "these motor manifestations, with the state of consciousness which is their subjective side, *are* attention."[1] They are "its constitutive elements." And again, in speaking of voluntary attention, and of the nature of will, he maintains that "our only positive conception of will" is our idea of the action of the voluntary muscles.[2] He recognizes the intimate association between the power of attention and the frontal lobes[3]; but the correlation offers no obstacle to his theory, since he also regards the frontal lobes as the physiological organ for the regulation of the motor centres. He calls attention to three large groups of muscular concomitants[4]: (1) Vaso-motor phenomena, including both peripheral and central hyperæmia; (2) Respiratory movements; (3) "Expressive" movements of other muscles of the body. Under

[1] "*Psychologie de l'Attention*" (1889), p. 38.
[2] *Op. cit.*, p. 73.
[3] P. 67.
[4] *Op. cit.*, p. 20.

the last rubric he gives the often quoted descriptions of the muscular mechanism of attention directed outwards toward external objects, and of attention directed inwards toward internal objects.[1] Ribot finds his greatest difficulty in the application of the motor theory when he enters upon the consideration of attention to abstract ideas and concepts. He admits that the motor elements here are very feeble, but adds that "this is in accordance with the experience that abstract reflection is impossible for many, difficult and fatiguing for almost everyone."[2] He finally explains the difficulty by maintaining that abstract thought deals only with words. A motor element is found in our word ideas, though its form varies somewhat according as the individual is more or less of the motor, visual or auditory type.[3]

It seems unnecessary to give any further summary of a theory so generally known as Ribot's.[4] Before we review any other theory, however, there are three criticisms to be passed on Ribot's discussion of the attention as essentially motor. (1) He assumes that the alternative to his own theory is a denial that there is any essential connection between muscular manifestations and attention. "The *crucial* test would consist in seeing whether a man deprived of all power of external and internal motion, and of that alone, would still be capable of attention. The case is one that can not be realized."[5] But the motor phenomena may be regarded as the inseparable concomitants of attention and yet not as its "constitutive elements." They may be only one class among several of the conditions of attention. This is Külpe's view of their significance.[6] Or they may be fundamentally related by the constitution of the nervous system to other processes that have a better claim to the name of attention. This accords with Bastian's view of attention as essentially sensory, yet inseparably bound up with motor activity.[7] No theory denies that the muscles have an important part to play in the process of attention. (2) Ribot does not give any materials for the resolution of a difficulty that presents itself after a moment's reflection upon his explanation of at-

[1] Pp. 27, 28.
[2] *Op. cit.*, p. 86.
[3] *E. g.*, p. 84.
[4] Ribot's treatment of the dependence of attention on affective states, and his definition of attention as an "intellectual mono-ideism," need not concern us here. Whatever may be the logical outcome of either position, neither is so developed by Ribot himself as to modify his conception of attention as essentially motor.
[5] *Op. cit.*, p. 88.
[6] "Outlines of Psychology," tr., p. 437.
[7] *Brain*, 1892, pp. 10, 11.

tention to abstract ideas. He states that the only motor element present in such attention is in the word itself, but the character of this motor element varies in individuals according to their mental type, whether visual, auditory, or motor.[1] Now if the motor changes constitute the very nature of attention, attention itself must be dissimilar in persons of different types, and those in whom the motor element is most distinct will have the greatest power of attention. Different degrees of attention would be merely different degrees of motor adjustment. (3) Ribot fails to analyze the idea of movement. Ordinarily he refers to the purely physiological aspects of movement, and speaks of attention as their sum. But even when he is definitely concerned with the psychological aspect of movement,[2] he refers to ideas of movement without analysis or definition of the term. The phrase, "idea of movement," can properly be used only in two senses: to mean (a) the idea to which movement itself is a stimulus; and (b) the idea upon which is based the knowledge that we have moved. Of the two definitions, the first presents the more legitimate use of the term. Just as the idea of sound is that to which the excitation of the auditory organ is a stimulus, so the idea of movement is the idea to which the excitation of the articular sensibility is a stimulus. By the second definition "ideas of movement" belong to the same class as ideas of magnitude or distance, and include in their content sensations of any and all sorts. But, in either case, the content of the term is a homogeneous or a heterogeneous mass of sensations. So it has come to pass that other psychologists, studying the same phenomena, reject Ribot's statement that the attention is essentially motor, and regard it as essentially sensory. The separation of these sensory and motor theories is an artificial one, but before completing their reconciliation, the differences between the two should be presented from the point of view of the "sensory" theorists.

II. *Theory of attention as sensory.* The sensory theory has been presented in a rather fragmentary way, by writers more directly concerned with the criticism of the motor theory than with the systematic formulation of their own views. The most complete statements of the position yet made are those of Bastian[3] and Marillier.[4]

Marillier defines attention as "a state of consciousness which is the result of the temporary predominance of one

[1] *Op. cit.*, pp. 84-88.
[2] *Op. cit.*, *e. g.*, p. 72.
[3] "On the Neural Processes underlying Attention and Volition," *Brain*, LVII, 1892, pp. 1-34.
[4] "*Sur le Mécanisme de l'Attention*," *Rev. Phil.*, 1889, pp. 566-588.

representation over the representations which are coexistent with it at any given moment."[1] He maintains that Ribot's analysis of the muscular movements in attention really proves "that what is essential here is the reinforcement of a representation, and that sensations are what determine this reinforcement. Movements are only a condition, as indispensable as you choose, but not an element of the phenomenon. What he [Ribot] succeeds in showing, after a long analysis of the mechanism of the voluntary attention, is the very important part played by muscular sensations in the memory of images and words."[2] Marillier goes on to say that after admitting that motor phenomena often play an important part in attention through the sensations which they excite, we must still protest against the implication that such peripheral excitation is the only way in which a representation may be reinforced. Account must also be taken of the interaction of the centres upon one another.[3] His objection to Ribot's definition of attention as essentially motor is, then, up to this point, a two-fold objection.

(1) Admitting that motor phenomena have often a prominent part in attention, we must at the same time trace these phenomena backward to their rise in sensations, and forward to their excitation of the sensations of movement; so that on this ground alone attention should be called sensory rather than motor. (2) Ribot's account of the motor mechanism fails to recognize the interaction of sensory centres and of motor and sensory centres, and moreover—here Marillier introduces a yet more fundamental objection—the motor adjustment is often such that it fails to reinforce, or hinders the attention. This is ordinarily the case as attention grows more profound. Excitation of the sensory centres, up to a certain degree, occasions a series of muscular changes well adapted to reinforce the original sensory excitation by the sensations to which they give rise. By connate or acquired associations of certain sensations with motor adjustment, it is possible for an originally feeble sensation to be so intensified as to absorb attention. Take, for instance, the case of a dog perceiving the faint odor left in the track of a hare. The sensation has awakened strong impulses, and his attention is so absorbed that he can scarcely hear the shouts of his master.[4] But in both animals and men, if the excitation is further increased, its propagation is no longer confined to definite motor centres, so as to produce coördinated move-

[1] *Op. cit.*, p. 566.
[2] *Op. cit*, p. 572.
[3] *Op. cit.*, *e. g.*, pp. 572, 587.
[4] *Op. cit.*, p. 574.

ments of a definite sort. It is diffused and results in irregular and disordered movements.

"They are no longer adapted to any end. A man makes gestures, speaks in a loud voice, walks back and forth, stops, starts again, waves his arms in the air, takes his hair in both hands ; his mouth works in a thousand ways; sometimes his face becomes rigid, his eyes are fixed, his brows contracted, his forehead lined with wrinkles, his hands tremble, his voice is hoarse, speech is difficult, breathing is obstructed. . . . If the excitation increases still further, there is a change again : the muscles relax, ... the heart beats irregularly and slowly, the skin becomes pale and cold, ... until at last there may be an arrest of the heart and the respiratory centre, and a total loss of consciousness." [1]

Marillier adduces as a subordinate proof of the lack of thorough cöordination of the motor and sensory centres the fact that morbid states of the attention are not ordinarily associated with motor troubles.[2]

Illustrations of similar cases of attention, not covered by Ribot's theory, are presented in an article by Sully.[3] The two most detailed descriptions can best be given in his own words :

"I was walking along a narrow lane lost in thought. I came on a lamp which shot its rays through the fog. I involuntarily stood still and fixated the lamp, thinking all the while intently on my psychological problem. When this intellectual effort relaxed, and not till then, I saw and recognized the lamp. Now here was energetic muscular action, and equally energetic concentration ; but what was the relation of the two ? That this involuntary assumption of the attitude of the seer, of the fixed head, convergent eyes, etc., somehow aided the process of mental concentration, is certain. But was this muscular adjustment the *whole* of the process ? If so, I ought surely to have been mentally occupied by no abstruse problem of psychology, but with the concrete sensible object before my eyes, even though it had been far less brilliant and imposing an object than the lamp. . . . The same partial independence of the process of attention and of the motor process appears, too, in ideational attention. If I think, for example, of a circle, with the eyes closed, . . . I not only have muscular sensations which tell me that the peripheral organ by means of which I acquired the idea is engaged, but I am aware of a motor impulse to retrace the curve of the circle. . . . But now let us suppose that I am trying to visualize, not any particular form, but merely some shade of color, say, peacock blue. In this case I certainly find the motor element much less prominent. I am hardly aware, indeed, in this instance, of any ocular strain, and should say the eyes were in the easy and natural position, described by Helmholtz as the primary position, nor does attention resolve itself in this case into a renewal of the muscular action concerned in uttering the name of the color.

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[1] *Op. cit.*, p. 576.
[2] *Op. cit.*, p. 580.
[3] "The Psycho-physical Process in Attention," *Brain*, 1890, pp. 145-165.

Indeed, I find that any thought of the name distinctly disturbs the visualizing process. And yet, though the muscular element in this case is, to say the least of it, considerably reduced, the active consciousness, the attention, is as clearly present as before."[1]

Sully compares the relation between attention and motor changes with "that which obtains between an emotion and the several sensory and motor phenomena which accompany it. Fear is always accompanied by characteristic physiological changes; . . . and fear would not be fear but for these processes which contribute, in the sensations to which they give rise, characteristic features to the mental state. Yet when Prof. W. James of Harvard College not long since proposed to prove that emotion is nothing but the result of the organic changes and correlated sensations, most persons probably regarded the proposal as paradoxical."[2]

Bastian is in substantial agreement with the parts of Marillier's and Sully's views that have here been presented. But he attacks two positions maintained by Marillier and Sully, not mentioned in the digest of their articles given above, because reserved for more extended notice here. The contested positions are: (1) The correlation of consciousness with efferent nerve currents in the cortex; and (2) the existence of motor and sensory centres in the cortex. After the discussion of these topics we shall pass on to the consideration of the second great class of theories of attention —the explanatory.

I. *The correlation of consciousness with efferent nerve currents.* With regard to the first position, the correlation of consciousness with efferent nerve currents in the cortex, Sully, Marillier, Fouillée, Waller and others maintain that there is such a correlation; while Bastian, Wundt, James, Münsterberg and others assert that motor centres or efferent currents have no correlative consciousness whatever. The point is not one of ultimate importance in the controversy between the sensory and motor theories, as is evident, indeed, from the fact that writers who agree in calling attention essentially sensory differ in regard to their ideas of "motor consciousness." The opposing theories could be reconciled on the basis already suggested, *i. e.*, the reference of the word "motor" to "ideas of movement," whether initiated solely by peripheral or also by central processes. Yet the subject is one of vital importance for the theory of attention in general, and it has been given such a prominent place in the sensori-

[1] *Op. cit.*, pp. 156-157. Sully also cites Helmholtz's instance of attention to an object in the lateral regions of the field of vision. But recent experiments made by Heinrich in the laboratory at Vienna, show that there is a change in the accommodation of the eye when the attention is directed to the side of the field of vision or to mental operations. See Ebbinghaus' *Zeitschrift*, Bd. IX, January, 1896.

[2] *Op. cit.*, p. 157.

motor discussions that it may properly be discussed in this chapter. We can only quote a few typical passages from both sides of the controversy. No one ventures to assert yet that the matter is finally settled.

To present the negative side of the issue, first, we quote from Bastian, James, Wundt and Münsterberg.

Bastian writes: "In my opinion, the ganglionic elements concerned with the motor side of this activity [*i. e.*, attention] lie altogether outside the cerebral hemispheres, just as the activity of such motor mechanisms lies altogether outside the sphere of consciousness."[1] Again he refers to certain expressions "as implying that there are motor centres in the cortex and that their activity carries with it a subjective phasis; both of which positions I, in common with James, Münsterberg and others, believe to be erroneous."[2]

In a diagram in this same article, Bastian pictures a sensory centre, one of his "kinæsthetic" centres, in connection with an afferent spinal (sensory) centre and an efferent spinal (motor) centre.[3] The fibres of the pyramidal tract connecting the kinæsthetic centres and the spinal motor centres he prefers to call "internuncial" rather than efferent, and their functioning is attended by no psychical accompaniments. And so because the kinæsthetic centre is situated on the afferent side of the nervous tract, it should not be called "sensori-motor," but merely "sensory."[4]

Prof. James does not fully agree with Bastian; for he speaks of "the distinction of sensory and motor cells as having no fundamental significance,"[5] and yet he also excludes the motor zone from the sphere of consciousness.

"If the motor cells are distinct structures, they are as insentient as the motor trunks are after the posterior roots are cut. If they are not distinct structures, but are only the last sensory cells, . . . then their consciousness is that of kinæsthetic ideas and sensations merely, and consciousness accompanies the rise of activity in them rather than its discharge."[6]

Wundt, in his last edition of the *Physiologische Psychologie*, describes the "sensation of movement" as derived from four sources: pressure sensations, articular sensations, muscular (contraction) sensations, and innervation sensations. The existence of innervation sensations in the sense of centrally excited components of the idea of movement has been fully established, but Wundt defines these central components as

[1] *Op. cit.*, p. 13.
[2] *Op. cit.*, p. 27, note.
[3] *E. g.*, p. 31.
[4] *Op. cit.*, p. 32.
[5] "Principles of Psychology," II, p. 581.
[6] *Op. cit.*, II, p. 517.

"*memorial images of previous movements*, . . . which partly introduce and partly accompany every voluntary movement. Since memorial images possess qualitatively the same sensation content as the original perceptions, such central sensations of pressure and movement, under normal conditions, will completely fuse with the more intense peripheral sensations of the same kind. But they will produce an independent effect if for any reason the peripheral sensations are suppressed."[1] The term *Innervations-empfindungen* has been so widely misused and misunderstood that Wundt gives it up in his fourth edition, and uses in its place more general terms, "central components," or "central sensations." Other passages, showing Wundt's definition of the term in the third edition of the *Physiologische Psychologie*, and elsewhere, are quoted by Prof. Titchener in *Mind*, N. S., Vol. II, 1893, p. 143. Münsterberg's analysis of the sensation of innervation in *Die Willenshandlung*, pp. 75-88, reaches the same results.

On the affirmative side of this question concerning the association of consciousness with motor processes, we quote first from Marillier.

"The feeling of muscular effort, as the writings of William James and more recent experiments have proved, can be wholly traced back to muscular and tactile sensations; it disappears in anæsthesia. But beside this feeling, there is another, a feeling of cerebral effort, of the more or less easy functioning of the sensory and motor centres."[2]

Sully takes the same position in the following statement:

"If every psychical difference of quality is to have its corresponding physiological difference, there is some *a priori* reason for correlating the great and profound difference between passive sensation and active consciousness with the most important and radical difference observable in the nervous process, viz., that between the afferent and efferent current."[3]

In commenting on Sully's paper, Fouillée expresses the same opinion more strongly.

"Münsterberg denies that motor impulse is accompanied by any psychical phenomenon before movements have taken place in the limbs through muscular action. This negation is entirely gratuitous. Everything that produces rupture of cerebral equilibrium must produce a contrast in the cœnæsthesia, and contrast is the very condition of distinct consciousness. Now motor discharge, even when it is spent not upon muscles, but intra-cerebrally in the form of innervation of sensory and ideational centres, involves a sudden transformation of tension into *vis viva*, of potential energy into actual energy. This sudden rupture of physical equilibrium

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[1] *Phys. Psych.* (IV*te Aufl.*), *S.* 425.
[2] *Op. cit.*, p. 586.
[3] *Op. cit.*, p. 155. *Cf.* "The Human Mind," I, p. 122.

must have its psychical counterpart; it constitutes cerebral work of a very different nature to cerebral passivity, and we call this work the substratum of attention. We are not conscious of the centrifugal current once let loose upon the muscles beyond the cerebral centres; we then experience, as a sort of *choc en retour*, mere passive muscular feelings. But we are conscious of the *starting* of a centrifugal current at the instant it is liberated in the brain."[1]

Waller, in his special study of the sense of effort, reaches the conclusion that effort and fatigue "are in major part central, in minor part muscular."[2] In the introduction to his account of his experimental study of fatigue, Waller refers to the two sides of the question, and the proper method for its solution, in the following words:

"The opinion that the sense of effort is a subjective concomitant of the outgoing nerve flow, is not in fashion with most working neurologists of the present day. Bastian goes the length of referring to it as "a doctrine now disproved," and Ferrier "is thoroughly in agreement with Bastian as to the sense of movement being dependent on centripetal impressions and not on outgoing currents." There is, however, as Dr. Jackson says, no reason why states of consciousness should not attend activities of motor as well as of sensory cells. . . . . In fact, as it seems to me, the proposition and its negative are of equal weight, equally admissible as statements of opinion, equally unproven and undisproven by the arguments invoked for and against them. *A priori* tenability is not proof, but failure of proof is not disproof. And I cannot admit as a positive premise either the opinion of Bain or the dictum of Bastian — the first to the effect that we know our movements by a central sense of motor emission, the second to the effect that the sense of effort as a concomitant of central motor innervation has been disproved. An appeal to our own feelings of effort does not prove one thing or the other; observations of clinical phenomena leave the matter unsettled; experiments on animals give answers which must be dressed out with interpretation and inference. There remains, however, in my opinion, very definite and accessible *objective* evidence to be obtained by the study of the manifestations of fatigue on man quite apart from introspective self-analysis."[3]

The "objective evidence" referred to in the paragraph just quoted was collected from a series of experiments with the sense of fatigue. The whole experimental proof proceeds upon the assumption of the similarity of "the sense of movement" and "the sense of fatigue."[4] He argues that "the incidence of fatigue" (which is the *result* of movement) may be taken as a guide to the incidence of "effort" (which is the concomitant of movement).[5] Waller concludes that effort is

[1] "Remarks on Mr. Sully's paper," *Brain*, XIII (1890), pp. 352, 353.
[2] "The Sense of Effort: an Objective Study," *Brain*, XIV (1891), p. 247.
[3] *Op. cit.*, pp. 179, 180.
[4] *E. g.*, pp. 187, 188.
[5] *Brain*, 1892, p. 380.

dependent on changes both at the centre and at the periphery. But it is not clear just what he means by this conclusion. He seems inclined to admit two kinds of consciousness, correlated with the central changes. He frequently contends that he can not agree "with the arbitrary and dogmatic exclusion of the motor zone from the sphere of consciousness."[1] And although with reference to Prof. James' discussion of the sense of effort,[2] he says, "I fully admit the destructive character of his arguments as opposed to the introspective and circumstantial evidence of a central feeling of innervation,"[3] yet he maintains that there is experimental proof of the existence of a sense of effort which is "a subjective concomitant of the outgoing nerve-current."

Such an account of what is involved in the central changes seems to us rather obscure and inconclusive, besides being inconsistent with Waller's theory of the cortical centres. He holds that there are neither motor nor sensory centres.

"Any 'motor' or discharging centre must also be a 'sensory' or receiving centre; it must be excited as well as excite. Any sensory centre must also be motor, directly or indirectly; else we could have no objective tokens of sensation; every centre, whether called sensory or motor, is *terminus ad quem* as well as *terminus a quo*."[4]

With such a conception of the cortical centres, it seems to us that Waller, to be consistent, should be as decidedly opposed to any theory of two kinds of consciousness as he is to the theory of two kinds of brain centres. We may grant all that he asserts as the result of his experiments with regard to the existence of central elements in effort and fatigue, and all that he maintains with regard to the sensori-motor nature of the cortex; but instead of seeing that there is any contradiction here of the interpretation of effort given by Wundt and Münsterberg, the two assertions just stated and the preceding quotations from Dr. Waller's articles are irreconcilable, except from Wundt's standpoint.

II. *Sensory and motor, or sensori-motor cortical centres.* The question whether the function of the cortex is sensory, motor, or sensori-motor, is as important with regard to the physiological basis for the theories discussed in this chapter as was the analysis of the meaning of "motor," "ideas of movement," etc., for the psychological investigation of the theories. In the psychological analysis we found that much of the apparent opposition arose from an obscure and diver-

[1] "Principles of Psychology," II, 449-518.
[2] *Brain*, 1891, p. 241.
[3] *Brain*, 1892, p. 351.
[4] *Brain*, 1892, p. 352. See also pp. 342, 343.

gent use of the same terms. The same phenomena can be described as motor when objectively regarded, and as sensory when subjectively regarded. The only ground, then, left for the controversy was the hypothetical distinction of sensory and motor in the physiological processes of the cortex. If there is no such distinction, if Waller's description of the cortex as essentially "sensori-motor" is true to the facts, then the sensory and motor controversy must come to an end. We should combine in one the observations and the verified inferences contributed by writers on both sides, and then turn to discussions of attention from some other standpoint, in search of some explanation for the descriptive theories of the present chapter. But we are forecasting the end before the final test is applied. What, then, *is* the current physiological theory with reference to the existence of sensory and motor centres in the brain?

We consider this topic in accordance with the principles of cerebral function stated in the preceding chapter. When we speak of localization, the term is used in the sense there defined. The dispute over the cortex as sensory, motor, or sensori-motor has long been waged. The names of many of the disputants have become familiar even to the general public, and it is quite unnecessary for us to review the history of the discussions between Flourens, Goltz, Munk, Hitzig, Ferrier, Gotch and Horsley, Schäfer, Schiff, Bechterew, etc. Summaries of the controversy have been given by Waller in the article on the "Functional Attributes of the Cortex," already referred to,[1] and by Mott in a discussion of the "Sensory Motor Functions of the Central Convolutions of the Cortex," published in the *Journal of Physiology* for 1894.[2] Dr. Mott's conclusions, from his own experiments as well as from his review of the experiments of others, favor the view of the cortex as sensori-motor. "I think that clinical experience, experiment, and anatomical investigation all tend to show that these cortical cells are discharged by sensory impulses traveling up fibres which terminate in the so-called 'motor area,' and that it is not 'purely motor,' but 'sensori-motor.'" "The fact still remains that motor paralysis is greatly in excess of the sensory disturbance in many clinical cases. This may be explained by comparing the expansion of the centrifugal and centripetal fibres to two funnels. . . . The base of the efferent cone consists of trunks, from which all the branches and collaterals spring. The base of the sensory cone consists only of the terminal twigs after

[1] *Brain*, 1892, pp. 329-396.
[2] *Journal of Physiology*, 1894, pp. 464-487.

collaterals have been given off."[1] Waller's quotations from both sides of the controversy show that "the differences of view have involved matters of fact far less than inferences from facts as embodied in words."[2] In fact, he calls attention to the inferences *necessarily* involved in the use of such terms for cerebral processes. "We are in presence of a central process associated with centripetal and centrifugal processes, and we have no right to say that the centre is motor, or sensory, or both, otherwise than inferentially."[3]

Still another view of the relation of sensory and motor activities is presented by Külpe in his "Outlines of Psychology." His explanation of the rapid restoration of sensory functions in the cortex depends upon reference to physiological processes, while Mott's explanation depends upon the anatomical fact of the distribution of the fibres.

"All these phenomena (*i. e.*, of recovery of sensation and loss of movement) are evidence that the specific function of a nervous excitation is as a rule dependent upon its normal place of origin: the peripheral organ in the case of sensory nerves, the central in the case of motor. It would seem, therefore, that we may compare the unknown processes of the sensory centres with the known phenomena of the motor periphery, and attempt in this way to gain a more definite idea of their nature. We must then correlate a particular sensation . . . with the excitation of a larger or smaller cortical area, according to the range of the peripheral stimulation, . . . and lastly, we may designate the state of the nervous substance, in which the various cortical areas are capable of reproduction,—*functional disposition*. Just as the piano player uses hands and fingers for the most varied combinations of movements, so the same parts of the cortex may be concerned in very different forms of excitation."[4]

This brief review of the physiological basis for the distinction of sensory and motor centres indicates that the distinction is not by any means so definite as sensory and motor theories of attention have made it. Both on physiological and psychological grounds, it is more correct to speak of attention as sensori-motor than as sensory or motor. Even if, however, separate areas are assumed for sensations and movements, so that the two are anatomically distinguishable, it is universally admitted that they are as mutually *dependent* in physiological function as sensation and movement themselves are in psychological analysis. Attention *must be* sensori-motor: sensory in its contents, motor in its mani-

[1] *Op. cit.*, pp. 480, 469. A diagram accompanies the last passage cited, and makes clear the meaning of the somewhat obscure statement.

[2] *Op. cit.*, p. 346.

[3] P. 342.

[4] "Outlines of Psychology," tr. p. 223.

festations, sensori-motor in its whole process. In the acceptance of this opinion the sensori-motor controversy is ended so far as we are concerned. But we have still reached no explanation of attention, no true definition of it. We have a description of its phenomena—subjectively in sensations, objectively in movements,—and we refer both to one general, continuous, physiological process. But this process accompanies all consciousness, and sensation and movement are present in every phase of consciousness. We must look further for the peculiar physiological processes, and for the psychological conditions which are the basis of attention itself.

Chapter III.

The Explanatory Theories of Attention.

The theories of the preceding chapter have been referred to as "descriptive"; those of the present chapter we call "explanatory." We have alluded to many facts and observations of attention which we may classify together as the outward expressions of the attention. We have also passed in review the reasons for characterizing attention as a sensory, a motor, or a sensori-motor process. But we have not yet been told what attention *is*. The theories have been either too narrow, defining it in terms of its secondary phenomena, or else they have been too broad, characterizing it in terms that apply to consciousness in general. The present chapter, however, is devoted to theories that do ascribe a specific function to attention. We have the essential, constitutive elements distinguished from the secondary, attendant phenomena, and the relations between the two are carefully analyzed. We have, thus, a definition of what attention is, and an explanation of its contents in the sense of a reference of all contents to fundamental principles of psychology and physiology.

There have been three types of explanatory theories. Attention is regarded (1) as essentially a facilitation of ideas; (2) as an inhibition of ideas; and (3) as both facilitation and inhibition.

I. *Theories of attention as a facilitation of ideas.* G. E. Müller is often referred to as the chief representative of the first type (*e. g.*, by Külpe). From his statement of the thesis of his monograph "*Zur Theorie der sinnlichen Aufmerksamkeit*," we should expect to find him in the third class, with those holding a mixed theory of attention. His thesis maintains that "the capacity for acting on the mind which is possessed by certain physical processes in the central organ, may

be modified by the activity of the sensible attention; they may be increased or diminished, or wholly destroyed."[1] If we look only at Müller's discussion of the physiological changes involved in attention, we must admit that he investigates both sorts of modifications mentioned in his thesis, — the inhibitory as well as the facilitatory. Külpe's criticism that Müller fails to discuss the phenomenon of inhibition ignores such passages as that extending from page 105 to page 110, as well as minor references scattered through the work.[2] On the other hand Müller certainly lays far more stress on the reinforcing than on the inhibiting function of attention. In fact, when he is confining himself to the psychological analysis of attention, he does almost entirely ignore all changes except those which he describes as reinforcements of a sensation or idea. Hence, we shall concern ourselves here only with those parts of the theory which maintain that attention is a facilitatory process.

We may neglect Müller's presupposition of "a mind that absorbs a part of the energy with which a nerve acts upon it for the production of an equivalent of mental activity."[3] His statement of his observations and most of his conclusions can easily be translated into the terms of a psychophysical theory.

In the summary of his discussion of voluntary attention, Müller mentions three ways in which attention reinforces its object. "We have found that the activity of the voluntary sensible attention consists, in many instances, in the effort to reproduce earlier sensations; in other cases, it may be evident merely in impulses imparted to motor nerves, and resulting in the adaptation of a sense organ;" this adaptation, in turn, may react on the central organs, reinforcing the idea through associations.[4] We have, then, an adaptation of the sense organ to the stimulus, a facilitation of the excitation corresponding to the stimulus in the central nervous system, and correlated with these the recollection of similar ideas previously experienced.

The brief statement just given includes what is of greatest theoretical importance in Müller's discussion. The most valuable part of the work—the application of these principles to a very large number of concrete cases, — we cannot dwell upon here. Müller's examples include references to Helmholtz, Wundt, Volkmann, G. H. Meyer, Lotze, and many others hardly less noteworthy. But his conclusions

[1] "*Zur Theorie der sinnlichen Aufmerksamkeit*," Leipzig (1873), p. 1.
[2] *E. g.*, pp. 14, 67, 71.
[3] *Op. cit.*, p. 70.
[4] *Op. cit.*, p. 103. See also p. 48.

are not systematically worked out, and his presupposition of a "mind" acting upon a "sensorium" has prevented his recognition of certain problems in attention which are the natural outcome of his theory, *e. g.*, the question of our knowledge of the difference between increased intensity due to the stimulus and increased intensity due to the attention. Such problems will recur when we reach the discussion of the third type of the explanatory theories. Meanwhile we must examine the second type of theory, that which is directly opposed to Müller's, and which, both logically and chronologically, is the next in order for our investigation. The two chief representatives of the theory that attention is essentially inhibitory are Wundt and Külpe.

II. *Theories of attention as an inhibition of ideas. A: Wundt's theory.* Wundt analyzes the whole process of attention into the following subordinate processes:

"(1) Increase of the clearness of a definite idea or group of ideas, accompanied by the feeling which is characteristic of the whole process from the beginning; (2) Inhibition of other available impressions or memorial images; (3) Sensations of muscular strain, with the sense feelings which belong to them and which intensify the primary feeling; (4) Intensification of the sensory contents of the apperceived idea by these strain sensations through the medium of associative co-excitation. Only the first and second of these four part-processes are essential elements of every act of apperception. The third may be of very slight intensity, or even entirely wanting; the fourth is demonstrable only in cases where the third, of which it is a secondary consequence, attains a certain duration and intensity."[1]

In our attempt to summarize Wundt's theory of attention, we shall take up the constitutive factors (part-processes) in the order just given. It is not the order in which they are discussed in the section on *Aufmerksamkeit und Apperception*, but it is evidently the order of their importance according to Wundt's own estimate.

The first process is "an increase of clearness of an idea with an accompanying feeling of activity." Clearness is distinguished from intensity.

"Since the intensity of the sensations which make up an idea exercises an undoubted influence on its clearness, these two concepts are often confused. But in strictness we can attribute intensity only to the sensation-elements, not to the idea itself. . . . . The essential difference between the clearness of an idea and the intensity of its sensation-components is shown above all in the fact that an increase and decrease in clearness can occur without a simultaneous increase and decrease of sensation-intensity. . . . If a continuous stimulus is allowed to act on a sense organ, even under conditions which preclude fatigue of the organ, it is more or less impossible to apperceive it continuously with the same clear-

[1] *Phys. Psychologie*, IV*te Aufl.*, II, 274.

ness and distinctness. A constant change in clearness is noticed, and this change appears to the subject as a process which is different from any objective oscillation in the intensity of stimulus. . . . If clearness and intensity are so entirely different, then the concept of the stimulus-limen acquires a double significance. As limen of *intensity* it means a limen of *consciousness*, since the entrance into consciousness (perception) of an idea depends upon the intensity of its sensory contents. The limen of *clearness* is something different; it is a limen of *attention* or *apperception*. Only impressions which lie above the limen of intensity can transcend the limen of apperception. But, if this is to happen, the subjective function of attention must also be discharged. . . . . We have proved, then, that an impression may oftentimes become clearer without growing stronger, and vice versa, and that the two processes are subjectively distinct. Still, this does not prevent their exerting a certain influence on each other. . . . An intensive impression, provided that there are no special dispositions present to oppose it, is ordinarily apperceived more strongly than a weak impression. But undoubtedly certain influences may be exerted in the contrary direction as well; as . . . when one makes an effort to recollect or to imagine, and tries to keep his ideas in consciousness at the highest possible degree of intensity. . . . Many persons, it would seem, are successful in increasing the clearness of such images, but are absolutely unable to increase their intensity to any marked degree. . . . Increase of clearness always precedes increase of intensity, and the latter always takes place more slowly, and appears as the accompaniment of strong strain sensations,—the character of the muscular excitation naturally being in exact correspondence to the form of the apperceived idea. . . . It is extremely probable that the intensification of sensations is a *secondary* effect, which may be—but is not necessarily—produced by certain concomitant phenomena of attention."[1]

Wundt's statements of the distinction between clearness and intensity have been quoted at length not only because the distinction is of such importance to his own theory, but also because the relation of the two phenomena is one of the most vital questions in any complete theory of attention. We shall return to this point later. We have now to consider the first part-process from its second point of view, *viz.*, the feeling of activity which Wundt has associated with the increasing clearness of an idea.

It must be noticed that "feeling of activity" is frequently used as a general term, including the negative feeling of passivity as well as the positive feeling of activity; for Wundt has two classes of attention, the passive and the active, and if we use the *Thätigkeitsgefühl* as the characteristic feeling accompanying increased clearness of an idea, it must be remembered that the term also covers the feeling present in passive apperception. To simplify matters we shall consider the term in this section only in its restricted and more ordinary meaning.

[1] *Op. cit.*, II, pp. 271-274.

Wundt states that the feeling can not be analyzed or defined. This remark is constantly quoted by his critics. Some misunderstand Wundt so far as to maintain that he is introducing a metaphysical concept. Wundt himself, however, distinctly states that he is speaking of "empirical facts and not of any metaphysical conception."[1] Other critics, proceeding on the presupposition that sensations are the only elements of mind, object to Wundt's *Thätigkeitsgefühl* because it has no content; and, thus condemning his introduction of a "feeling of activity," assume that his whole theory has been demolished by such condemnation.

Criticism of this sort is crude and ill-considered. It is true that certain passages in Wundt's writings give some basis for it, but the discussion as a whole cannot be overturned by the demonstration of a few small inconsistencies. We are bound to admit that there are inconsistencies in Wundt's account of the "feeling of activity," but they have been exaggerated, and, moreover, the whole theory of attention has been made to depend upon the validity of this one factor. We hope to show that the "feeling of activity" is not essential for the logical coherence of the rest of the theory in general. But before we take up its relation to the discussion as a whole, we should notice carefully what Wundt himself has to say in defense of the much criticised *Thätigkeitsgefühl*. He first characterizes it as a feeling *preceding* the apperception or the increased clearness of an idea. "And we think of the ideas associated with this feeling as originated by ourselves. Other ideas are accompanied by the feeling of passivity. This latter feeling comes into existence *simultaneously* with its associated ideas, so that the idea seems to arise without any activity on our part."[2] But the feeling of activity does not merely precede, it may also persist, even when an idea has reached perfect clearness in consciousness. In this connection Wundt indicates that the feeling itself cannot take sole possession of consciousness. In the interval that he refers to as "preceding" that of the full clearness of an idea, the feeling accompanies the appearance of a series of memory images and their more or less complete fusion with the idea attended to.[3] "At the same time definite sensations take part in the process,"—the strain sensations of Fechner; and again he says of the *Thätigkeitsgefühl*, "As soon as we reflect upon it, it is referred by us to the whole disposition (*Anlage*) of consciousness ordinarily contained in the word 'I.' But if we analyze this reflection, the feeling is brought

[1] *Op. cit.*, II, p. 284.
[2] II, p. 266.
[3] II, p. 270.

into connection with definite, complex motives, *i. e.*, with complicated associations of ideas involving strong feelings. I find that all these feelings and motives are empirically given facts."[1]

To repeat a former statement,—it seems to us that there *is* some justice in the criticism of Wundt's account of the feeling of activity as confused. He describes the feeling as unanalyzable, and yet gives it a diversity of contents. This is partly due to the fact that at one time he is regarding it from a purely subjective point of view ; at another time, from an objective point of view, he sees its mechanism,—its physiological expression. Another reason for the confusion is due, in our opinion, to the indefiniteness of the whole system in its treatment of the feelings (*Gefühle*). After maintaining that there are only two affective qualities, pleasantness and unpleasantness, Wundt refers to several concrete, *unanalyzable*, feelings. The *Thätigkeitsgefühl* is such a feeling, accompanying apperception. But apperception is analyzed into conscious processes that every one must recognize, whatever name one may choose to give them. Wundt, in his last edition, does not maintain the existence of an activity of apperception as an immediate fact of consciousness, in any sense that excludes its analysis into changes in sensations or ideas with accompanying variations in their affective tone. The activity itself is an *inference* from the facts observed. "The phenomena of the connection of ideas in active attention cannot be accounted for by reference to the so-called laws of association alone, but the influence of more remote acquisitions and dispositions of consciousness makes itself felt here."[1] Later in the same passage Wundt refers to the apperceptive process as one in which "the whole past experience of consciousness influences the new impression."[2] And yet, elsewhere, he does maintain that apperception finds immediate expression in consciousness in one way—in the form of the "feeling" of activity, and this feeling is unanalyzable!

To understand what Wundt includes in the *Thätigkeitsgefühl*, why he makes it a factor in attention, and what its relative importance in the system is, we must digress for a moment, and refer briefly to his conception of the feelings in general. The digression is justified by the fact that even those who are in accord with Wundt's system as a whole often misapprehend his treatment of the "*Gefühle*" and the affective side of consciousness. It seems to us that Wundt

[1] II, p. 284.
[2] II, p. 284. See also "Human and Animal Psychology," tr., p.252.

regards the feelings from two points of view: that which considers the components or the sources of the feeling, and that which considers the very nature of the feeling itself. In many cases we are able to distinguish the components of a feeling, but the feeling itself is a *unitary* state. It is not the mere sum of its components, but their product or resultant,[1] and it is, therefore, in a sense unanalyzable and indefinable. But besides these qualitative distinctions in compound feelings, there are qualitative differences also in the most elementary feelings. Pleasantness and unpleasantness are the most common and extensive of the variations in quality, but Wundt does not hold them to be the only affective elements. "Both are qualitative states, and each may pass over into the other through a zero or indifference-point. Each of them may go through extremely different degrees of intensity or may be present in very many shades of qualitative difference."[2]

And after an account of the relation in many sense departments between the intensity of the stimulus and the feeling of pleasantness and unpleasantness, he adds that "in sensations of the two higher senses there are contrasting feelings analogous to pleasantness and unpleasantness, but not to be directly characterized by these terms."[3] Among the feelings which are connected with sensations of sound and light, every feeling has its opposite, as is the case with all classes of feelings, but the contrasting states cannot here, any more than in the case of the lower sensations, be characterized simply as pleasant or unpleasant.[4] Wundt accounts for this difference in the qualitative variety of the feelings accompanying sight and hearing by reference to "factors which have their source in the development of consciousness," due to inherited dispositions and to individual activity.[5] But this account of their origin does not make them any the less "elementary" in consciousness as we now know it.

The feelings can never exist alone. They must be con nected with a sensation or with an idea. As dependent upon ideas of sometimes very great complexity, the æsthetic, intellectual and moral feelings may be said to be complex, but as we have already noticed, Wundt emphasizes their unitary character and their absolute qualitative distinction from one another and from their component elements.

We have nothing to say here with regard to the truth or un-

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[1] "*Phys. Psych.*," II, p. 498.
[2] I, p. 555.
[3] II, p. 558. See also p. 561.
[4] I, p. 570.
[5] I, p. 590.

truth of the statements with which such a theory of "feeling" must stand or fall. They are matters of introspection and analysis quite outside of our province. We only wish to point out that feeling and emotion may be interpreted in very different ways without affecting Wundt's theories of the other phases and processes of consciousness. Wundt himself has given us an instance of one such change in his modification of the *Innervationsgefühl*. The *Thätigkeitsgefühl* could be interpreted in the same way — analyzed and defined, *e. g.*, in the way in which Külpe describes it,—and yet the rest of Wundt's theory of attention would be left undisturbed by the change. Indeed it seems to us that the whole discussion of apperception in the fourth edition of the "*Psychologie*" carries one on to a position where an "unanalyzable" feeling of activity has no place, and that Wundt himself has shown more clearly than anyone else that it is not necessary in order to explain the facts. It would have been, we think, more consistent with his own system, and more true to the facts, if he had recognized the "feeling of activity" as a feeling in the ordinary sense of the word—a concrete, complex phenomenon, including muscular sensations; the idea of activity, or of a self, reached by inference from the facts of consciousness; and, at the same time, the affective tone accompanying these sensations and ideas. Such a conception of the feeling of activity would complete the work Wundt has already carried so far, *i. e.*, an analysis of attention that shall combine the psychological data of the neo-Herbartian theorists and the physiological observations of the empiricists. On the one hand, Wundt records the psychological facts freed from any metaphysical implications; on the other hand, he proceeds on the assumption that physiological changes accompany all the conscious processes, and no theory is accepted unless it agrees with both series of facts so far as they are known.

The second factor in Wundt's account of the process of attention is that with which we are specially concerned in this chapter; attention is an inhibition of all impressions and memory-images except those attended to. This inhibition is the function of the frontal lobes—the so-called "apperception centre." The apperception centre is intricately connected with the other centres in the brain. An excitation passes from a sensory centre on to the apperception centre, and outwards along the motor path. The effect of the entrance of some particular excitation is the inhibition of the passage of all other excitations. In accordance with the law of the relativity of consciousness, the idea corresponding to the uninhibited excitation gains in clearness in proportion as it is freed from competition with other ideas. As the excitation

completes its course by the production of movements which are in harmony with the apperceived idea, these movements give rise to sensations akin to the idea. The motor adjustment causes "associative co-excitation," which may, and ordinarily does, intensify the original idea. Wundt describes this indirect reinforcement in the third and fourth divisions of his definition of the attention, and in that connection refers to it as a very frequent factor in attention, although not absolutely essential. If, however, such intensification of an idea is a secondary effect, we must ask whether there is any *direct* reinforcement of the sensory centre from the apperception centre. Wundt says:

"According to the general principles of central excitation, we could as well think here of an excitatory as of an inhibitory effect. . . . . But in view of the fact that increase of clearness, with which we are here concerned, is quite distinct from increase in the intensity of a sensation, the first of these suppositions has evidently little probability. In order to carry it out, we should have to conceive of the excitatory effect of these central processes as qualitatively different from other excitatory effects. This would contradict the principle of the uniformity of elementary functions, and it is also in opposition to the fact that the motor effects of the centre *A C* are just like other motor excitations. On the other hand there is nothing to oppose our regarding the effect of the apperceptive centre to be inhibitory. This inhibition, indeed, is not to be thought of as a *destruction* of certain excitations in sensory centres. It simply consists in the fact that in consequence of the excitatory effect of the signal stimulus, the entrance of other signal stimuli to the apperceptive centre is prevented. This fully harmonizes with our experience that the focus of attention narrows with its degree, and that, after repeated attention to certain ideas, the focus can extend so as to include more of these ideas."[1]

It is hardly necessary for us to state that Wundt is not maintaining the existence of an "organ" or "centre" of apperception in any form contradictory to the principles of localization presented in the first chapter. Wundt's account of the sense in which he uses such terms is so explicit that we need only refer to it without quotation.[2] He asserts nothing more than that the functioning of certain parts of the brain "is a necessary part of the physiological processes which accompany the intellectual functions."

It seems strange that after such an explanation of his position, Wundt should be accused by Münsterberg, Bastian and others of making attention a "faculty" and localizing this faculty in some part of the brain. Just as Wundt maintains that there is no "consciousness as such," but that there are "conscious states," or "conscious states and processes,"[3]

[1] *Op. cit.*, p. 276. See also p. 286.
[2] I, pp. 224-228, and II, p. 285.
[3] I, p. 226; II, p. 255; and "Lectures," pp. 236, 238.

so he would affirm that there is no "attention as such," but that there are "ideas attended to." And the changes in the ideas which constitute what we call "our attending," are accompanied by physiological processes; primarily, by processes in the frontal lobes; secondarily, by processes in other parts of the cortex, in the sense-organs, or in any part of the periphery. This is practically Wundt's position, and we do not see that it is touched by any criticisms directed against the localization of a faculty.

One difficulty, however, we do feel in an attempt to follow out Wundt's account of the action of the apperception centre. The description of the inhibitory action of the frontal lobes is very vague. A "signal-stimulus" enters, and all other stimuli are inhibited. How are we to conceive of this inhibition? "Inhibition" is itself an excitation, and some physiologists refuse to use the term except in referring to the action of certain excitations upon muscles. If, however, the term may properly be used in speaking of the interaction of excitations in the nerve-substance, there is still much obscurity to us in the application of the process in order to explain the facts of attention. Wundt and Külpe pass over the matter too lightly. They should recognize the difficulties still left in the way, and either answer them, or state that they are unanswerable in the present state of our knowledge.[1] In fairness, however, we must recall the fact that they do refer to their use of inhibitory processes as somewhat hypothetical. The difficulties that arise are not merely such as are due to ignorance. The nature and extent of inhibition are subjects of investigation among neurologists at the present time; and occasionally, as we shall see later, the inhibitory nature of the frontal lobes is denied.

Before leaving the topic, we take up two questions raised with reference to Wundt's theory in a recent treatise, "*Zur Theorie der Aufmerksamkeit*," by H. E. Kohn. The consideration of the two objections will clear away certain misapprehensions that might obscure Wundt's real meaning.

The first objection is a charge of inconsistency in Wundt's references to the action of the frontal lobes. Dr. Kohn cites passages in which Wundt speaks of the action as "*eine hemmende Wirkung*," and others in which he speaks of it as "*erregende*."[2] But the apparent inconsistency is due to the two uses of "*erregen*." It may be defined so as to include inhibition, or so as to stand in contrast with it,—either referring to excitation in general or to adjuvant excitations. With

[1] See below, p. 41 and note.
[2] "*Zur Theorie der Aufmerksamkeit*," 1895, pp. 42, 43.

this in mind there seem to us to be no contradictions in the passages quoted.

The other objection raised by Dr. Kohn maintains that Wundt's theory fails to account for any increased clearness in an idea. "The 'signal-stimulus' has only this effect, that the energy of the apperceptive centre released by it merely inhibits other 'signal-stimuli.' We do not see what the original stimulus gains from the signal-stimulus which calls it forth, and from the apperceptive process which it excites. If the stimulus reaches the sense centre, it experiences absolutely no change through the apperceptive process."[1] Wundt's answer to this would probably be that clearness and intensity are known relatively, not absolutely. If competitive stimuli are absent, the stimulus present is relatively clearer, and it is also the more likely to be intensified by the "secondary effects" already described. Külpe states the case rather more clearly than Wundt: "If we accredit attention with inhibitory functions only, the peripheral and central excitations and their relations, if they can secure free and unimpeded recognition in consciousness, produce all the phenomena which characterize the state of attention, of their own power and by their own laws; and the function of apperception consists simply in the suppression of competitive activities."[2]

We have discussed the first and second of the four part-processes which Wundt includes in attention. In the course of the discussion we have had to refer occasionally to the last two processes, since they are the source of the increase in intensity frequently accompanying attention, and since this intensification is the ground for the consideration of attention as a reinforcing process. Partly because they have been already referred to, and partly because they are recognized to be of more or less importance by every theory of attention, we need give no further consideration here to "the muscular strain sensations, with their attendant feelings," or to "the intensifying effect of these strain sensations on the sensory contents of the apperceived idea through associative co-excitation."

B: Külpe's theory. Külpe's theory of attention, in so far as the importance of inhibition is concerned, is much the same as Wundt's, but it discusses more fully the relation of attention to other processes, it emphasizes more distinctly certain factors, it rejects Wundt's first factor, and it recasts Wundt's material into quite a different form. We shall only

[1] *Op. cit.*, p. 42.
[2] "*Grundrisse der Psychologie*," 1894, § 76, 4; Eng. tr., p. 444.

consider these differences in so far as they may possibly offer some further explanation of attention.

The best "explanation" is often a well-ordered description of the facts in their observed relations. Hence, we consider first the order of Külpe's treatment. After defining attention as a *state of consciousness*, he describes its effects, the phenomena which accompany it, its conditions, and lastly the theory of attention, "the determination of the essential factors in attention itself."[1] The term "effects of attention" is applied to "the changes which conscious contents undergo in the attentive state."[2] These changes are an increase in sensitivity and sensible discrimination; greater liability and fidelity of reproduction; the disappearance of feelings when attended to as such; a greater ease in the analysis of fusions; the concentration of consciousness; the more rapid rate of perception or reaction.

The section on "the phenomena of attention" describes the phenomena regarded by Ribot as constitutive elements, but by Külpe as concomitants, characteristic, but not essential to attention. Some of these are changes in respiration and in other bodily movements, central and peripheral hyperæmia, centrally excited sensations, adaptation of the sense organs, and sensations of strain.

By "conditions of attention" Külpe means "the incentives which lead to the appearance of particular contents in the attentive state."[3] The conditions are divided into two classes, external and internal. The external include those motor and sensory changes which direct, or tend to direct, the attention upon certain impressions. The internal conditions are: the affective value of the impression, and the relation of the impression to the psychophysical disposition; including (α) the associative relations of the impression to the ideas already in consciousness, (β) its relations to the materials of reproduction, and (γ) the relative vacancy of consciousness.

The last section, on the "theory of the attention," is "a determination of the essential factors in attention itself." A large part of the section is negative, presenting a refutation of three views of attention: that which regards it as nothing else than an increased intensity of sensation; that which maintains that attention is "an emotive state translated into terms of motor energy" (Ribot), and that which explains attention in purely psychological terms. As the criticism of this last view leads up to Külpe's own theory, we must spend a little time upon it.

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[1] *Op. cit.*, § 76, 1.
[2] § 73, 1.
[3] *Op. cit.*, § 75, 1; tr., p. 437.

"An explanation of the attention in purely psychological terms, such as has been attempted, *e. g.*, by Herbart, obliges its adherents to ascribe a determining influence to the unconscious as a psychical process, if not to make it the one primal force in mind. For there can be no doubt that the most essential conditions of the origin and maintenance of attention must be sought outside of consciousness. The evidence on this point is overwhelming. The force of attention is wholly unintelligible on any other hypothesis; it is a frequent experience that the incentive to the preference of a content by apperception does not come to consciousness; and individual variation of the capacity of attention in normal subjects, as well as the differences observed in pathological cases, put the assumption of definite physiological conditions of a central character beyond the range of question."[1]

In accordance with the opinion just quoted, that the most essential conditions of attention must be sought outside of consciousness, Külpe maintains that the essential function of attention is to inhibit. Neither the mechanism of inhibition nor the inhibitory process, however, is conscious.

Our chief objection to Külpe's treatment of the attention is his inconsistency in defining attention as "a state of consciousness," and yet refusing to recognize any factor as *essential* except the unconscious, purely physiological process of inhibition. Every psychophysical theory involves some physiological correlate, but that this process *constitutes* attention, and that all the psychological phenomena are secondary, we deny. Külpe, however, does not arrive at his conclusions without consideration of the psychological changes that have been regarded by others as essential factors of attention, and before any elaboration of our objections to his position, we shall quote from his own argument against theories of the psychological type, selecting, above all, those passages which criticise Wundt's opinion that increased clearness of an idea is an essential.

"Introspection discovers nothing really new in attention, nothing which is characteristic of the process as such. . . . When we find the increased clearness of a perception or the increased vividness of a sensation or conscious concentration upon one or two definite ideas, interpreted as functions of attention, we must reply that while all these changes appear in the attentive state, they are always changes in the conscious contents, and cannot be conceived of as separated from them. It is, therefore, altogether impossible to add all these changes together and account them a specific process, and to give this process the name of attention in contradistinction to the particular contents; for every item in the sum proves to be . . . . nothing more than a purely quantitative process, which may be set up in consciousness by other means than that of attention. The reader may incline to find a possible exception to this in the clearness of the quality, difference, etc., in the state of attention. For clearness or distinctness is certainly not identical with the intensity of an impression. . . . Now distinct-

[1] *Op. cit.*, § 75, 3; tr., p. 443.

ness is partly referable to conditions in the sense organ. . . . . But, this apart, we mean by the term simply the relatively most favorable apprehension of an impression, as expressed in a relative maximum (α) of its discriminability from other contents, and (β) of the liability of reproduction of its attributes. It follows, of course, that clearness or distinctness is not a new character, which can be detached from the particular contents to which it is ascribed, and constituted the predominant factor in attention."[1]

There are two lines of thought here. With one of them we entirely agree; *i. e.*, with all that Külpe has to say of attentive changes as "purely quantitative," introducing nothing that can be "conceived of as separated from the conscious contents," or considered "in contradistinction to them." We agree also with his analysis of clearness. But it does not follow that clearness cannot constitute the predominant factor in attention; nor is it true, in our opinion, that clearness can be "set up in consciousness by other means than that of attention." Külpe is ignoring here the facts of "passive attention." All that he says in this passage only goes to show that attention is a relative state, and is always present in some degree in our conscious life. Even in that dim region which Wundt refers to as lying above the "limen of perception" and below the "limen of apperception," it does not seem to us that clearness, distinctness, attention, or, in other words, apperception itself, is wholly absent. There is a difference in degree, which appears to be a difference in kind when considered in its relations to memory, language, or practical and experimental uses. But when we consider conscious facts apart from such relations, we cannot see that there is any absolute separation in consciousness of consciousness as such, and attentive or distinct consciousness.

Our own modification, then, of Külpe's theory would be the elimination of the increased clearness of a perception, in its two-fold definition quoted above, from the section on the "effects of attention," and its introduction into the section on the theory of the attention as a constitutive factor of the state. The question as to whether the essential physiological factor is inhibition must still be left open, at least until the evidence in favor of other theories has been more carefully considered.

III. *Theories of attention as combined facilitation and inhibition.* We have reviewed the theories which attempt to explain attention as a central reinforcement, and central inhibition of ideas. We now turn to a theory which holds that neither of these alone gives an adequate explanation of the facts, and maintains that attention must be both a reinforcement and

[1] *Op. cit.*, § 72, 2; tr., pp. 424, 425.

an inhibition. The chief exponent of this theory is Exner. He enters into the subject from a physiological standpoint, with an intimate knowledge of the nervous system and its processes. It is impossible to do justice here to Exner's construction of a physiological basis for his theory of attention. We have quoted in our introductory chapter the evidence he adduces in favor of the new concept of *Bahnung*. But his systematic application of this and of more familiar concepts cannot be properly valued without a careful review of the work as a whole. Obscurities in our summary of his theory will be removed, we think, by reference to the chapters preceding that on attention, in which Exner describes and schematizes the nerve processes correlative to the more elementary processes of conscious and unconscious movement. We, however, can attempt to present here only those portions which stand in immediate connection with the explanation of the peculiar and distinguishing characteristics of attention itself.

Of all the sections preceding the chapter on attention, that which deals with reaction times (pp. 156-162) seems to us to stand in closest connection to the subsequent definition of attention, and as a preliminary to the citation of that definition, we quote the author's explanation of the motor type of reaction.

"There can scarcely be a doubt that this form of a typically voluntary movement is to be referred to the fact that the intention (*Willensintention*) to execute a definite movement as quickly as possible upon the appearance of an expected sense stimulus, depends upon a change which the cortical processes bring about in the relations affecting the excitability of sub-cortical centres. . . . The reader will at once recognize the similarity between the relations here described and those already mentioned in the account of *Bahnung* [quoted in our first chapter] and of the regulation of voluntary movement by ideas [pp. 151-154]. In fact it was through the investigation of reaction times that I was led to believe in the existence of the phenomena which I have described above under the name of phenomena of "facilitation," and for which I later found proof in experiments on animals."[1]

If we bear in mind, then, that voluntary action is to be thought of as "a change which cortical processes bring about in the relations affecting the excitability of sub-cortical centres," and that this change is referred to as either a facilitation or an inhibition, or both, we have the two most important ideas involved in the definition and explanation of attention. Exner states the definition in these terms:

[1] "*Entwurf zu einer Phys. Erklärung der Psychischen Erscheinungen.*' p. 158.

"We have shown that an act of will can bring about changes in our nervous system, the effect of which is that an excitation now follows a path *A*, and now, when a different change has been voluntarily set up in place of the former, takes the path *B*. The changes thus set up have the character of states. I see in this interaction of different parts of the nervous system the essence of what we ordinarily call attention."[1]

Exner's schemata are so serviceable in the course of his explanations that we reproduce here the "schema for the demonstration of the effect produced by the direction of the attention to sense-impressions." And we quote from the context the passages that give the substance of Exner's explanation and application of the schema.

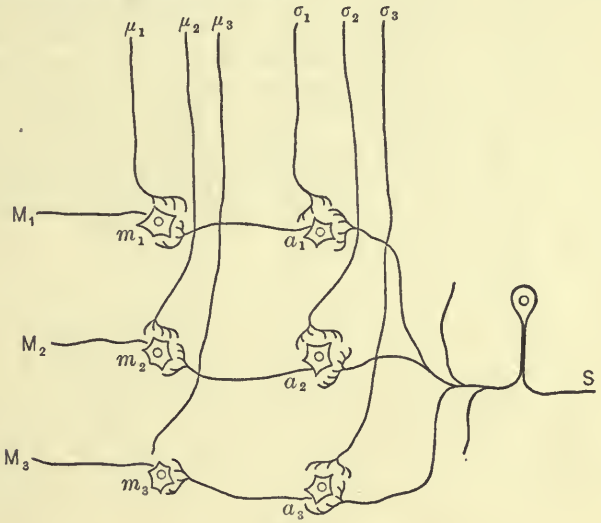

Fig. 48.

"If we apply the diagram to the case of the motor form of reaction when only the group of muscles represented by M_1 is to contract, then we must think of the cell m_1 as being charged through μ_1; and perhaps also the cell a_1 is charged through σ_1. Then when the stimulus enters through *S* it will pass through a_1 and m_1 to M_1. In this instance the paths facilitated lie in the sub-cortical centres. Similar changes can take place in the cortex, as we shall see later."[2]

"But attention can also be applied to the stimulus entering through *S* without being connected with a tendency to movement, as when, for example, some particular part of an object interests us. The physiological state of attention then consists in a charging of the *a*-cells through the *a*-fibres. [These *a*-fibres will carry excitations both to and from the cortex: *e. g.*, pp. 153, 155 and 164.] A feeble excitation by way of *S* will then bring these cells to the point of

[1] *Op. cit.*, p. 163.
[2] P. 163 (paraphrase).

discharge; and if the charging is still kept up through the *a*-fibres, the *a*-cells will remain in continuous excitation until they, or the central terminations of the *a*-fibres, or both, are exhausted, — in which case we speak of fatigued attention."[1]

"But although attention *may* thus be exclusively sensory, 'it will probably be found, in accordance with the diagram, that there must be a *tendency* to movement in sensible attention, since the *m*-cells receive stronger impulses than when the *a*-cells are not charged; impulses which are stronger before as well as at the time of the entrance of the sensation. . . . Introspection shows that at least those muscles whose region of innervation is nearly related to the sensory region concerned can scarcely be kept at rest if the attention is directed to the corresponding sensations.' "[2]

Examining the physiological phenomena of attention more closely, we find that "whether the attention is turned to sense-impressions or movements or memorial images, it always causes certain paths of the nervous system to become specially practicable *(fahrbar)*, and to remain in this state a longer or shorter time; and, furthermore, reduces the conductive power of a great number of other paths. The more intensive the attention, the lower is the excitability of these other paths. . . . I will designate this total state of the system by the term *Attention* [not *Aufmerksamkeit*], and accordingly speak of attentional inhibition and attentional facilitation. The dividing line between them may have to be drawn at very different points in different sense departments if we choose to venture on comparisons of department with department, and will certainly vary from case to case with the disposition of the whole nervous system."[3]

Exner's definition of attentional inhibition is rather perplexing. He says, "By the term attentional inhibition, I mean a state of the centres somewhat like that which prevails in a reflex organ or in a centre subserving instinctive movements,—a centre which is stimulated to action by an adequate stimulus but prevented from acting by the will. I mean, *i. e.*, an increased tonus of the cells, in spite of which discharge is obstructed. And this region of simultaneous facilitation and inhibition may be variable."[4] Since Exner's concept of the will is a thoroughly psychophysical one, the statement quoted cannot mean what on the surface it seems to mean. The passage must be interpreted in the light of his general treatment. The last sentence of the quotation shows that here, as elsewhere, attentional inhibition and facilitation are being considered together as coöperative and complementary processes. To make the passage at all intelligible or consistent, we have to paraphrase it in the following fashion. If we attend to an object there may be a rise in the tonus of a region *a*. This region may now be compared to that connected with a reflex organ in which there is a permanent "facilita-

[1] P. 164.
[2] P. 164.
[3] Pp. 165, 166.
[4] P. 166.

tion" of discharge in certain directions. In both cases there is a tendency to discharge, but actual discharge will be prevented if there is at the same time an attentional facilitation of some other region. Exner might also refer here to his account of the inhibition of *motor* phenomena in the passage already quoted from pp. 163 and 164. But apparently he thinks of that as so exceptional that after once stating its possibility, he makes no further use of it. And with this exception he always refers to attentional inhibition as attendant upon and simultaneous with attentional facilitation.[1]

The most important point with regard to attentional facilitation is the relation of attention to the intensity of a sensation. As Exner says, "From the preceding explanation we might expect the intensity of a sensation to increase as the attention was more fully directed upon it. As a matter of fact, if the cell σ_1 (Fig. 48) is charged, and at the same time receives impulses through the fibre σ_1, the retroactive excitations must be greater than if σ_1 had carried no impulses to a_1. In other words, the intensity of the intercellular tetanus (see chapter II, p. 94) depends upon each of the coöperating factors."[2] We recall at once the conclusive objections against the consideration of attention as nothing else than an increased intensity of sensation so concisely stated by Külpe.[3] But Exner's further development of his theory shows that it is not touched by the objections stated by Külpe. For although he holds that attention does increase the intensity of a sensation, he also maintains that there is a recognizable difference in consciousness between the enhancement due to increase of stimulus and that which results from increase of attention. Another diagram will give his idea more exactly.

The accompanying statement is as follows:

"Nevertheless, the excitations which reach the organ of consciousness will be different according as the external stimulus, or the attention, is increased. And if they are different, the two cases will be distinguished in consciousness. Let a represent a cell through which impulses of attentional facilitation, following the path C_1, flow from the organ of consciousness toward s; and let there be, running from s to the cortex, the other path, C_3, which has occurred so often in our previous figures. There will then be an intercellular tetanus established between a and s. The impulses given off from a may be diffused along several paths; we are ourselves concerned with the further path C_2, which may also give occasion to a conscious sensation.

[1] Notice that this statement holds only with regard to *attentional* inhibition. It does not refer, of course, to the purely physiological inhibitions described in Exner's second chapter, pp. 71-76.

[2] P. 168.

[3] "Outlines of Psychology," § 76, 1; tr., p. 441.

"Now when we consider the diffusion experienced by every excitation that penetrates the gray matter, due to the ramification of its paths, we cannot doubt that conscious processes may be aroused by the stimulation of S by way of C_3 as well as by way of C_2, and probably also by way of C_1. There is just as little doubt that in case of simultaneous facilitation by way of C_1 . . . the relation between the impulses flowing into the organ of consciousness by way of C_2 and C_3 is altered. There are at least no reasons for assuming that the relation remains the same, while there are many for supposing that it undergoes a change (cf. p. 58).

"In other words, if C_3 conducts an excitation of a certain intensity to the cortex, and at the same time C_2 conducts one of much less intensity, we have *one* total impression. If C_3 conducts an excitation of the same intensity as in the first instance, and C_2 another of greater intensity, then we have *another* total impression. These two impressions must therefore be distinguishable in consciousness, just as according to the modern theories of color-vision the impression of red-orange is distinguishable from the impression of yellow-orange owing to the relatively unequal excitation of the same kinds of fibres."[1]

Exner gives two illustrations to show how this theory explains the facts "in the domains of sensitivity and motility." The first instance is an application of the schema to the fact that we have a sensation of blackness when there is no excitation of the retinal elements. The second instance is an explanation of the apparent movements of objects when the motor apparatus is rendered incapable of functioning.[2]

Exner further limits the influence of attention to processes accompanied by consciousness. Sense impressions have,

[1] Pp. 168, 169.
[2] Pp. 169, 170.

therefore, been "worked over" once at least before they can be modified by attention.[1] This is one reason for the high degree of accuracy of mere "impressions," or of judgments with regard to sensations inattentively experienced.

To conclude our summary, we may quote the closing paragraphs of the chapter on attention:

"I must not omit to emphasize the fact that I do not assume the processes of attentional facilitation here described merely for cases where the attention is intensively directed upon its object. I believe, on the contrary, that no central function ever wholly disappears; that a certain degree of excitation (which I have repeatedly referred to, in contradistinction to intercellular tetanus, as the tonus of the cells) is always present; that the degrees of this tonus vary; that its magnitude is primarily dependent on excitations that run their courses along related paths; that in connection with these, phenomena of inhibition and facilitation may appear, etc. . . . . But the more intensively the attention is applied to one complex of paths, the more it is withdrawn from the rest."[2]

We pass now to a consideration of the comparative validity of Exner's theory of attention. We recognize that in any attempt to evaluate theories representing the life work of men who are recognized as authorities, we are treading on dangerous ground. Any judgment must be a merely tentative one;—indeed it can hardly be called a judgment, — it is rather an investigation of the ground of the differences in the theories and a statement of the alternatives offered in the acceptance of the one or the other.

It is evident that the fundamental concept in Exner's theory is that of coördinated facilitation and inhibition, and of these two processes we are concerned only with the member which other theories of the day reject—facilitation. Exner treats of facilitation first as a purely physiological process, and secondly as a process involved in attending. What he had to say under the first rubric we have quoted in our first chapter. We suspended comment there in order to review the theory as a whole before criticising any part of it. As we return to it now, the account of the various experiments on animals seems to us to be an account of facts known before presented here under a new name. Certainly we knew that there was interaction between nuclei connected with groups of muscles assuming a single function, or closely related functions. But these nuclei are in close anatomical connection. If *Bahnung* means simply that nerve currents in the same organ, or in organs with close and definite anatomical connections, can reinforce each other, then it is no new concept. We think the whole subject would have been clearer if Exner had stated

[1] Pp. 166, 167.
[2] P. 171.

this himself, and then given his reasons for emphasizing and further illustrating by experiments of his own facilitatory interaction of certain nuclei of the nervous system. It seems to us that he emphasizes the experimental proof of this interaction in the nervous system of animals because he wishes to extend the concept further to cases where there is no direct, intimate anatomical connection, and the facilitating process is accompanied by consciousness. To this extension of the concept he gives the name of "attentional facilitation," our second subordinate topic. Having accepted the first, the purely physiological concept of *Bahnung*, what have we to say to this extension of it to activities accompanied by consciousness?

In the first place we must recognize that facilitation in attention is as yet only an hypothesis. Exner would doubtless admit this, for he refers occasionally to the hypothetical nature of his explanations (*e. g.*, p. 87). At the same time he maintains that the hypotheses advanced are those which are in closest correspondence with our knowledge of the physiology of the nervous system. From this standpoint there are many facts to render probable the hypothesis of attentional facilitation. (1) All nervous impulses are recognized from the outset to be both excitatory and inhibitory.[1] (2) No more intimate connection of the cortex with other parts of the nervous system needs be supposed for combined facilitation and inhibition than for inhibition alone. (3) The brain centres certainly "work over" incoming currents in some fashion, and there is no reason apparently *against* the assumption that their energy may reinforce that of the incoming current, while Exner shows that there are many reasons *for* the supposition. (4) Moreover, in many cases where two organs function together, the limen of their common discharge is lower than the limen of either alone, when the two are separated. In these cases "facilitation" may mean either the lowering of the limen of discharge or the reinforcement of a nerve current. For these reasons among others, the concept of *Bahnung* is valid from the physiological standpoint.

The crucial point in the psychological application of *Bahnung* is found in Exner's assertion that attention increases the intensity of a sensation, but that increase of intensity due to attention is recognized as different from increase of intensity due to the stimulus. Wundt and Külpe also recognize, as indeed every one must, that the intensity of a sensation ordinarily increases in attention, but they ascribe the increase to "associative co-excitation." They deny that attention di-

[1] *E. g.*, Wundt, "*Phys. Psych.*," I, pp. 252, 258.

rectly intensifies a sensation. Exner admits the existence of associative co-excitations, but ranks them as secondary phenomena, and finds them insufficient to account for the facts of attention. When psychology has obtained better experimental control of attention, test-experiments may be devised to decide between the theories of Wundt and Exner. At present, we can make no absolute decision. If we accept the theory of Wundt and Külpe that attention is purely inhibitory, we must explain the increased clearness and efficiency of an idea primarily by the law of the relativity of consciousness, and secondarily by associative co-excitation. At the same time we have no satisfactory schema for the process of inhibition itself.[1] If we accept the theory of Exner that attention is both inhibitory and facilitatory, we explain the increased clearness and efficiency of an idea by correlating them with the facilitatory processes, while at the same time the absence of unrelated ideas is ascribed to coöperative inhibitions; we maintain that attention intensifies sensations, but that intensification due to attention is recognizably different from intensification due to increased stimulus. Both theories must acknowledge that attention does actually reinforce some ideas while it inhibits others. Any instance of close attention in daily life is a picture of the two processes combined. But Exner regards the reinforcement or facilitation as equally fundamental with the inhibition; or rather, throughout his discussion he refers to facilitation as the more fundamental process, preceding or occasioning an inhibition of unrelated regions. Wundt and Külpe reverse the order of the two processes, and, moreover, deny that there is any direct facilitation by central processes; all reinforcement must come by way of associative co-excitation. Neither side has final and completely satisfactory proof for its position; and until we know more of the physiology of the central nervous system, the question whether attention is primarily facilitation or inhibition must be left open.

The conclusions reached by Bianchi, in his recent study of "The

[1] We notice a similar criticism of Külpe's treatment of inhibition is made by Meumann in *L'Année Psychologique*, 1894, p. 514. He says: "I cannot share the opinion of the author that inhibition may be regarded as an independent process. We can think of the inhibition of physical or psychical processes only as the *negative* side of another process. We can only suppose that the energy of one part of the brain is lessened because some other part is expending a surplus of energy. Inhibition, then, does not explain the clearness of a sensation, but just the reverse is true: we interpret the appearance of inhibition in one part of the nervous system as a consequence of the expenditure of too great energy in another part."

Functions of the Frontal Lobes,"[1] must be taken account of in any attempt to explain attention by means of inhibitory or facilitatory processes in the frontal lobes. Bianchi's experiments were performed upon twelve monkeys and six dogs. All the operations were successful except two, and the animals were kept under observation for months or even years. The skill and care with which the whole work was performed cannot be called in question. For his conclusions, Bianchi makes no greater claim than that they give "a plausible explanation of the phenomena observed. . . . . I feel, at any rate, certain of the accuracy of the observations themselves."[2] On the basis of these observations he states very positively that "the frontal lobes are not centres of inhibition. . . . Without attempting to go fully into the theories concerning inhibition and its centres, it will be granted that inhibition depends upon a general psycho-physiological process, and that every part of the nervous system becomes, under different circumstances, either an inhibitory or an inhibited centre. . . . Physiology and psychology swarm with facts showing the error of those who assume a special cortical centre for inhibition."[3]

One statement in this connection we must object to. "We may ask ourselves whether there exists really any centre the function of which is to inhibit, hence whether there exists a faculty of attention. I reply distinctly, No."[4] The "hence" in this sentence is obviously a *non sequitur*.

Bianchi's own "hypothesis is that the frontal lobes are the seat of the coördination and fusion of the incoming and outgoing products of the several sensory and motor areas of the cortex. . . . The frontal lobes would thus sum up into series the products of the sensori-motor regions as well as the emotive states which accompany all the perceptions, the fusion of which constitutes what has been called the *psychical tone* of the individual. . . . With the organ for the physiological fusion which forms the basis of association, disappear also the physical conditions underlying reminiscence, judgment and discrimination, as is well shown in mutilated animals."[5]

Bianchi's general description of the rank and influence of the frontal lobes agrees with that given by Wundt, but their characteristic physiological process is said to be one of coördination and fusion instead of a process of inhibition. This tallies with Exner's definition of *Bahnung*, and it seems at first sight to add much to the probability of Exner's theory. The inhibitory theorists, however, would doubtless maintain that Bianchi misinterprets their concept of inhibition. They could agree with him in regarding the frontal lobes as necessary for the fusion of impressions, and yet explain the relation between the two by assuming that the fusion of certain impressions is possible only when there is inhibition of all other impressions. It must also be remembered that Bianchi's experiments were made upon animals that had already had the use of their frontal lobes for some time. Many of the phenomena that persisted after their removal must have been at some earlier time dependent upon the functioning of the frontal lobes, so that conclusions must be drawn very carefully. Yet, after all due allowance

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[1] *Brain*, Part LXXII, 1895, pp. 497-522.
[2] Pp. 519, 522.
[3] Pp. 520, 521.
[4] P. 520.
[5] Pp. 521, 522.

has been made for these two objections to Bianchi's summary disposal of the inhibitory function of the frontal lobes, it still seems to us that his observations tend to overthrow the theory of the purely inhibitory character of these functions. The animals operated upon performed all simple acts in a wholly normal way. With regard to higher functions, they were passive, and unresponsive to stimuli that formerly had excited their higher activities. It is hard to see how such results can be fully explained on the hypothesis that the *sole* function of the frontal lobes is inhibition.

Our restriction of the term "explanatory" to the three types of theory discussed in this chapter leaves us open to the criticism of those who maintain that attention is primarily the direct result of variations in peripheral organs. In answer to the criticism we would say: (1) that the only completed theories of this order are those of Ribot (in so far as he considers attention as essentially motor) and Münsterberg. These have already been reviewed in the preceding chapter; and although each has made positive contributions to our knowledge of the phenomena of attention, it is evident that neither goes far enough to be called an explanation. A third attempt is being made by Dr. Heinrich of Zürich, but at the date of our writing only the first chapter of his work has been published.[1] Moreover, references in an earlier work show that Dr. Heinrich admits the probability of the dependence of attention upon central factors. ("*Die moderne physiologische Psychologie*," pp. 129 and 232.)

Chapter IV.

Attention and Distraction: An experimental investigation of the effect of so-called distractions on sensible discrimination.

In the preceding review of the current theories of attention frequent reference has been made to the relation between changes in attention and changes in the intensity of a sensation. At one time attention was frequently taken to be the same thing as an increased intensity.[2] Later it was maintained that attention only *indirectly* heightened the intensity of sensations.[3] Others, again, have regarded the intensification as an essential part of the process of attention, but not the whole process; and, moreover, the intensification due to attention is said to be recognizably different from that due to increase in the intensity of the stimulus.[4] Still a fourth

[1] Ebbinghaus' *Zeitschrift für Psychologie und Physiologie der Sinnesorgane, Bd.* IX, *Heft* 5 *u.* 6, *S.* 342-389.
[2] James Mill, etc.
[3] Wundt, Külpe, etc.
[4] Exner.

opinion holds that attention has an opposite effect, and that "all stimuli appear relatively less when the attention is directed to them from the outset." This view has been advanced by Prof. Münsterberg as the outcome of a series of experiments made in the Harvard laboratory and published in the *Psychological Review*, Vol. I, January, 1894, pp. 39-44. Prof. Münsterberg speaks of his conclusion as "an unexpected result." It seemed to us not only an "unexpected," but also an unexplained result. The published account raised many most important questions, to which it gave no answer. The conclusions drawn by the author could not be accepted on the evidence given. There seemed to be a good opportunity for other interpretations of the numerical results. But no one would be competent to judge between different possible interpretations without repeating the experiments. Since the question was one of great significance for any theory of attention, it clearly demanded further investigation. And it was evident that the first step in our investigation must be a critical examination of Prof. Münsterberg's results, on the basis of a careful analysis of the same and similar experiments. Should our results coincide with his, we should then be in a position to decide independently whether they confirmed his conclusions or seemed to be more reasonably explained through factors not noticed in the original experiments. And if our results should materially differ from those obtained by Prof. Münsterberg, this fact would only emphasize the need of a more careful and complete analysis of the factors included in the experiments.

We may here anticipate our account of our results far enough to state that the greatest value of the experiments seemed to us to lie in their bearing upon a problem not mentioned by Prof. Münsterberg,—the problem of the nature and degree of the distraction employed in order to secure inattention. No one can answer the question of the intensifying effect of attention, on the basis of these experiments, until he has first secured some reliable source of distraction, or some method of measuring the degree of distraction obtained. We think that these particular experiments have no conclusive answer to give to the problem of "the intensifying effect of attention"; but as material for the analysis of so-called "distraction" they have been valuable and suggestive. Accordingly our criticisms and conclusions have been grouped together under the heading of this chapter, "Attention and Distraction."

We shall give (1) a brief account of our own experiments, (2) a comparison of these results with Prof. Münsterberg's, together with a statement of our criticisms and conclusions,

and (3) a discussion of the sources of error discovered, and of the precautions suggested by our study of these errors.

I. *Account of our own experiments.*

In general, Prof. Münsterberg's directions were followed out. The one important exception was a difference in the relative intensities of stimulus used. It seemed to us that the difference judged should be somewhere near the limen of differences; for the object of the experiments was the discovery of a tendency to overestimate or underestimate stimuli under certain conditions, and unless the differences given are comparatively near the limen of difference, the tendency, though it may be present, may give no evidence of its presence in the judgment. We found that in the series with weights, distances and light stimuli, the larger differences used by Prof. Münsterberg were correctly judged by our subjects with such ease and certainty, both when their attention was free and when it was distracted, that these differences were eliminated from the series. The change would inevitably have made any tendency to overestimate or underestimate stimuli more clearly evident in our numerical results than in Prof. Münsterberg's, had any such tendency been present.

Minor variations in the experiments, such as slight changes in the intervals of time or in the manipulation of the apparatus, will be mentioned in connection with the special series in which they occurred. The general directions for the experiments we give in Prof. Münsterberg's words:

"Our problem was to arrange the experiments in such a manner that the intensities of two impressions of moderate strength could be compared, and at the same time the attention be directed toward one and away from the other. In this way we examined intensities produced by light, sound, and the lifting of weights, and also the distances between visible points, the distances serving as measures for the intensity of the sensations produced by the movement of the eyes. The method always employed for diverting the attention was as follows: The subject was directed to give his attention fully to the adding of numbers, which in the case of optical impressions were read to him, and in the case of the auditory impressions were read by him. The adding took place before and during the time the stimulus was present. Since the order of the stimuli to be compared is of great influence upon the judgment, two sorts of experiment were arranged for each series. In one case, the attention was directed to the first stimulus, while the second was perceived with diverted attention; and in the other case, the attention was directed to the second stimulus, while the first was perceived with diverted attention. In order to discover from these series the influence of the attention, independently of other conditions, both series must be compared with the results of experiments in which the attention was either directed to both stimuli, or turned away from both. If we designate attention to the first stimulus by A, and that to the second by A^1, and, correspondingly, the inatten-

tion by I, I^1, we have then for each sense and for the same magnitude experiments with A-A^1, A-I^1, I-A^1, and I-I^1."[1]

We have, then, four sets of results: (1) for visual distances, (2) for light, (3) for weights, and (4) for sounds.

Visual Distances. "The optical distances were given by an apparatus consisting of a black cloth surface, 80 cm. square, upon which were two white points. The vertical distance between these points could be changed by a screw upon the back of the screen and the exact distance moved could be accurately read."[2] The subject opened his eyes at a signal; looked at the points for 3 sec.; at a second signal closed his eyes for 5 sec., while the distance between the points was being changed; at a third signal opened his eyes again, and looked at the points for 3 sec. In every instance a distance of 30 cm. was compared with 28.5, 29, 29.5, 30, 30.5, 31, or 31.5 cm. In half of the experiments it preceded the other member, and in half followed it. It was most frequently compared with 29 and 31 cm., and least frequently with 28.5 and 31.5 cm. The series were not precisely the same for the different subjects in any one of the four groups of experiments, since their ability to discriminate varied considerably; but the same series were used for each subject under all four sets of conditions. We had four subjects and made 400 experiments with each. The following table gives the numerical results:

TABLE I.—*Visual Distances.*[3]

SUBJECT.	A-A^1.				A-I^1.				I-A^1.				I-I^1.			
	Second stimulus correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.
P.	63	29	8	21	69	26	5	21	79	12	9	3	67	20	13	7
W.	66	27	7	20	62	28	10	18	67	24	9	15	73	31	7	16
R.	66	16	17	–1	58	27	15	12	66	17	16	1	76	11	12	–1
M.	66	23	11	12	71	19	10	9	66	24	10	14	68	16	16	0

[1] "The Intensifying Effect of Attention," *Psych. Rev.*, I, pp. 39, 40.
[2] P. 40.
[3] The results in all our tables are given in percentages of the whole number of experiments in each separate series.

We postpone the discussion of these numerical results until we have given the results of the experiments with the other stimuli.

Light. For the light stimuli two rotating disks were used with variable black and white sectors. The time intervals given were the same as in the preceding group. The darkest gray was produced by a black disk with a white sector of 65°, the lightest by a disk with a white sector of 115°. In each instance the subject was given differences of 5°-15° to judge, and care was taken that the number of cases in which the second disk was lighter should equal those in which it was darker. We have results from four subjects, and from 320 experiments given to each subject.

TABLE II.—*Light Stimuli.*

SUBJECT.	*A-A*¹.				*A-I*¹.				*I-A*¹.				*I-I*¹.			
	Second stimulus correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.
P.	80	12	8	4	70	11	19	−8	81	9	10	1	75	13	11	2
W.	73	19	8	11	66	11	23	−12	69	17	14	3	75	15	10	5
R.	75	12	13	−1	85	10	15	−5	88	4	8	−4	74	13	13	0
H.	74	13	13	0	80	8	12	−4	78	22	0	22	75	17	8	9

Weights. "The weight was given by lifting a funnel-shaped vessel, held between the thumb and first finger. The elbow rested upon the table, and the weight was raised without movement of the wrist. Weights were put into the funnel in such a way that they could be easily changed."[1] The funnel was lowered into the hand, steadily lifted and lowered, and after 5 sec. lifted and lowered again, but with the weight changed. A weight of 300 gm., including of course the weight of the funnel, was compared with an equal weight and with weights 10, 20 and 30 gms. heavier and lighter. With one subject, *V.*, differences of 50 gms. were used. Five subjects tried the experiments with weights. Each gave 400 judgments, 100 in each series.

[1] P. 41.

TABLE III.—*Weights.*

SUBJECT.	*A-A*¹.				*A-I*¹.				*I-A*¹.				*I-I*¹.			
	Second stimulus correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimat ion.
P.	71	16	13	3	70	25	5	20	78	11	11	0	71	21	8	13
W.	77	16	7	9	64	29	7	22	71	19	10	9	71	20	9	11
R.	69	28	3	25	62	20	18	2	62	37	2	35	71	15	14	1
V.	55	43	4	39	62	34	4	30	64	34	2	32	63	34	3	31
A.	71	25	9	16	63	25	12	13	61	34	5	29	61	27	12	15

Sounds. The sound was made by the striking of an ivory ball upon an ebony plate. "The ball was held by an electro-magnet and fell at the breaking of the current. The time between the two sounds was 5 sec. The normal height of the fall, 50 cm., was compared with 35, 40, 45, 50, 55, 60 and 65 cm. A signal preceded the sound, and simultaneously with this the adding of the numbers began as they were read."[1] These experiments were tried by two subjects who had had the practice of all the preceding series. Each subject completed four series of 80 experiments, 320 in all.

TABLE IV.—*Sounds.*

SUBJECT.	*A-A*¹.				*A-I*¹.				*I-A*¹.				*I-I*¹.			
	Second stimulus correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.	Correctly judged.	Overestimated.	Underestimated.	Preponderance of overestimation.
P.	73	15	12	3	78	12.6	9.4	3.2	74.7	13.8	11.5	2.3	72	16	12	4
R.	70	17.5	12.5	5	66	21	13	8	77.5	10.5	12	−1.5	70	18.8	11.2	7.6

[1] *Op. cit.*, p. 41.

The first result to be noticed is that out of the fifteen cases *only two* show the highest percentage of correct judgments in the series without distraction. In six cases the maximal accuracy is reached when the attention was distracted during the first stimulus; and in four cases, the maximum occurs in the series with distraction throughout. How are these results to be explained? Must we conclude that attention is unfavorable to sensible discrimination? The mere figures are of no value in answering this question until they have been interpreted by the introspective evidence gleaned from the subjects during the whole course of the experimentation.

We notice first the evidence bearing upon the nature and effects of the "distraction." The subjects usually found that it acted as a spur rather than as a check to the attention. Their attention was wholly absorbed in the addition for a part of the interval, but as a rule the distraction was not continuous, and there came free instants in which the stimulus flashed into consciousness with great clearness and distinctness. Although the subjects were instructed to give their attention to the addition, the fact that they must give some judgment of the stimuli made them instinctively attentive to the stimulus, whenever there was any break in the continuity of the distraction. The series with distraction required greater effort; and if the subject was not in good physical condition, the mind did not pass quickly enough from addition to stimulus and back again. At such times (as also in the infrequent cases when the addition did furnish a continuous distraction) the subjects were completely at a loss how to judge the two stimuli. They seemed to have no memory of them, sometimes even no knowledge of the fact that the second stimulus had been given. The judgments in such cases were nearly as often wrong as right, with a slight tendency to overestimate the unnoticed stimulus.

The important fact, then, with regard to the distraction which appears from the evidence gathered in our experiments, is the fact that in many cases it is *not* a distraction in the required sense. It prevents attention to a stimulus for any length of time, but it by no means prevents a clear and keen perception of an object for a fraction of the allotted interval,—a perception that is evidently as useful in the formation of a judgment as the undisturbed perception during the whole 3 sec. in the series without distraction.

The subjects occasionally referred to a loss of "memory" occasioned by the distraction. A stimulus would be perceived, instantly judged with reference to the preceding, but the judgment would be sometimes forgotten in the course of further distraction. On the other hand, two of the sub-

jects (*R.* and *M.*) found it easier to remember stimuli or judgments, when some distraction was given, than when they had no distraction at all.

We know of no experiments that investigate the relation between the duration of attention and the accuracy of judgment, nor have we any statistics to offer on this matter. But we took several series of experiments with lights and distances, in which the subject merely gave a glance at the second object exposed. The judgments in these series were even a little more accurate than in those where the subjects were allowed 3 sec. for the second stimulus. And those who made the judgments were ordinarily better satisfied with the brief glance than with the long exposure. In fact, after the first few experiments some of them habitually gave the judgment as soon as they had opened their eyes the second time, —not caring at all for a longer observation. They were not cautioned against this mode of judgment, because the experimenter was more concerned with the "goodness," or degree, of their attention than with its duration. Moreover, the sound experiments gave only a momentary stimulus, and yet the subjects did not find that this fact made it any more difficult to judge between the stimuli. The time during which a stimulus is attended to doubtless has a marked effect, however, on the length of time it can be remembered. Thus, in these same experiments the subjects were more inclined to look the full 3 sec. at the first object which they knew they must recall at the end of 5 or 6 sec., than at the second object which could be ignored as soon as the judgment was once made.

To summarize the points that are of importance in the preceding analysis of the distraction used, we would notice: (1) that the distraction is discontinuous; (2) that for the required judgments the *duration* of the attention is of little significance, especially in the last interval of the experiments: the *degree* of attention affects the judgment more than the duration; and (3) that the so-called distraction shortens the duration of the attention, but, as a rule, on account of its lack of continuity, allows the subject brief intervals of attention; and at the same time, by adding definiteness and interest to the task, it heightens the degree of attention. The subject is alert and active; the distraction works, as we have said, more as a spur than as a check. The inevitable conclusion from these observations is a distrust of *any* inferences drawn from such experiments. Until we have some reliable experimental control of attention, until we can objectively regulate its degree, and know the effects of its duration, and the relative value of the various ways in which individuals seek to reinforce attention,—until we have some answers to

these questions, we can have little confidence in the array of figures supposed to represent attention and inattention. We may quote here a passage from Münsterberg's writings:

"Through empty experiments, which have figures as their chief result, psychology can be helped into a dilemma which is as fatal to it as any metaphysical presupposition. Numbers in and of themselves have no value, only concrete numbers can possess any scientific significance; and there is danger of collecting numbers, of examining and explaining these in their relations, without considering the preliminary question of what these numbers really mean and for what psychological process they furnish a measure. If the usefulness of the experimental method is not to be paralyzed by the injuries brought upon it by the ambiguity of indefinite numbers, every investigation must be preceded by a very thorough consideration of what the desired numbers can and must properly signify. And above all, the subject, from whose psychical experience the numbers are obtained, must clothe the numerical skeleton with the flesh and blood of his own most accurate recollection of the conscious processes experienced."[1]

It seems to us that Prof. Münsterberg's condemnation of "experiments which have figures as their chief results" may apply in some measure to this part of his own work. To further justify this conclusion we shall mention here some of the disturbing factors discovered in the course of our work.

(1) In the series with weights we noticed that some subjects relaxed the muscles of the hand and arm after raising the first weight, while others tried to keep them in just the condition assumed while raising the first weight until the second weight was given. This latter method seemed subjectively much more certain and accurate to those who used it than the method of relaxing the hand in the interval, but it was decided that greater constancy of conditions would be secured by the relaxation method, and from the time that the difference was discovered, the subjects let the hand fall loosely during the intervals between the raising of weights.

"The comparative accuracy of the two methods of judging weights was investigated by Prof. C. E. Parrish, of Randolph-Macon College, who has kindly allowed her results to be given here. Series of experiments, from 150 to 225 in number, were given to seven subjects, no one of whom had any knowledge of the question being investigated. Each subject was given weights to raise, and to judge heavier or lighter, in the manner already described in our own experiments. The standard weights were from 250-270 gms., and the differences given were from 10-30 gms. Every series of experiments was given twice. The first time the subject was told to keep the muscles of the hand and arm in precisely the same state they were in while he was raising the first weight until the second weight was lowered into the hand. When the series was repeated, he was told to relax all the muscles of the arm during the interval before the raising of the second weight. The tabulated results are as follows:

[1] Quoted by Heinrich, "*Die Moderne Psychologie*," p. 154.

Discrimination of Weights with Muscles Adjusted and Relaxed.

Subjects.	Number of Experiments.	Percentages of Correct Judgments.	
		Muscles Adjusted.	Muscles Relaxed.
W.	226	63	89
B.	150	77.3	78.6
K.	112	78	92
D.	158	79	86
Br.	184	70	79
H.	166	71	69
M.	176	83	78

From this table it will be seen that five of the seven subjects reached their best results with the hand relaxed. Of the other two, who were both entirely new to laboratory work, the experimenter states that *M.* did not fully relax the hand, and, when the signal was given to have the hand ready for the second weight, tried to put her hand into the same state of tension that it had with the first weight. So that this series really does not fulfill the conditions of the experiment. The variation of the *H.* series is to be explained in a different way. *H.* visualized the weights very definitely, and speaks of "keeping the image in her mind" throughout the interval between the two weights. She saw "a black ring of weight" where the funnel rested on her hand. She kept this image, and compared it with the "ring of weight" seen when the second funnel rested in her hand. When the visualizing element is so strong it is not surprising to find results that are quite different. We are far more accustomed to attending to visual ideas than to the sensations of pressure and contraction accompanying any adjustment of the hand. Trained by daily experience, the attention can be directed much more steadily and successfully to a visual image. And so it happens that in the case of *H.*, where the attention is fixed on a visual idea, a particular adjustment of the hand is more easily and accurately kept than when the attention is directed toward the sensations from the hand and wrist. In the latter case a greater degree of accuracy is secured when the hand is relaxed in the interval, just because the attention is so little used to the investigation and control of muscular and pressure sensations that it fails to preserve a particular adjustment of the muscles concerned. The very effort to attend introduces small changes in the muscular contraction and causes slight fatigue or summation effects, with a consequent tendency to overestimate the second weight.

(2) Another individual variation discovered in the course of the experiments was the difference in the methods of adding numbers. Some visualized the numbers, some depended more upon auditory or tactual-verbal images. As a result

the addition was much less of a distraction to some than to others.

(3) There was an equally marked difference in the way in which the first stimulus was remembered. Some retained visual images of the disks and distances throughout any undisturbed interval, or heard again and felt again the sounds and weights just given. Others let the interval remain empty, so far as possible, and recalled the first stimulus only when the second was given. We believe that these differences are intimately connected with the individual differences in the relative frequency of overestimation in the four series. For the memorial images tend to grow fainter, even as this short time passes, unless a pronounced effort is made to prevent their decrease. The effort, however, is more likely to introduce errors than the tendency it seeks to correct, so that the subjects who retained memorial images made no special attempt to prevent the slight diminution of intensity naturally present. In the series A-A^1 and A-I^1, this factor will have some influence; in the series I-I^1 it could have no part, because none of the subjects retained their images while they were adding numbers. In the series I-A^1, the addition, as a rule, lasted into the intervening period, so that in this series memorial images occurred less frequently. We cannot give statistics from our own experiments to show the relation between the appearance of memorial images and the overestimation of the second stimulus. But after the individual differences with regard to the occurrence of memorial images had been discovered, occasional notes were taken of the subjects and series in which they were most common. The cases noted are those of *P.* and *W.* in the series A-A^1 with disks, and series A-A^1 and A-I^1 with distances; in series A-A^1 and A-I^1 with weights, images were less definitely and less frequently present. Reference to these instances will show that the retention of the image is accompanied by a tendency to overestimate the second stimulus. In the experiments with weights the tendency is weaker in the series A-A^1 than in the series A-I^1. This anomaly, and the occasional appearance of a strong preponderance of overestimation in subjects and series that were quite free from the memorial images, indicate that other factors must take part in producing the tabulated results, and explanations must not depend too much upon the influence of the images in the series where they were specially noticed. Still, on the other hand, their influence must not be ignored. We shall refer to this somewhat later when we take up Prof. Münsterberg's conclusions.

Some light has been thrown upon the last two topics by the results of a series of experiments performed by Mr. F. E. Moyer

He gave three subjects the task of discriminating shades of gray produced by rotating disks under the general conditions of Prof. Münsterberg's experiments and our own. The important differences were as follows: (1) In series I-A^1 and A-I^1, he gave only about 50 experiments, while in A-A^1 and I-I^1 he gave 90 or 100. (2) He gave about twice as many experiments where the only possible error was a judgment of "darker" as where the error must be a judgment of "lighter." Hence the percentages given in his table are not percentages of the whole number of experiments, but only percentages of correct judgments in the number of experiments belonging to each class. (3) Another variation was the restriction of the smaller differences to be discriminated to one class of experiments,—that which allowed errors only in the direction of judging darker. Mr. Moyer's chief object in these experiments was the study of the different ways in which the subjects added and carried the memory of the first disk through the intervals of free and distracted attention.[1] The three differences in experimental conditions just mentioned were introduced for the sake of his own subject. But his tabular results are also valuable for comparison with my own within certain limits not affected by the variations adopted. For since precisely the same series were given by Mr. Moyer to his three subjects, and repeated in all four sets of conditions, the results of the different subjects and sets can be legitimately compared with each other. We also call attention here, as before, to the fact that "overestimation" is used, *in the table*, to mean an error in judging the second disk to be lighter. We do this in order to avoid confusion in the reading and comparison of the different tables in Prof. Münsterberg's article and our own. But, as we have already said, for reasons given under the next topic, it is more often true that the term *ought* to be applied to errors in the direction of judging a disk to be *darker*. Finally, a new set of figures has been introduced into this table to show the whole number of experiments in each class and the number of errors.

With this table before us, let us turn for a moment to the evidence gathered by Mr. Moyer with regard to the ways in which the three subjects combined addition with the discrimination of the different shades of gray.

(1) *Different modes of addition: their value as distractions.* One subject, *R.*, first visualized the numbers given her, in order to get a good, clear memory of them, and then continued the process of addition by auditory images. This subject repeatedly states that she sees the disks clearly *while* she is adding. Both from her own testimony and from her comparative accuracy in many series "with distraction," it is evident that the addition was often no distraction at all. Another subject, *H.*, visualized the first numbers given, but lost the visual image immediately, and added by means of auditory and tactual-verbal images. The disks were not seen during the whole process of addition, but appeared, clearly and distinctly, at certain stages in the addition. After some practice this subject found it much easier to coördinate the addition and the judgment of the disks than at the first. Here, again, the addition ceased to be a serious distraction. The third subject, *P.*, finds that his attention alternates in the same way between the addition and the judgment. His most noticeable peculiarity is the absence of visual and auditory images during addition. He uses tactual-verbal images

[1] Mr. Moyer's own report of this experimental work will be published in a later number of this JOURNAL.

Subject.		A-A¹. Total.	A-A¹. Chances for overestimation.	A-A¹. Chances for underestimation.	A-A¹. Preponderance of overestimation.	I-A¹. Total.	I-A¹. Chances for overestimation.	I-A¹. Chances for underestimation.	I-A¹. Preponderance of overestimation.	A-I. Total.	A-I. Chances for overestimation.	A-I. Chances for underestimation.	A-I. Preponderance of overestimation.	I-I. Total.	I-I. Chances for overestimation.	I-I. Chances for underestimation.	I-I. Preponderance of overestimation.
R.	No. of experiments,	101	32	69		98	33	65		46	16	36		98	33	65	
	No. of errors,	27	2	25	−30	15	1	14	−18½	7	2	5	−4⅙	15	1	14	−18½
	Percentage correct,	73¼	93¾	63¾		84.7	97	78.5		84⅘	87½	83⅓		84.7	97	78.5	
P.	No. of experiments,	104	26	78		104	34	78		56	16	40		94	25	69	
	No. of errors,	28	5	23	−10.2	12	1	11	−22.4	14	2	12	−17.5	38	8	30	−11.5
	Percentage correct,	73.7	80.7	70.5		72.7	90	67.6		75	87.5	70		59.6	68	56.5	
H.	No. of experiments,	95	33	62		60	19	41		52	16	36		90	33	57	
	No. of errors,	24	10	14	7.4	13	3	10	−9.8	18	3	15	−23	27	4	23	−27.8
	Percentage correct,	74.7	70	77.4		78.3	84.4	75.6		65	81	58		70	87.8	60	

throughout, except that for an instant, in the beginning, the figures are sometimes visualized.

The effect of the difference between *R.*'s method, of continuous combination of the two processes, and the method used by *H.* and *P.*, of alternating attention to the two processes, is to be seen in the tabulated results. *R.*'s lowest percentage of accurate judg-

ments is found in the series with no distraction (A-A^1), and her percentage in the series with distraction throughout (I-I^1) is as high as in any of the series. On the other hand, *P.* is least correct in the series I-I^1, and quite even in the percentages of the other three series. (The minimum accuracy for *H.* is in still another series, A-I^1,—a peculiarity that is explained, we think, in connection with the factor considered in the following paragraphs.) Mr. Moyer's conclusions with regard to the topic of this present paragraph may be summed up as follows: (1) The subjects use distinctly different methods of addition. (2) The difference in method results in a marked difference in the degree of distraction occasioned by the addition.

(2) *The effect of images on overestimation.* Mr. Moyer made a record of about fifty cases in which images were carried through the interval, in order to test the inference drawn from my own experiments,—that the tendency of an image to fade away is likely to favor an overestimation of the second stimulus. Just here it was all important to decide what should be called overestimation and what underestimation. It will be noticed that in Prof. Münsterberg's report the records of two subjects were reconciled with the general theory on the supposition that in two cases the stronger stimuli were the *darker* disks, whereas with two other subjects the stronger stimuli were the *lighter* disks. Now the only basis for such a distinction must be the testimony of the subjects that the lighter or darker disks seemed to them to have a more positive character. Varied evidence (most clear with *H* and least so with *P.*) indicated that for Mr. Moyer's three subjects the darker disks were the more positive stimuli. Hence "overestimation" *should* refer to a judgment of a disk as too dark, although if we tabulated results merely with reference to the physical stimulus rather than with reference to the psychological perception of it, we should define overestimations and underestimations in precisely the opposite way. But Prof. Münsterberg is certainly justified in giving precedence unhesitatingly to the psychological factor here; and we simply emphasize that method of procedure by applying it to all three subjects, instead of confining it to those whose results can not be explained in any other way.

With the interpretation, then, of "overestimation" as a judgment of a stimulus as *darker* than it was, we turn to the following results: In the series with no distraction (A-A^1): (1) when the second stimulus was lighter, *P.* had 36% more of overestimations than of underestimations, *R.* had 2.38% more of overestimations, *H.* had 13.47% more of overestimations; (2) when the second stimulus was darker, *P.* had 16⅔% less of underestimations than of overestimations, *R.* had no difference, *H.* had 5% more of underestimations (only sixteen experiments).

No data were collected from the other series because images were not noticed in two of them, I-A^1 and I-I^1; while in the third, A-I^1, they were soon interrupted by the giving of the numbers for addition.

The results just quoted for cases in the series A-A^1, in which the memorial image did have an opportunity to exert its full influence, seem at first glance somewhat ambiguous. But the apparent ambiguity has its own significance. We notice that in the first part, when the second stimulus was lighter, *P.* has the largest preponderance of overestimation, *H.* the next largest, while *R.* has only 2.38%. Now *P.* has been proved to be a poor visualizer; *H.* visualizes rather better, but still quite indefinitely; while *R.* is a clear and definite visualizer. Consequently *R.* holds an image well, at-

tending steadily and evenly to its various details; while *H.* and *P.* have a more vague and scanty image, and are likely to find it dying away. The second part of the experiments, those in which the second stimulus was darker, shows precisely the same tendencies, with the exception of those made with *H.;* but this exception is worthless since it is based on only sixteen experiments.

(3) *Comparison of results with Prof. Münsterberg's and our own.* This comparison can be made more intelligibly when we are discussing the bearing of our own results upon Prof. Münsterberg's conclusions. (See p. 58.)

II. *Comparison of our results with Prof. Münsterberg's, with statement of our criticisms and conclusions.*

The first and most fundamental question that arises as one reads Prof. Münsterberg's account of his experiments is a question with regard to the validity of his decision to compare the series A-A^1 only with I-A^1, and the series I-I^1 only with A-I^1. He gives the following reason for thus confining the comparison:

> A-A^1, as well as I-I^1, give the constant error resulting from position, although with a different mean variation. It appears, however, that the results in the two series are different; the overestimating of the second stimulus in the case of A-A^1 being much more marked than in the case of I-I^1. Accordingly, we should compare those series only in which the judgment is made under the same conditions. That is, A-A^1 ought to be compared only with I-A^1, and in the same way I-I^1 only with A-I^1. . . . . Obviously, the actual numbers are valid merely for the relations of these stimuli chosen arbitrarily, and only their relative value, considered as plus or minus, comes in question.[1]

Looking at the results of our own experiments, the first statement which fails to apply to our results is that "the overestimating of the second stimulus is much more marked in the case of A-A^1 than in I-I^1." We found several cases in which this was true, but there were also several cases in which it was not at all true. Two subjects in the series with weights, two in the series with disks, two in the series with sounds, and one in the series with distances, overestimate the second stimulus more frequently in the series I-I^1 than in the series A-A^1, while two more show a preponderance in the other direction of only 1 and 2%. So that nine out of the fifteen cases fail to confirm Prof. Münsterberg's comparison.

It might still be maintained, however, that although there is no constant difference, in one direction or the other, between A-A^1 and I-I^1, the reason given (independently of the relative overestimation) for limiting the comparison holds good, viz., that "we should compare those series only in which the judgment is made under the same conditions." This would be a sufficient reason if the conditions under which the judgment

[1] *Op. cit.*, p. 40.

is *finally* made were the only conditions affecting the overestimation or underestimation of the second stimulus. But, in the first place, we have already referred to one factor (*i. e.*, the presence of memorial images) that in certain subjects exercises considerable influence in the series A-A^1 and A-I^1. And, in the second place, we maintain that the judgment must be affected quite as much by any circumstance that exerts an influence on the memory of the first stimulus as by the conditions existing at the moment a judgment is made. Since it is quite as probable that the memory of the first interval is affected by the way in which the intervening period is passed as that the final judgment is affected by the conditions under which the second stimulus is received, we maintain that *all four* series must be compared in order to make due allowance for both sorts of influence. Indeed, if either one is to be ignored, we think it should be just the one that Prof. Münsterberg has considered all important. For what *is* this "difference in the conditions under which the judgment is made" except the very matter under investigation, *i. e.*, the difference between free and distracted attention? And it seems strange that on this basis two series should be cut off from comparison with the very two that exhibit the other phase of the problem in question.

If, however, setting aside Prof. Münsterberg's restriction, we do compare all four series, then, in order to sustain his conclusion that "all stimuli appear relatively less when the attention is from the outset directed to them," the series A-I^1 should show a relatively greater, and the series I-A^1 a relatively smaller, preponderance of overestimation of the second stimulus than A-A^1 or I-I^1. Examining Prof. Münsterberg's results, we find this to be true in only three cases out of ten. In our own results it holds good in only five cases out of fifteen. We take this as further evidence that these series are not what they profess to be; they are not pure experiments with free and distracted attention.

On the other hand, even if we should accept the restriction to which we object, and follow Prof. Münsterberg's example in comparing series A-A^1 only with I-A^1, and I-I^1 only with A-I^1, our results still fail to harmonize with his. In thirty comparisons sixteen agree and fourteen disagree with his statement. So that whether we accept or reject the restriction, we are wholly unable to accept the conclusion that stimuli appear relatively less when attended to.

Reference to the tabulated results of Mr. Moyer's experiments given on page 55 will show that his results work against Prof. Münsterberg's conclusions in the same way that my own do. As they were performed wholly independently and for the investiga-

tion of a different problem, the concurrence of the two results is worthy of consideration. Mr. Moyer's experiments, like my own, fail to confirm the conclusion that attention lessens the intensity of a stimulus. If we compare his series in accordance with Prof. Münsterberg's directions, we find that out of six comparisons three agree and three disagree with Prof. Münsterberg's conclusion.

Our second criticism of Prof. Münsterberg's experimental work is a criticism of the way in which he has handled his numerical results. Every error in judgment is given the same numerical value, whether the stimuli wrongly judged were equal, nearly equal, or widely different. Such an evaluation of results is quite as capable of concealing a tendency as of revealing it. We have of necessity followed the same method since our first object was a comparison of results. At the same time we think it must be condemned as untrustworthy and unscientific. Only the discovery of sources of error which convince us of the worthlessness of the experiments in connection with their original problem, allows us to leave them without recasting the results on a more scientific basis of evaluation.

In the third place, if we turn to Prof. Münsterberg's *explanation* of the conclusions drawn from the experiments, we find an explanation that will not apply to attention in general or to the kind of attention used in our own work. The explanation is valid only where there is a pre-adjustment of the attention to some particular stimulus.

To draw out our meaning further, we quote a few sentences from the last paragraph of the article:

"The explanation seems to me to rest in the fact that we must always judge intensities relatively, the standard being in our muscular tensions. . . . . Let these be previously strengthened by expectant attention and the stimulus will appear weaker than if the stimulus itself were to arouse reflexly all the corresponding muscular tensions. . . . The feeling of intensity comes to represent the intensity of a stimulus only through its relation to the subjective sense of strain. If we purposely strengthen the subjective strain simultaneously with the strains aroused by the stimulus, the stimulus will indeed appear stronger, because we interpret the tension as the result of the stimulus. . . . If, on the other hand, the tension precede the stimulus as an element in the preparatory adjustment of the attention, and if consequently it be interpreted by consciousness, from the outset, as a subjective function, the increase of the tension aroused by the stimulus can appear only slight, the ratio of the two intensities has become reversed, and accordingly the stimulus is slightly underestimated."

All this may be quite true. Such a possibility of weakening an impression by a certain preparatory adjustment of the attention was noticed by G. E. Müller nearly twenty years ago, and it has been verified many times. But it is only true of attention when it is working under peculiar conditions and

in one particular way. Prof. Stanley has emphasized this point in his discussion of Prof. Münsterberg's article. After some reference to the genetic development of attention, he says:

"Believing, then, that sensation intensities are bound up with attention intensities as a general fact of mind, we were interested to see how Dr. Münsterberg's experiments would bear on this law, to which he alludes in his opening remarks as the scope of his inquiry. However, we discover that it is only a certain kind of attention, expectant, and a certain kind of this, too much expectancy, that is really treated, with the result that sensations of light, sound, etc., are rendered less intense when we set our attention at too high a notch."[1]

In our own experiments there was no preparatory adjustment of the attention to a definite intensity of stimulus,—no "expectant" attention to any specific memory image. Attention in our case meant, to use Exner's terms, an inhibition of stimuli in general, and a readiness for, or a "facilitation" of, a certain class of stimuli. It cleared the field of all other impressions and said, "Something is coming *this* way. Ready, look!"

In the passage just quoted Prof. Münsterberg maintains that the subjective strain due to a preparatory adjustment of attention is distinguished in consciousness from the strain aroused by the stimulus, but if the subjective strain is strengthened simultaneously with the strain aroused by the stimulus, the two are not distinguished; "we interpret the tension as the result of the stimulus." This brings forward once more the question discussed in the preceding chapter,—the question of the distinction between increase of intensity due to attention and to changes in the stimulus (pp. 37-38, 40-41). We think that the view there cited from Exner is the only one that is consistent with the facts of experience. For instance, when we are listening to the far-away striking of a clock, we do not confuse the subjective tension with the tension aroused by the stimulus. Although the distinction of the two is more difficult when they occur simultaneously, it cannot be impossible; for the same data are given in consciousness when their occurrence is simultaneous as when successive, only they are more obscure in the former case than in the latter. The quick notice and accurate memory of an expert, however, will render possible the analysis of either complex state. Indeed, unless there were certain *measures* of the facilitation due to attention by which it could be distinguished from the intensity of the stimulus, attention would obscure and interfere with every case of sensible discrimina-

[1] "Attention as Intensifying Sensation," H. M. Stanley, *Psych. Rev.*, II, p. 55.

tion,—and we believe that no one holds this to be true. On the other hand, we do not wish to dispute Prof. Münsterberg's statement that expectation of too great or too small a stimulus causes underestimation or overestimation of the stimulus actually present. But we affirm that such expectation is not an essential element in attention. We are more and more convinced that there is no necessity that attention should produce either result; and we hope to show in the next section that both effects may more properly be traced to certain sources of error and of individual variation noticed in the course of our experiments.

III. *Discussion of the sources of error observed and the precautions suggested.* The mention of the sources of confusion discovered in our own experiments may be the best conclusion of our present account. Our other results have been largely critical and negative. We may hope that their worth is not decreased on this account, since the whole subject of attention is still in so chaotic a state. Negative criticism of conclusions too hastily reached is specially needed in the first stage of experimentation in any subject,—and experiments upon attention, with the exception of those upon oscillations of the attention, have hardly passed beyond the first stage. Moreover, if negative criticism can indicate clearly enough the sources of error in the works which it criticises, it leads in the end to a knowledge of how the errors are to be avoided, and shows, in part, at least, the correct method for the solution of the problem.

We conclude, from our own experiments, that the most probable sources of error are as follows: (1) *The pre-adjustment of the attention.* There should be objective aids to secure, so far as possible, constancy in the manner and degree of the adjustment. Any means for securing similarity of conditions at the outset will do much toward ensuring trustworthy results. We have said that in our own experiments there was no definite pre-adjustment,—no preparatory recall of a particular stimulus. Prof. Münsterberg's closing paragraphs indicate that he did have such preparatory adjustments in his experiments. To avoid these differences and to prevent the appearance of other disturbing factors in the first stage of the experiment, it would be well to start with the same stimulus in all the experiments. Let the subject know that the first stimulus is always the same, and let him keep account of its apparent variations, if there are any. Such a partial use of the "method with knowledge" would be of value in giving the attention a definite direction. It would help to insure the same degree as well as the same kind of attention or of preparatory adjustment. This single

precaution would go far, we believe, toward correcting or eliminating the fluctuations, contrast effects, variations in adjustment, etc., that are otherwise likely to occur during the exposure of the first stimulus and during the interval between the two stimuli.

(2) The experimenter must use some measure, however crude, of the *continuity of the distraction.* For this purpose he must take notice (a) of the regularity or irregularity of the rate at which the subject works; (b) of the most effective kinds of distraction, and (c) of the ways in which the subject treats whatever is assigned for a distraction. Under these three topics we have a few suggestions to offer as the fruit of our experimental work.

(a) It might be advisable to arrange the distraction and the apparatus so that the rate at which the subject does whatever is given him to do, may be recorded. This time record would reveal clearly—and often at the moment, and to the subject himself—the irregularity and discontinuity of his attention to the objects discriminated or to the distracting stimulus. This information would *tend* to make him more even and uninterrupted in his attention to one or the other. The record would also tell the experimenter something of the degree and value of the distraction. Yet too much must not be expected from this device. (b) Our experiments, and others conducted in the same laboratory, indicate that in spite of every effort exerted to keep the distraction continuous, any task of so intellectual a nature as addition will permit intervals of keen attention to other objects. It was noticed, however, that when the addition was performed while there was any strong affective coloring of the subject's consciousness, it was usually a successful means of distraction. Affective reactions rarely, and only accidentally, accompany the addition of numbers, the recognition of liminal stimuli, the perception of regular intervals of time by metronome beats, and the other similar distractions which have been used in the experimental study of attention. But it is possible that other stimuli may have a much stronger affective tone. This is in general, true of all strong odors.[1] And beside these, each individual has certain classes of perceptions which are very likely to arouse strong feeling. Singing aloud, reciting with careful expression one's favorite poems, reading or writing backward, recalling details of a beautiful landscape or painting,—these and many other such tasks will affect different individuals very differently, and for certain subjects we have found them to be quite a satis-

[1] This fact was evident in the experiments by Mr. Moyer already referred to, p. 54.

factory distraction. (c) Whatever distraction may be used, it is evident that the experimenter *must* know, as well as he can, *how* the different subjects are treating the task assigned for distraction. It is as important to know this as to know the way in which the subjects attend to the stimuli to be discriminated. It would seem to us quite unnecessary to emphasize directions so apparent as these if they had not been unpardonably ignored in the experimental study of attention. As we have already said, Mr. Moyer's investigation of addition as a means of distraction, showed that it was treated differently by each of the three subjects. One was visual and auditory-verbal; one was auditory-verbal and tactual-verbal; the third was quite purely tactual-verbal in his method of adding. And these differences affected the results. The experimenter cannot give any reliable interpretation whatever of his results without an analysis of these complicating factors. Control of the variations in the treatment of the distraction may be impossible, but this fact will not destroy the value of the experiments if only the variations are known and if their influence is carefully traced.

(3) The subject's *methods of remembering* a stimulus must be noticed in the same way that his ways of attending or of pre-adjusting the attention are to be observed. The most important instance under this head that we can give from our own experiments is the instance of the presence and absence of memorial (reproductive) images in different series. We have only to refer again to the account given of Mr. Moyer's experiments to show the influence of the memorial image upon the overestimation of the second stimulus. Besides the persistence of definite images, other mnemonic aids may be used and may affect the results. Certain subjects, who do not steadily retain any images, recall them at stated intervals, usually with each inspiration or expiration of the breath. Under these circumstances the coincidence of the second stimulus with the moment for the recall of the image will make considerable difference in the accuracy and the direction of the results. Any other aids to memory—naming, localizing, etc.—may be used by the subjects; and here again it is necessary for the experimenter to know what factors are entering into the experiments.

(4) Results obtained by one method, *e. g.*, attention in sensible discrimination, must be *tested by experiments in other methods*, *e. g.*, reaction to a stimulus. This latter method has been well developed by Patrizi.[1] By means of an

[1] "*La Graphique Psychométrique de l'Attention*," *Archives Italiennes de Biologie*, Vol XXII, pp. 189-196.

electrically driven Baltzar kymograph and an electric circuit, including a Deprèz signal and an electro-magnetic hammer, he secured a record of sixty successive reactions made within an interval of two minutes. The stimulus recurred regularly at intervals of two seconds. The subject reacted to the stimulus as soon as possible, and the record of stimulus and reaction left on the rotating cylinder showed how much time had intervened between the two. The hammer could be replaced by a Geissler tube or a simple shock apparatus when it was desirable to use other kinds of stimulation. By means of this apparatus, Patrizi obtained a graphic record of the degree or goodness of the attention, since (other things equal) it is evidently inversely proportional to the time of the reaction. The method has also the merit of investigating attention under purer conditions than are found in other methods, because the quick recurrence of the stimulus helps very much to prevent the wandering and "unpreparedness" of the attention. And the fact that "the stimuli given are always well above the limen of any sense department, eliminates the effects of the adjustment and muscular fatigue of the peripheral sense organs that have complicated all the experiments on oscillations of attention." Experiments performed by Patrizi's method could be advantageously compared with those by another method in two ways: (1) It can be used to find the comparative value of different distractions; and (2) after the value of the distraction is known, the relations of different degrees of attention and inattention shown in the numerical results of one method can be verified or modified by the graphic results of this other method.

In closing we wish to give brief notice of "An Investigation of the Distraction of Attention" made by Bertels.[1] It is the only thesis on the subject that we have yet come across, and deserves consideration on that account. But the author's work does not touch the problems with which we have been dealing. Bertels started with three questions in mind. "1. How is distraction affected by the intensity of the distracting stimulus? 2. How is it affected by the interval between the test-stimulus and the distracting stimulus? 3. How is it affected by the quality of the distracting and the test-stimuli?"[2] But he had time to investigate only the second question—the effect of the interval between the two

[1] "*Versuche über die Ablenkung der Aufmerksamkeit.*" Dorpat, 1889. A. Bertels.

[2] *Op. cit.*, p. 10.

stimuli. Visual stimuli were used in all the experiments. The distracting stimulus, as well as the test-stimulus, was given only for a moment. Light was admitted for an instant into a tube leading to one eye, and then after an interval, light was admitted to another tube containing two Nicol prisms. The distracting effect of the first stimulus was measured by the angle through which one of the Nicols had to be turned before the second light could be discerned. The most important result of his experiments was the discovery that the first stimulus acted more as a signal-stimulus than as a means of distraction. It distinctly aided the attention, most of all at an interval of $2\frac{3}{8}$ seconds, and at intervals that were multiples of this number. So that the thesis tells us nothing with regard to distraction, except that what was expected to act as a distraction acted otherwise.

Summary of the four chapters.

The introductory chapter briefly discussed certain physiological concepts, which play an important part in theories of attention; *i. e.*, the question of the nature and extent of cerebral localization, and the question of neural reinforcement or facilitation (*Bahnung*), and neural inhibition (*Hemmung*).

The second chapter analyzed the "descriptive" theories of attention, or those which deal chiefly with the effects and secondary phenomena of attention. These theories describe attention as merely motor (Ribot and Münsterberg), merely sensory (Bastian, Marillier, etc.), or as sensori-motor (Waller). The discussion of these three classes involved reference to the controversy over sensory and motor centres in the cortex, the correlation of consciousness with efferent nerve currents, and allied topics.

In the third chapter the "explanatory" theories of attention were presented—those which seek for the fundamental principles in the process. The three types found here regard attention as a facilitation (G. E. Müller), as an inhibition (Wundt and Külpe), or as a combined facilitation and inhibition of stimuli (Exner). After a review of each theory separately, we discussed the fundamental differences between them, and especially the problems still left unsettled by one or all of these theories. Some of the most important topics were the relation between attention and the increased clearness of an idea, the "feeling of activity," inhibition, associative co-excitation, reinforcement or facilitation, changes in intensity due to attention and due to variations in the stimulus.

The fourth and last chapter, under the title, "Attention and Distraction," gives an account of an experimental investigation of the effect of so-called distractions on sensible discrimination. The experiments are, in part, a repetition of those made by Prof. Münsterberg in his study of "Attention as Intensifying Sensation." The negative and critical results of our work show that the experiments do not sustain Prof. Münsterberg's conclusion that "all stimuli appear relatively less when attention is directed to them from the outset." (1) The distraction acted more often as an incentive or spur than as a check to the attention, and this fact renders the experiments worthless for their original purpose; (2) Disturbing factors were noticed which materially affected the numerical results. These factors were not considered, and no precautions were taken against them in the original experiments. Among the most important we would mention the effects of the presence or absence of distinct memory images, different ways of treating the distraction, and different methods of judging weights. (3) The original experiments treat only a certain kind of attention, expectant, and a certain degree of this, too much expectancy; their results, even if they were wholly accurate, could not apply to attention under any other conditions. (4) An unscientific treatment of the numerical results destroys the force of any psychological conclusions based upon them. The positive results of our work have taken the form of certain directions advisable for further experimentation. They refer: (1) to a pre-adjustment of the attention; (2) to the continuity of the distraction; (3) to methods for remembering stimuli; (4) to the testing of results obtained from one method by those secured from other methods. The chapter closes with brief mention of an earlier study of distraction by Bertels.

OLD AGE AND DEATH.

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Biological. From the most general point of view it must be admitted that senescence is a constant accompaniment of development. The evolution of both the race and the individual is as much concerned with the effective dismissal of old and ante-dated organs as with the production of new ones.[1] Minot[2] indeed regards the whole course of individual life from the moment of the union of the two reproductive cells as a gradual decay, and has attempted by elaborate weighings to prove that during the minority or period of growth of guinea pigs, the actual vital force diminishes steadily. At the same time we must not lose sight of the fact that senescing cells, such as glandular products and organs like the gill-slits, etc., of the vertebrata, exercise a stimulating influence upon the organs which remain or take their place. Their force is passed on rather than lost, and while decay is undoubtedly a constant and necessary factor in all vital manifestations, and whatever may be true of the ultimate "vital force," it must be admitted that the functions of life as they may be observed in any specialized organism, increase for a time in strength, range, and complexity, pass through a period of comparative poise, and finally break up and disappear. These three natural periods, however further they may be divided (Cf. Flourens, *e. g.*) are emphatically punctuated by the advent and decline of the sexual and reproductive functions, which may thus be regarded as crowning the physiological development of the individual.

In many species, however, as Weissmann, Goette, Geddes and others have pointed out, the closing stage is wanting. There is no gradual senescence, but death

[1] The ability to forget, *e. g.*, is as important to psychic health as the capacity to acquire. Cf. paragraph on the funeral.

[2] *Jour. Phys.*, May, '91, and *Biologisches Centralblatt*, XV, No. 15.

follows immediately upon the completion of the reproductive functions. Weissmann regards this as due entirely to external conditions operating upon the individual through natural selection, and tries to show that death is a favorable adaptation to get rid of senility, which he thus accepts as fundamental and due to a "wearing out." Goette[1] on the other hand regards death as the fundamental fact, a necessity inherent in life itself, an unavoidable consequence of reproduction, and represented in the protozoa by encystment and rejuvenation.[2] Death must, he says, have become necessary and hereditary in a number of individuals before it could possibly become useful and thus operated upon by natural selection.[3] Senility he regards as having been "acquired in the course of development of the race."[4]

But it is impossible to separate, as Weissmann does completely and Goette to a less extent, the individual and its environment. A view which combines the internal physiological causes of Goette and the external, natural selection, or teleological causes of Weissmann as both necessary and complementary to each other, is the only one which can have any application to organisms as they at present exist. The point of fundamental importance brought out by both Goette and Weissmann is that death and senility are ultimately functions of the species, primarily of phylogenetic importance, whether regarded as being originally necessary to the continuance of life, or impressed upon it from without, and enter the life of the individual as such, in connection with the sexual and reproductive functions.

The experiments of Maupas[5] with *Stylonichia pustulata*, one of the most highly developed protozoans, are interpreted by him (in opposition to Weissmann's view of the immortality of the protozoans) as demonstrating the fact of senile degeneration followed by death in these animals. *S. pustulata* multiplies by division at a temperature of 24° to 28° C., dividing as often as five times in twenty-four hours.[6] Beginning with an individual which had just conjugated, Maupas followed the multiplication to the 313th division when he had 510 individuals. He

[1] Life and Death, "Biological Memoirs," p. 135.
[2] "*Ueber der Ursprung des Todes.*"
[3] *Op. cit.*, p. 6.
[4] *Op. cit.*, p. 54.
[5] *Recherches expérimentales sur la multiplication des infusories ciliés*, in the *Archives de Zoölogie expér. et gen.*, 1888, No. 2.
[6] If all of the resulting individuals could be nourished to the fiftieth generation, that is, in thirty days, there would be one followed by forty-four zeros, which, if united in one mass, would make a sphere a million times greater than the sun in volume.

found that at the 100th division degeneration began and increased to the 240th. At the 130th generation, sexed individuals appeared, which were about half the original volume. At the last fission the animals were only 1-60 of the original volume. At the 316th division he isolated one of the 510 individuals and found that it produced "nothing but abortions, incapable of reproducing, and which shortly died."[1] This extinction Maupas calls senile degeneration, thus very questionably homologizing this series of separate cells, artificially prevented from normal conjugation, with a series of mutually dependent and connected cells such as may be found in any metazoan. A. M. Marshall[2] appears to accept this homology, but nevertheless agrees with Weissmann in thinking that death is not an intrinsic necessity of life, but appears first in the higher protozoan in close reciprocal connection with conjugation and reproduction. Since we do not know, says he,[3] "at what period or to what extent the somatic cells of a metazoan lose their power of conjugating," nor what occurs in vaccination or transfusion of blood, he suggests, as a matter of theory, the possibility of discovering some means of rejuvenescence for the somatic cells, a possibility which G. A. Stephens of Norway Lake, Me. ("Long Life"), in establishing a laboratory for the purpose, seems to be inclined to devote some effort towards realizing!

Other special hypotheses on the causes of death have not been particularly fruitful. Bütschli[4] thinks that life is the result of a ferment which the protozoans and the germinative plasma have the power of manufacturing. When the ferment is exhausted, life ceases. According to Lendl[5] every cell by the very fact of living accumulates in it substances, some useful, some not, which are nevertheless foreign to the pure germinative plasma. This material he calls *ballast*, and regards it as the cause of death. The reproductive cells keep themselves pure by loading this material on to other cells. He supposes that the protozoans divide so that one cell retains the ballast, while the other is free. A certain number of the protozoans are thus doomed to death. Delbœuf[6] says that the precipitation of the substance of the organs towards the inorganic causes death. Dantec[7] represents death with

[1] J. Delbœuf, "*Pourquoi mourons-nous?*" *Rev. Phil.*, Mar. and Apr., 1891.

[2] "Biological Lectures and Addresses," chap. on Death, p. 283.

[3] P. 287.

[4] "*Gedanken über Leben und Tod*," *Zoöl. Anz.*, V, 64-67.

[5] "*Hypothese über die Entstehung von Soma- und Propagationszellen.*" Jena, 1890.

[6] *Art. cit.*

[7] *Rev. Phil.*, Jan., Feb. and May, 1895.

the primitive forms as an alternative to evolution, or change into another species. This becomes necessary, both because material for assimilation becomes exhausted owing to the narrow confines of the globe, and formed products are left within the plastid. He thinks that it might be much more possible to develop a new species from a moner than to begin higher up the scale where the plastids or individual cells are already highly developed. Delage,[1] observing the almost universal correlation of differentiation with loss of germinative power, looks upon differentiation as the cause of death. Minot[2] insists upon the converse of this and regards the embryo as a special arrangement permitting the increase of undifferentiated cells, and consequently a higher organization. Spencer says that for both somatic and germinal cells it is a matter of environment which may permit or not the continuance of nutrition.

Of the general vital theories, all of which bear upon the question of death and senility, we shall be forced to confine ourselves to a brief mention of the ideas of Roux, which perhaps, because he has paid the greatest attention to ontogeny, apply more directly to the concrete facts, about to be discussed, of the last stage of human existence, where, with the ceasing of the deeply hereditary racial or reproductive life, the more purely individual or ontogenetic features are more sharply defined. Roux[3] is described by Delage in contrast with the animists, evolutionists, and micromerists as an organicist, by which he means the acceptance of a moderate determination by heredity with the addition of "surrounding forces, always active, always necessary, not simply the condition of activity, but an essential element of the final product."[4] Roux thus harmonizes the extremes of Weissmann and Goette, already referred to, by bringing to view the fact of an internal or physiological struggle for existence among the organs, the cells, and the protoplasmic molecules of the organism. "This unsimilarity of parts," says he,[5] "makes it impossible to establish laws of heredity which shall govern details of function to the last cell or molecule,—as in any army the commander-in-chief does not give special orders beforehand affecting every private in the ranks. There must be a possibility of adaptation to surroundings, especially in details, which, too, are more

[1] *Op. cit.*, p. 709.
[2] *Biol. Centr.*, XV, 15.
[3] "*Der Kampf der Theile im Organismus*," Leipsic, 1881.
[4] *Op. cit.*, p. 720.
[5] "*Der Kampf der Theile im Organismus*," p. 71.

easily changed than events on a larger scale." How is this freedom of organs and of adaptation obtained?

Roux believes that the principle that lies back of all development of tissues and organs is over-compensation of what is used, a quality which permits self-regulation, and is really a necessary precondition of life. Living matter, unlike inorganic matter, presents an external continuity in spite of the change of conditions. To effect this, assimilation must always be in excess (over-compensation), for if less than consumption the organism comes to an end of itself. If equal, conditions change, and nourishment will fail or injurious events will cause destruction. Continuance can only be assured when more is assimilated than is consumed. He illustrates this by the example of fire, which assimilates more than it uses, *i. e.*, it always has energy left over to kindle new material. This would (like life) become eternal if it did not use up materials quicker than other processes can make them. In the same way organisms assimilate more than they consume, but they do not turn all they use to assimilation; energy remains over by which the process performs something. This work-product controls the excessive assimilation which otherwise would come to an end by not having sufficient material to assimilate. He thus regards the more complex processes of life as essentially a radiation of assimilation, which, although not identical with combustion, is similar to it, the load which it carries favoring its continuity. This radiation, load, or work-product becomes directed, of course, by natural selection, to keep up a supply of food, primarily by moving the assimilating mass. Performance of function over and above assimilation is just as much a condition of continuous assimilation as assimilation itself is of performance. On the other hand there comes to be an inverse relationship between growth and production (within limits), and we have capacities which, although they use up material, do not in themselves increase assimilation. The course of development consists in properly directing this work-product.[1]

[1] The proper growth of the higher centres favors permanence. Idiots age much earlier and die younger than normal people. Too rapid growth seems connected with this. Geoffroy St. Hiliare (*Hist. des Nom.*, 17th ed., Vol. I, p 197) has given full particulars of a boy of six who was five feet high and broad in proportion. His growth was so rapid that it could almost be seen. He had a beard, looked like a man of thirty, and had every indication of perfect puberty. He had a full, deep bass voice, and his extraordinary strength fitted him for all country work. At five he could carry any distance three measures of rye weighing 84 lbs., and at six years and a few months he could easily carry on his shoulders bur-

This so far represents merely a continuous productability of function in connection with assimilation. But a productability which is stored up and discharged by an outer stimulus of environment will be much more economical, and will give rise to what we find as reflex excitability. When this reflex work-product dominates, according to circumstances, function will sometimes be greater and sometimes less. If under these conditions assimilation keeps on continuously, there must sometimes be an overplus, sometimes a balance, and sometimes by excessive function death, and thus elimination. To avoid this last, it is necessary that assimilation should depend upon use or upon a stimulus which use calls forth. From the psychical side this stimulus is recognized as hunger.

This kind of process where stimulus is an indispensable factor, is more special and limited than the more general process of assimilation plus movement, etc., but has characteristics which favor it greatly in the struggle for existence. "Connected with the most complete self-regulation of functioning is the greatest saving of material, while those parts always according to their use are strengthened and grow, the unused degenerate and the material for their subsistence is saved. This kind of process unites the greatest economy with the highest functioning of the whole, but at the cost of the independence of the parts."[1] Senescence becomes thus a result of differentiation, in which the parts exist merely on account of the function which they perform for the whole. The senescing organs wither up like state officials after pensioning, although they may linger on as pensioners for a long time, and may even descend in this condition from generation to generation, a fact which often allows of fresh starts in development. During the course of a life-time the organism moves from a more general, more easily impressible condition to one which is more perfectly mechanized. "Through a long period it becomes, through the continuous working of a given stimulus, more completely adapted to itself, and also more differentiated, and thereby more stable, so that an always increasing opposition is formed to the additional development of new forms and characteristics."[2]

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dens weighing 150 lbs. But he did not become a giant, as every one expected. He soon got feeble, deformed, his intellectual faculties did not develop. He became idiotic and soon died. Bébé, the court fool of King Stanislas, had all the attributes of decrepitude at 23 years.

[1] "*Der Kampf der Theile im Organismus*," p. 224.

[2] *Op. cit.*, p. 201.

Dantec,[1] while opposing himself to Roux in many points, really offers a simpler form of Roux's conception of over-compensation of used material. According to him function and assimilation are not to be separated at all. He evidently rejects the ordinary analogy of a machine capable of wearing out or running down (fatigue), and regards the activity of every cell or plastid as a chemical combination in which the substances which increase the growth of the plastid are added to the living matter. During the same reaction, however, there may be by-products formed, which, until their removal from the neighborhood, stand in the way of future reaction (fatigue, senility, etc.). Dantec also simplifies the question of death by emphasizing the fact that what dies is always the cell or plastid, or a number of them. The death of a many-celled individual is nothing additional or independent of this.

Longevity and Natural Selection. Whether senility or death is ultimately the most deeply-rooted in the vital process, there seems to be no doubt that in the case of man as compared with the animals most closely related to him, the last of the old age period at least, has come in as a survival, which is correlated with, if it does not owe its existence in the struggle for existence to the greater development of the higher moral and sympathetic qualities of the race.[2] Other reasons, however, have prepared the way, or assisted in this result. Among many of the lower animals a long life is frequently a necessity for the species, when it is associated with decreased fertility or lack of ability to raise offspring. Eagles, for example, live to about 60, but owing to the dangers to which the eggs and young are exposed from weasels, mice, etc.,[3] it takes about this time to successfully raise a pair. Many plants and animals, on the other hand, make up for their short lives by great fertility. This distinction, it is evident, is only of value when comparing species, and is of very little significance for the individual. With some animals, as with man, where the period for raising the young is long, it is found that life is normally increased to this extent beyond the actual sexual period.[4]

But beyond the immediate value for the offspring, in man at least there is an added value in old age for the tribe and

[1] *Rev. Phil.*, Feb., Mar., 1896.

[2] Cf. G. M. Humphrey, M. D., "Old Age," 1889, p. 8.

[3] Weissmann, "The Duration of Life," p. 13.

[4] With man the period of growth is variously put, and is actually different in different peoples and classes, the higher classes of the highest races not ceasing to grow physically till about 30. If the grand climacteric be placed at 50 (often earlier), this would give 80 years as the normal life-time, the latter 30 years of which is held in fee for the support and education of the young.

race. Dr. Gascom[1] points out that personal, family and national prosperity and affluence are increased by longevity, and thinks that "longevity, peace and liberty would bless all the world with abundance."[2] In early races old men were the convenient and portable libraries, offering a means of ready reference to past experience. If they were not actually the leaders in times of strain and stress, they were very generally the counselors, the prophets, and the seers.

But while the practical results of old age have probably been favorable, this cannot be expected to have been foreseen or calculated upon. Unreasoning sympathy, an extension of the love for wife and child, has been the deepest motive power. This even becomes intellectualized abnormally in a kind of fetichism, instead of resulting in a calculation on the greatest good for the greatest number, which, despite the possibility of exceptions of individuals like Bentham and J. S. Mill, has never yet become a motive for masses of men. With certain tribes of South Australia, for example, it is *taboo* to catch or eat certain animals until they (the Australians) reach an advanced age. They are convinced that the most evil consequences would result to themselves individually if this rule should be broken. These animals, it is observed, are just those which are the easiest to catch, are perfectly wholesome and nutritious, and thus the best adapted for old people's use. A large proportion of the motives which govern our treatment of the old to-day are really only more refined, although sometimes equally superstitious, and perhaps equally beneficial fetichisms.

From the point of view of natural selection to the question whether old age is to be regarded as an abnormal phenomenon on account of the small number of people who attain it, as Montaigne suggested,[3] or whether the most of men should naturally reach a much greater age,[4] that men do not die, but kill themselves, it might be replied that the present condition where only a few reach an elderly age may be the most serviceable for the race in its present state. As G. M. Beard points out,[5] the majority of people in all lands are muscle-workers rather than brain-workers, and quotes Dr. Mitchell as having shown that if of the population of Scotland a few thousands were destroyed or degenerated and their places unsupplied, the nation would fall downwards to

[1] Prize essay on "Longevity" written for Assurance Co., Boston, 1869.
[2] P. 6.
[3] Essay on "Age."
[4] 100-150, as Flourens held possible.
[5] "American Nervousness," 1881, p. 97.

barbarism. But if these do exist, a superfluity may be unnecessary. Leaders, prophets, seers, are in the way if in too great a number, and it may be better for men to "kill themselves" in effective service, even if not of the rarest kind, than to go on to an old age full of nothing but selfishness, weakness and discontent.

On the other hand, the results of Humphrey,[1] which show that old age is correlated with large families, lead us to expect a gradual increase in old age and just among those stocks which have been successful in serving the basal altruistic functions of the race. The more radiated altruisms also seem favored in the struggle for longevity. Dr. G. M. Beard,[2] believes he has established from statistics that brain-working classes live longer than muscle-working classes, and "that the greatest and hardest brain-workers of history have lived longer on the average than brain-workers of ordinary ability and industry." Donaldson[3] shows from the present admittedly meagre statistics that the curve of brain weight rises with eminent men to 65 years, while it falls from 55 in other classes. Clergymen are particularly long-lived, while born criminals and idiots age quickly and die young.[4] Neurasthenics,[5] generally of an overdeveloped type, are long-lived, although not prolific, as if they represented the last effort of goodstock.

When these distinctions depend upon choice of professions, it has been usual to assume that the character of the occupation exercises the determining influence, although it may just as reasonably be held that the naturally long-lived, sometimes by a sort of instinct, as Dr. Gascom[6] thinks, choose professions where rewards are not obtained till late in life. Farr[7] shows that the greatest commercial value of a laborer is at 25, that of a professional man about 40. As Beard says:[8] "With muscle-workers there is but little accumulation and only a limited increase of reward; and in old age, after their strength has begun to decline, they must, with increasing expense, work even harder than before. . . . . The literary or scientific worker goes on from strength to strength, until what was at 25 impossible, and at 30 difficult, at 35 becomes easy and at 40 a pastime." The oppor-

[1] *Op. cit.*, p. 40.
[2] "American Nervousness," chap. on Old Age, p. 195.
[3] "Growth of the Brain," p. 324.
[4] Lombroso "*L'homme criminel.*" Strahan, "Suicide and Insanity," p. 112.
[5] Beard, Krafft-Ebing *et al.*
[6] *Op. cit.*
[7] "Vital Statistics for 1885."
[8] *Op. cit.*, p. 208.

tunity to choose a profession also is generally associated with wealth and thrift, which represents ancestral effort, and increases with old age. The correlation is just as marked in one way of looking at it as the other. Both factors have probably had their due effect.

Involution. It must be admitted that the phenomenon of involution entails ultimately a general decay and weakening of most of the physiological functions. Height and weight decrease. Locomotion and digestion are impaired. The circulation is feeble, the temperature frequently lower. In many cases the blood becomes uræmic and venous. The arteries harden or the muscular coats undergo fatty degeneration. The testicles become dense and decrease in volume and weight, although spermatozoids are found in half the cases to the latest age,[1] some observers, however,[2] describing them as weak and languishing. The prostate frequently hypertrophies. The ovaries become entirely obliterated, and the vagina sometimes disappears. In the brain the cells atrophy and many of the associational fibres disappear, while the connective tissue hypertrophies and takes their place, or more or less hydrocephalus effects the same result. Ottolenghi[3] finds that sensibility to pain increases toward adult life and diminishes with old age, but that with adults sensibility varies more with social station and grade of degeneration than with age. In morbid cases melancholia[4] and dementia, in line with the general lack of susceptibility to acute diseases, is more frequent proportionally to other insanities than in earlier years. All the magnificent and touching poetry of the last chapter of Ecclesiastes is abundantly supported by the details of modern science.

As to the order in which this involution occurs, a great variety of opinions has been advanced. Reveille-Parise[5] thought that deficient oxidation connected with lessened vascularity of the respiratory organs was the first sign of failure, thus with the ancients making the breath (*spiritus animus*, etc.) the fount of life. Stephens ("Long Life") on the other hand suggests that excessive oxidation is the proximate cause of senescence, showing itself in dryness of the skin and wasting of the organs generally. The theories of Lendl, Dantec, Delage, already referred to, in regarding failure to

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[1] Duplay, *Arch. gen. de Med.*, 1843, 1855.

[2] Reveille-Parise, "*Traité de la Viellesse*," Paris, 1853.
"*Das Gefühl und das Alter*," *Zeitschrift für Psy. u. Phys. der Sinnesorgane*, Jan., 1896.

[3] Sixty-seven per cent. according to Fürstner, *Arch. für Psy.*, pp. 465.

[4] *Op. cit.*, p. 36.

carry on a chemical process as the ultimate cause, involve respiration as only one of the necessary conditions. Hamelin thought the continuance of ossification, especially as affecting the thorax, as the essential point of departure. Cazalis, followed by many others in more recent times, regarded arterio-sclerosis with its consequences of renal and liver disease, cirrhosis, toxic blood, and various kinds of apoplexies, as the starting point of senility. Bouchard thinks that old age begins with a failure in nutrition, and traces diabetes, gout, obesity, etc., to this source. This, as Andre[1] points out, is hardly a distinction, the question rather being, where does nutrition begin to fail? In answer to this Tilt,[2] basing his opinion on a large collection of cases, refers the initial failure to the sympathetic ganglia which innervate and control the blood vessels of the great viscera, an involution which is first shown in the reproductive functions. Following Haller, he regards the sympathetic as an off-shoot of the cerebro-spinal system, an opinion which is supported by the facts of recent embryology. This failure in the sympathetic shows itself about the time of the grand climacteric in general malaise, sleeplessness or excessive sleep, blushings, slight nervous troubles, with their psychical correlations of uneasiness, irritability, slight melancholia. On the other hand the more serious nervous troubles, according to his carefully elaborated statistics, are much more frequent earlier in life. From an estimation of the cases admitted during ten years to the Bethlem Hospital for the Insane, he shows that liability to insanity for women is greatest at 36 to 40, and diminishes from 40 to 55.[3] He supports this by the fact that deaths from brain disease, as shown by the Registrar General's reports, are most frequent in women from 20 to 40, results in accordance with the statistics of Haslam, Pinol, Esquirol, and Foedéré. With men, the period of greatest liability is from 40 to 60. Deaths from all kinds of nervous diseases are only 13% of the whole, about half of which are due to infant eclampsia, and occur about 5 or 6. Of the remaining moiety, it is to be remembered that a large proportion, more than half, are directly due to arterial degeneration, and not primarily an affection of that portion of the brain which subserves the higher psychical functions,[5] while here, too, are to

[1] "*L'Hygiene des Viellards*," Paris, 1890, p. 36.
[2] "Change of Life," 1882.
[3] *Op. cit.*, p. 115.
[5] Cf. Age Curve given by Althaus, "Diseases of the Nervous System," p. 8.

be found the cases of phylogenetic degeneration evidently not due to the influence of old age.

By another way, however, through the support of the cerebro-spinal system to the sympathetic, the former may indirectly affect the innervation, the lack of which results in arterial aneurisms, lack of elasticity, etc.[1] Hammond, for example,[2] points out that traumatic lesions of the marrow are complicated with functional trouble of the cervical sympathetic. "These cases go to show that the cervical sympathetic draws a great part of its nervous action from the superior segment of the spinal cord." Claude Bernard[3] showed that if an animal was debilitated, excision of the cervical sympathetic resulted in mucous suppuration of the bronchi, etc., a trouble which Humphrey[4] notes as one of the commonest affections of old age. The value of the tone of the cerebro-spinal system to the height of the blood-pressure, proximately mediated by the sympathetic, is shown by Owsjannikow,[5] who demonstrated that removing layer after layer of the trunk causes a fall of manometrical pressure before the pons (circulation centre) has been reached. Gley[6] supplements this by showing that cutting off the medulla causes a fall in pressure, cutting out the spinal cord a greater fall, after which, however, contraction of the blood vessels was still possible in reaction to the injection of certain chemical substances, thus proving the partial independence of the sympathetic as well as the support afforded by the spinal system.

The importance of this connection is witnessed by many more purely psychological phenomena. Mosso ("*La Peur*," *e. g.*) has made special studies on blushing (less prevalent in age) and cerebral circulation. Careful experiments with the plethysmograph in many psychological laboratories have shown the almost instantaneous influence of psychical impressions on the circulation of various parts of the body.

In face of death by starvation, the most typical of all forms of death, it has been abundantly demonstrated that while all the other organs of the body gradually atrophy, the heart, the kidneys, and more especially the brain, remain exempt.

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[1] The smaller vessels of the brain itself are not generally supposed to be supplied with sympathetic fibres, which, if a fact, would only result in making the strain of a weakening sympathetic fall primarily upon the other organs.

[2] "Diseases of the Nervous System," 1890, p. 866.

[3] "*Path. du Sys. Nerv.*," T. II., p. 535.

[4] *Op. cit.*

[5] Quoted by Meynert, "Psychiatry," trans. by Sachs, 1885, p. 206.

[6] *Arch. de Phys. n. et p.*, Brown-Sequard, 1894, p. 202.

As Mosso says,[1] "the last overflow of the vital material of the body is sent by the last heart-beat to the brain." He points out that increased nervous stimulability of the brain in face of starvation would be a favoring factor in natural selection. The flaring up of dormant faculties just before death is, no doubt, an expression of a similar condition.[2]

With the approach of old age there seems to be plenty of cases which follow an order of involution which is not descending. Muscular power, for example, generally fails before the capacity to direct the labor of others. Humphrey, from reports of 900 cases observed by medical and scientific men, notes "how many of the very aged are in good possession of their mental faculties, taking a keen interest in passing events, forming a clear judgment upon them, and full of thought for the present and future welfare of others."[3] Even in centenarians "the brain held out as well or better than the other organs."[4] In green old age (*age de retour*) there can hardly be any doubt that the intellectual qualities are even relatively improved. Balfour,[5] following Beneke[6] and other anatomists, points out a rather remarkable adaptation which favors the brain, namely, that while the other arteries of the body may be completely calcified, the internal carotids and vertebral, which feed the brain, normally remain soft and yielding. Towards old age also, the heart normally hypertrophies, beats faster, and correlated with these changes the blood itself actually increases in hæmoglobin, and when these changes do not occur at the proper age the whole physical and mental health suffers. Heart stimulants, *e. g.*, digitalis and strychnine, the latter of which at least acts primarily on the nervous system, are found highly successful, often changing at this period of life the anæmic and dejected individual into a healthy and active old man. The most commonly repeated difficulty of either the natural or the artificial adaptation for old age, appears to be degenerative changes in the internal arterial coats (which may be primarily caused by lack of innervation). These either by coming off in pieces and forming plugs, or by pocketing in weak spots (miliary aneurisms, *e. g.*), give rise to hemiplegias and apoplexies of various kinds. The maxim of Cazalis, "a man is the age of his arteries," although by no means applicable to every case, seems to be supported by greater numbers than the descending degeneration theory of involution.

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[1] "*Die Ermüdung*," p. 285.
[2] Cf. Féré, "*Path. des Emotions*," p. 170 et seq.
[3] *Op. cit.*, p. 24.
[4] *Op. cit.*, p. 48.
[5] G. W. Balfour, "The Senile Heart," 1894.
[6] "*Die Altersdisposition.*"

Even in the etiology of the distinctly mental troubles of old age, recent opinion shows an increasing tendency to give a large place to causes of a somatic nature. Of mental diseases generally, Dr. Rohé[1] states that the view that many mental disturbances are due to auto-intoxication is gaining ground among alienists, and cites to this effect Price, Kerkley, Lash, Emminghaus, and Kraepelin. Norberry[2] claims that "senile dementia" covers diseases "essentially different in nature and symptoms." J. A. Houston[3] examined the blood of fifty-two melancholiacs, and found hæmoglobin deficient in every case. The editor of the *Jour. of the Am. Med. Assn.*[4] thinks that most of the cases of mental confusion in old age may be due to uræmic intoxication. Ludwig Wille[5] ascribes the pathological mental involution as originating in "derangements of the circulation and nutrition of the central nerve substance caused by the morbid condition of the organs of circulation," a view in which Kraepelin in his chapter on old age coincides.[6] W. F. Farquharson[7] analyzed 230 cases of melancholia during twenty-seven years, and says, "Leaving out of consideration hereditary disposition and previous attacks, the cause of melancholia was found in a marked preponderance of cases to be of a physical nature." Nötzli[8] brings to view the great prevalence of lesions due to arterial degeneration. He carefully weighed the different parts of the brain in 110 cases, and found that the cortex lost considerably less than the basal ganglia. Within the cortex the frontal lobes did not lose more than the occipital. Senile dementia is, however, in the most of cases more probably a phenomenon of phylogenetic degeneration, and is not to be regarded as a peculiar characteristic of old age. Krafft-Ebing and Lombroso claim that senile dementia is more frequent with the morally insane and born criminals than with other classes.[9]

From these facts it would seem as if Roux's conception of a liberating stimulus to the lower ranges of assimilation originating in and controlled by the highest work-product, would be fulfilled by some such relationship of the cerebro-spinal and sympathetic nervous system as Tilt suggests, when the stimulus to nutrition is to be regarded as the last or the most

[1] "Mental Diseases," *Medical Annual*, 1894.
[2] *Hosp. Bulletin* of 2nd Univ. Hosp., Aug., '92.
[3] *Boston Med. and Surg. Jour.*, Jan. 18, 1894.
[4] "Psychoses of Old Age," Nov. 30, 1895.
[5] "Old Age and its Psychoses," Hack Tuke's Dict., p. 869.
[6] "*Kompendium der Psychiatrie*," Leipsic, 1883, p. 367.
[7] *Jour. of Mental Science*, London, Jan., Apr., 1894.
[8] "*Ueber Dementia Senilis*," 1895.
[9] Lombroso, "*L'homme criminel*," p. 569.

complete form of the general nervous activity, and that the body, as far as it is an organism, is so mainly because there is thus brought into immediate connection the extremest functions of the organism. The human body is, first of all, an organism, and the organs of relation are thus in normal cases the most permanent and enduring.

Despite these facts, however, since the days of Bichat and earlier, there have not been wanting authors, principally alienists, to hold that the failure of old age begins normally at the top. In the present times Ribot, Ross and Mercier have adopted this theory. Mercier[1] regards the essential phenomena of old age as a cutting off of the most recent and most highly developed brain layers. Old age is like a frost-blight, which nips the buds the latest grown. He and Ribot[2] also seem not to distinguish very clearly between the phylogenetic development, repeated and appropriated by the individual, and the mere repetition of actions in time in as far as this refers to old age. Memory of recent events no doubt fails in old age. But what evidence have we for supposing that these acts of memory presuppose any new brain growth, such as would be necessary if we are to use a simile like that of the budding tree, or the upper and lower brain levels of Mercier's theory? The really most recently grown structure (like the city which has originated from the surrounding country, used as a storage depot and an organ of control) may be just as permanent as any other, or more so, except under the strain of distinctly degenerative (phylogenetic) causes. No doubt in an ultimate sense we must admit the complete co-determination of structure and function, but this does not excuse us for running away with crude ideas of structure, wholly derived from the limited range of present observation. In brain matters particularly, our knowledge of function is vastly ahead of that of structure. Memory, it must be remembered, is no mere partial faculty. It is really a fundamental quality of all tissue.[3] And with the loss of memory that comes from hemiplegia and similar morbid causes, which give the greatest number of cases of aphasia upon which the strongest argument rests for degenerative senile involution, we have frequently a portion of the brain entirely destroyed, so that no vital quality, memory or otherwise is left behind. Where this focalized lesion attacks the language centres, there are no doubt many cases in which in a

[1] "Sanity and Insanity."
[2] "Diseases of Memory."
[3] "Memory in Disease," Strahan, *e. g.*

general way the degeneration begins at the top of these centres; but there are others where this does not seem to be the order followed, and besides this there are many cases, as Bastian[1] points out, "where aphasia has been most complete, but the mental powers have been well preserved." The number of cases, too, where the left brain (the centre of language) is affected do not seem to be the greatest. Brown-Sequard found, of 121 cases of hemiplegia, the left brain was affected in twenty-four, the right in ninety-seven cases.[2]

The normal failure of memory, so-called, in old people is really a failure of recollection of certain events in preference to certain others. This may not be due to descending degeneration. Recollection, while it presupposes memory, is yet something more. In the first place it depends directly upon blood circulation and drops out in sleep. Here it must be admitted that Mercier has the courage of his conviction, and is consistent with himself in saying that sleep itself is a form of dementia, indeed the "last and most complete stage of dementia known as coma,"[3] an extreme which surely indicates the necessity for more careful distinctions.

Old people may dwell upon youth and early married life because it was their happiest period, while, as far as we have any proof, this is the period of the formation of the highest layers, the latest buds, etc. The only way, if we are to apply recapitulation, is to compare memories, *i. e.*, capacities formed in early childhood with those later on while still in the course of recapitulated phylogenetic development. Beyond this period there exists a more purely ontogenetic development which has not had the same necessity for being so thoroughly established in philogeny, to which the criterion of race development does not apply to the same degree. Peculiarities of the individual, or of his immediate ancestry, as Roux and Darwin mention, come out more strongly. These of course may form the new material for selection and may result from a new creation, or from a pathological condition or decay. Geddes, indeed, is of the opinion that all sports or variations may be originally pathological. The beginning and continuance of senescence may thus be the most important of all the periods of life for the origination of fresh development. But in any case we are not in a position to apply the recapitulation theory.

Instead of a fresh budding of growth, the recollection of events may just as well be compared to the sending of a train,

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[1] "Paralysis from Brain Disease," p. 198.
[2] Quoted by Bastian. *Op. cit.*, p. 209.
[3] *Op. cit.*, p. 299.

for example, between New York and Chicago. That the train does not pass is no proof that the track is destroyed. There may be at the time or for short notice (the inelasticity of age) no coal or no crew. So no doubt in imperfect recollection we have a lowered state of the physical organism, which is similar to, and perhaps caused by, greater slowness and imperfection of digestion and circulation as well as by general physical decay, but which is no proof that there is greater structural or permanent functional impairment of the higher brain-paths than of others, or of the brain itself as compared with the rest of the body.

Here early writers, Bichat for example, seem to have initiated a faulty way of looking at the brain, in drawing so strict a distinction between the animal and the vegetative functions. Careful measurements now show us that in sleep, as in other lowered functional conditions, such as old age, the vegetative as well as the psychical functions are materially lessened, and we have no right to regard the plastids of the brain, which only more specially subserve animal or psychical functions, as not being just as vegetative and just as much organs of digestion as any others in the body. We have here not a question of specialized vegetative functions of the really living protoplasm. The plastids of the stomach, for example, are as capable of being starved as any other, since nervous stimulus is necessary for their activity, and the food which they use is furnished by the blood as for any other organ.

The body, although in itself an imperfect organism, is, in fact, as Roux insists, a collection of parts which are themselves again imperfect organisms. The vegetative functions, meaning by this simply the basal qualities of assimilation and digestion, belong to every plastid. Among these, however, a struggle for existence takes place, the results of which are more marked in old age than in any other period, but for the just estimation of which we must not confine ourselves to any one class of phenomena, and more especially when these are of an admittedly morbid, *i. e.*, phylogenetically degenerative character.

The truth seems to be that in the struggle for existence among the various organs, through the course of a life-time, certain of these, partly through hereditary strength, and partly through a greater compensation due to exercise, or for their opponents either over or under use, obtain an advantage over the others, which, when it becomes so marked as to deplete some other necessary organ, results at last in debility and death. The organism in old age thus loses its power of self-regulation and, as Johannes Müller[1] recognized,

[1] "*Physiologie*," Coblenz, 1844, Bd. II, S. 767.

is to be compared "more to an ingenious mechanism than to that basal form of the organic whole which produces the mechanism from itself, and makes it capable of compensating for its loss. Therefore in old age a very small outer strain is able to bring to an end the whole, as is the case with a mechanism."

Even when the good adjustment and balance of the several parts which are necessary to a healthy old age exists, "a time comes at length when in the course of the descending developmental processes, the several components of the machine, slowly and much, though equally, weakened, fail to answer to one another's call, which is also weakened; a time when the nervous, the circulatory and the respiratory organs have not force enough to keep one another going; when the wheels stop rather than are stopped, and a developmental or physiological death terminates the developmental or physiological decay. The old man who had gone to bed, apparently much as usual, is found dead in the morning, as though life's engine had been unable to repair itself in sleep sufficiently to bear the withdrawal of the stimulus of wakefulness. Or some exertion may be followed by too great exhaustion. Dr. Willis, the attendant upon King George III, at the age of 90, after a walk of four miles to see a friend, sat down in his chair and went to sleep, or was thought to be asleep, but he did not wake again. Or some slight scarcely noticed excitement may have the same result. A cattle dealer, aged 98, who attended Norwich cattle market on a Saturday of last year, soon after talking and laughing somewhat heartily with a few friends on the following Tuesday, was found to be dead. Or a slight indisposition, further lowering the status and force of some organ, fatally disturbs the feebly maintained equilibrium. A lady, aged 94, attended the early service at church, walking a distance of a quarter of a mile, to and fro, caught a slight cold and died in the night."[1]

Among the different organs there is none whose normal activity conduces more to the best balance of the various parts than does the brain. This, indeed, along with the storage necessary for such a task, appears to be its principal function. It is thus easily understood why the intellectual and liberal professions allow the greatest opportunity for longevity. Ultimately the forces of life are controlled and stimulated by the highest development of the work-product of assimilation, represented in our psychical life as thoughts and feelings. Intellectual labor, emotional susceptibilities, ideals and aspirations, and their wise direction by a fully

[1] Humphrey, *op. cit.*, p. 6.

cultivated art of education, are thus functions which without transcending the here and now of a strictly biological sphere, tend to increase the vigor and the length of life.

With the beginning of the grand climacteric and the increase of age, the individual qualities *per se* assert themselves, with of course only a relatively greater strength. These qualities are, however, formed in the earlier periods of life and in contact with the great passions which underly them, the brain, as the highest work-product of assimilation, offering the means for radiation. In these periods it has been necessary in the course of natural selection for the individual to be held under by the race. But with the age of descent he passes out to a certain extent from the protecting shadow of the phylogenetic life and becomes more ontogenetic and individual. Old age is the period of distinction. It is in line with this that it is a period of extremes among individuals, which may account for the fact that authors have differed so much in describing its features. Cicero, for example, praises old age, while Aristotle condemns it. Melancholy, irritability, egoism increases; so does good health, calmness, sacrifice. Samuel Rogers, the poet, said he never knew what health was till he was 55. It is the race life, however, that is normally the source of our greatest force and happiness, and old age is only successful when it has so absorbed this life that its more intellectual service becomes its deepest motive and highest happiness. In maturity we serve the race by the blind impulsion of instinct if in no other way, but in old age much more because we elect to do so. In this respect old age is really the test of life from an individual standpoint. Solon's apothegm, a man can never be pronounced happy until he is dead, had no doubt some such significance.[1]

The questionnaire. With the aim in view of obtaining a general picture of the common notions on the subject of old age, death and the future life, the questionnaire subjoined[2]

[1] Cf. George Meredith's poem on "Old Age."

[2] TOPICAL SYLLABUS FOR GENETIC PSYCHOLOGY.

(Second Series, Academic Year, 1895-6.)

IV. THOUGHTS AND FEELINGS ABOUT OLD AGE, DISEASE AND DEATH.

I. *As a child*, how old were people you thought aged? How long did you want to live? How did you fancy old people felt, thought, etc.? Did you love the companionship of any old people, and what traits in elderly people attracted and what repelled you?

II. As a child, when and how did you make your first acquaintance with death, with details, and how it affected you? What were your earliest ideas about corpses, funerals, hearses, coffins, shrouds, mourning, the grave, and what took place in it? Did you think of worms, bones, etc., or conceive the body as feeling cold, damp,

dark, or shut in and smothered down? Did you have spells of dwelling on such things, and did you develop any mental imagery of the soul in or leaving the body, or what it was, or where, or its state? Was it gaseous, luminous, easily blown away, bluish, heart-shaped, resident in the head or breast, or what?

III. What diseases did you fear most for yourself or others? How did you think they acted? What accidents or other death-bringing agents did you develop most imagery about? Did you ever fancy yourself either dead or dying? and, if so, tell all about it.

IV. When in your teens, or later, did you ever have spells of dwelling on death, coquetting with flitting suicide thoughts, or day-dreaming how others would feel or act if you were found dead, and, if so, were these feelings or fancies associated with anger, love or religion, or any other experience, and how? At what period of life have you thought most of these things? Under what circumstances have you ever thought suicide might be justifiable? How, when, and in what condition would you prefer to die? Have you ever been suddenly very near to death, and what were your feelings at the time and afterwards? What background feelings when a sense of the miserable shortness of life comes over you?

V. What used to be and what are your deeper and most instinctive feelings, thoughts or questionings about a future life for yourself or others, and what changes have these sentiments undergone? Are these things fixed beliefs or fluctuating with moods? and, if the latter, describe your different sets of psychic states. How long after death do your thoughts run, and what used to be your fancies about heaven, souls, angelic occupation, association with friends, etc.? Do you have two sets of feelings — one hopes, taught beliefs, and another to fall back on if the former should be more or less mistaken? and, if so, describe them. What is your feeling about the friends you have lost?

VI. Will you ask old people of your acquaintance to either write themselves or tell you whether they dread death, if so, why? What they expect hereafter if they dwell much upon it, etc.? Ask them if they would like to live their life over again if it were to be the same, or to go on to death, and what changes, if any, would make a difference with their answer. Ask what period of life they considered most worth living, and why. Also, what they dwell on most in the past. Ask about their sleep habits, and what they dream of, or what reveries they prefer to dwell in. Ask especially at what period of life they thought most of death. How they first realized they were growing old, and how each increasing sign of it made them feel, and especially ask them to state how the climacteric period affected them. Have they made wills, had life insured, directed about their funerals, and otherwise provided for the disposition of their body or effects, and if not, why not? Get any points bearing on what might be called the psychic phenomena of increasing senescence. Have they ever longed for death, or felt life a disappointment or failure hardly worth living?

VII. State any texts, hymns, phrases, proverbs, sermons, or literature, whether prose or poetry, or any expression or conversation, that have modified your feelings about these things. What is the best literature on old age you know? State also how loss of nearest friends or sudden death or prolonged suffering has affected your feelings. What, if any, *real* sources of consolation have you found?

VIII. State anything you know of the experience, past or present, of your confidential friends in these matters.

was issued some months ago by Pres. Hall and myself, to which were received answers from 226 persons. Our thanks are due to those friends who so kindly furnished us with returns, and in an especial manner to Miss Lillie Williams, professor of psychology in Trenton Normal School, by whose instrumentality a great number of them were obtained.

The returns altogether have furnished nearly 15,000 answers on various subjects, and as there were some 120 questions, it will be seen that on an average only a little over half of the questions were answered by each. About sixty per cent. of the answers were from females, and although these were kept separate in working up the returns, there was not found to be sufficient practical difference between the sexes in the ideas mentioned to keep them separate in this report.

The returns pertaining to childhood are specially valuable as they are derived from reminiscence. A person will generally tell what he thought as a child of such matters much more freely and without bias, than the child is able to tell himself, or than the adult will consent to tell of his present ideas. This latter point is indicated by the number who omit to give their present convictions with regard to the soul and the future life. The importance of child thought with regard to the future life has recently been emphasized by Runze.[1]

In making curves and tables indicating quantitative results, those only which are decided and emphatic are considered as of value in comparison. For this reason the percentages are

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IX. Always state age of every experience, also sex and nationality. Describe, briefly, health, temperament, complexion, size, signs of age, as baldness, decrepitude of any sort in walking, vision, hearing, memory, whether good looking or deformed, etc. Also whether married happily, how long, how many children, their health and success, what circumstances, friends, etc.

Send returns to

G. Stanley Hall,
or Colin A. Scott.

Clark University,
Worcester, Mass., Nov. 1, 1895.

N. B. Please answer as many of these questions as you desire; or, if you should wish to ignore the questions altogether, and communicate your impressions in your own way concerning any of the above topics, your contribution will still be of value, whatever form it takes. Every communication will be treated as strictly confidential, and in the report which will be sent those making returns, everything thought likely to betray the personality of the sender will be suppressed. Those not wishing returns can write anonymously.

[1] "*Psychologie der Unsterblichkeit.*"

kept in whole numbers. This perhaps should always be observed as one of the necessary safeguards of the questionnaire method. The individual cases, however, have an importance of their own, and sometimes the mere fact of a large number of erratic or unrepeated answers is not without quantitative value. These answers are on the whole like the sediment found in the bed of a stream, partly original or derived from the immediate surroundings, and partly the remains of ancient beliefs washed down by time, but full of fascinating problems for the psychological geologist.

It is interesting in this connection to observe that many of these beliefs show signs of weakening and decay. The limited number who mention hell, for example, indicates a considerable change from the days when, here in New England, the most widely circulated publication of its period (for 100 years, says Tyler) was a poem (!) by the Rev. Michael Wigglesworth. This production, which children were compelled to memorize, gives the course of an argument between unbaptized babes condemned to eternal damnation on account of original sin, and the Lord Christ, in which the latter obtains the best of the argument, but with a show of mercy concludes:

> "A crime it is, therefore in bliss
> You may not hope to dwell,
> But unto you I shall allow
> The easiest room in hell."

Rubric 1. Child's Idea of the Thoughts and Feelings of Old People.[1] Here it is perhaps natural to find that 80% of those who give returns on this point (104) take a pessimistic view. Of these 24% pity old people because they could not run and play; 12% thought of them as tired and stiff; 14% as weak, miserable and unhappy; tired of life, don't enjoy, indifferent, 14%; felt in way, 6%; thought of nothing but religion, reading the Bible, praying, and what they would do in heaven, 13%; nothing but read papers, sew, knit and can preserves, 12%; cross, 7%; thoughts of death, waiting for death, 19%; wishing they were young, 11%; as willing to die as live, 3%; want to die, 2%; died when they made up their minds to, 1%; rather be a little infant than die, 1%; were solemn, gloomy, stupid, sorry, sad, lonely, sleepy, conceited, jealous, 16%; didn't want others to enjoy, 3%; thought of nothing but the wrong things little children did, 2%; that nothing could hurt them, they could not cry, 3%; did no wrong, 1%; didn't know if they did feel, 2%; never thought about them, 3%.

[1] Cf. Rubric 4.

Of the 20% who took an optimistic view, 8% thought of old people as happy, that they were wise and knew everything (weather, *e. g.*), 7%; pleasant to have some one wait on you, 2%; do what they pleased, 2%; looked forward to the time they would be children (cf. Sully), 2%; preferred to be old, 2%; enjoyed watching children play, 1%.

It is evident from adding the percentages together that for both the optimistic and the pessimistic classes above mentioned, one person may contribute to more than one of the subordinate expressions.

Rubric 2. What Children Liked in Old People. Of 140 returns, those who mention gifts, pennies, candies and eatables were 34%; telling stories, 21%; stories of childhood not included in last, 16%; kindness and petting, 16%; those who played with them, 10%; gave means for games and looked on, 8%; gray hair, 15%; caps, 6%; aprons, 2%; let help, 4%; interest in the things the child did, 4%; indulgent, 4%; intercession with parents, etc., 4%; advice, 2%; looked neat, 2%; cleverness and knowledge, 2%; restfulness, 2%; never got angry, 1%; loved to be with, 7%; preferred to children's society, 7%; no traits disliked, 4; generally liked, 21%.

Sub-rubric. Individuals mentioned as specially liked were 45 in number. Of these a grandmother was mentioned 24 times (or by 24 individuals); a grandfather, 10 times ; some old woman, 7 times ; some old man, twice ; an aunt, once ; and an uncle once.

Rubric 3. What Children Disliked in Old People. 140 returns. Wrinkles, 24%; untidiness, clothes, etc., 12%; tobacco chewing, 11%; tobacco smoking, 2%; snuff-taking, 1%; tobacco in any form, 5%; liquor drinking, 1%; slow and tottering gait, 10%; trembling voice, 5%; slobbering, 4%; eating habits, 3%; forgetfulness, 4%; cross and scolding, 5%; bad pronunciation, 2%; whiskers, 3%; bent form, gums, loss of teeth, 8%; sunken eyes, 2%; matter in eyes, 2%; gray hair, 3%; advice, 2%; kissing, 2%; no traits liked, 2%; generally disliked, 10%.

Sub-rubric. Individuals especially disliked, 10%: old woman, 3 times ; old man, 3 times ; aunt, twice ; grandfather, once ; grandmother, once.

Rubric 4. As a Child, what Age in others was Considered Old. 75 cases.

Average of	24.5 years	53%
Average of	47.3 "	35%
Average of	60.6 "	12%
Total average,	37.3 "	

Sub-rubric. Other indications of age besides years. 24 cases. Of these white and gray hair was the sign in 12 cases ;

4, confused old with grown; 5, had no signs of age; 1, judged by trousers and long dresses; 1, by a full beard, and one thought that after a certain age a person did not get older.

This rubric may be compared with Nos. 1, 2 and 3, where it is probable from the character of the answers that those making returns have in view in the most of cases a greater age than the total average of 37 years given in rubric 4. It is, however, quite plain that children, although they no doubt discriminate the ages of their companions very keenly and even jealously, have a very hazy idea of the ages of adults. Up to the age of 17 the first of these characteristics shows itself. Seven of those who answered the questionnaire were careful to say they were 17½ or 17 and so many months. From 18 on there was no division of the years in giving the age. There is of course abundant reason for this in the rapid changes which characterize this period of life.

Rubric 5. Wished to Live to what Age? (As a Child.) 110 returns. Live to 100, 20%; several hundred, 1%; as far as could count, 1%; to average of 20 years old, 14%; to average of 69, 25%; (*total average of foregoing 111 years, by 63%*); live forever, 9%; no idea how long, 4%; till end of the world, 2%; be the last alive, 1%; very long, 2%; at 40 (the pleasures of life then over), 3%; "not longer than" an average of 56, 4%; when old get little again, 2%; when mother died, 1%; extinguished when too old to go school, 1%.

These five divisions may be more concretely illustrated by the following quotation from a return made by H. B., a lady of 33, happily married, with four children. This return is particularly interesting as showing the transition of the child's ideas towards those of adolescence. It is evident that the dwelling on length of life in this case takes the place of dwelling on death referred to in the table on that subject, and comes in at the same age:

When about 12 to 15 I always wanted to live till I was very old. It used to give me great pleasure to count the years by tens, because ten years seemed such an immense long time. In 10 years I'd be 25, and beginning the life I wanted especially (that is, my marriage, which was always the beginning of my life). In 10 years more, 35. It would take such a long time to pass. In 10 more I would be 45, and if I once could live to be 45, and go through the experiences I wanted, having a husband, a home, and children, I felt death would not be a great terror to me, but I felt it would be a terrible thing to be born and live, and not go through these experiences. I used to think (12 to 15) that death would not be so bad if I had my very own, part of myself, *i. e.*, husband and children, to die with, and I feel this yet. When I would try to reflect—now you might die and not have this experience,—it is impossible to describe how terrible it felt to me. I felt it would have been in vain

to be born. But if I reached 45, death would be robbed of its terrors. (I don't have this feeling now, but would like to live to 75 at least.)

After 15 I felt (with a little scornfulness) that it would be *impossible* for me to die—that it was certain that I would have these experiences that I longed for.

At this time these emotions were played on a good deal by religion. I frequently attended class meetings, revivals, etc. My companions were converted and tried to impress upon me that I was not saved. I felt if I was a Christian I would have to make the greatest sacrifices, do without gloves, etc., and would have to influence other people to live good lives, and I did not feel able at this age to do so. But I thought I'll live a good life now, but I'll postpone conversion till after I'm married. It will be so easy to be everything good after one is married. That would be a solving of all questions. Marriage was to be the opening up of my life in every respect: conversion, morality. I felt that I was willing to do all these things when I entered the married state. The texts, "Her daughters shall arise and call her blessed," and "Her husband shall sit on high places," used to thrill me. It makes me smile now—I was so young to be thinking of such things.

At this age and before it, I had no special reverence for old age. I thought it was a deplorable state to be in, and old people were always comparing themselves to their own disadvantage with youthful people—that it was always in their heads. But I used to try to make things easier for them. Knowing that my father (then about 60, and he is still living), had an aversion to speaking of old age, I never liked to have any one allude to it in his presence. When I was very young I noticed how his shoulders stooped, and used to like to take off his boots and put on his slippers. I wanted him to know that I loved him, and this was my way of expressing it. He never used to ask me, but thanked me, saying, "That's the lass!" but yet I never did it for the praise, but to show him that I loved him. I would follow him to the hall door and see that his coat and hat were brushed, and took a pride in seeing him look young. I even brushed his boots so that he would not have to bend his back. The brighter I could get them the happier I would be. The boys, my brothers,wouldn't do it. I used to bribe the boys, give them things of my own, and plead with them to cut the wood, etc., so that father would have no anxiety. I used to try to economize on his account. I did all this with mixed feelings of love and pity, used to sob for his old age. I never experienced anything of this kind with my mother.

After 16, when I was beginning to get introduced to young men, I began to get more selfish, and to think more of my personal appearance, but I could not bear the thought of my father dying. I used to sob and cry often with the thought that my father was old and did not have many years to live.

Rubric 6. Wished to Live to what Age? (*As an Adult.*) 48 returns. Before feeble or very old, 32%; when work or ambition is complete, 20%; in midst of work, 2%; average of 60 years, 16%; to 100 years, 2%; as long as possible, 4%; when old, 6%; never die, 2%; never thought of it, 10%.

Rubric 7. Aged People's Desire for Life. 16 cases, of an average age of 76 years. Would not care to live life over, 94%; would like to live life over, 6%; longed to die, 70%;

have not longed to die, 30%; thought most of death in later years, 44%; most in childhood, 14%; life best worth living in youth and early marriage, 60%; not worth living now, 14%.

Illustrative case. Married male, 65 years old, does not believe in future life. Have asked several old people, myself included, whether they would like to live their lives over again if it was to be the same, with the same trials, temptations and struggles for an existence. Most every one says "go on to death." Some think if they had their present knowledge they might try again.

Rubric 8. How Prefer to Die? (*Adults.*) 98 returns. Average age, 22%; short illness, 35%; suddenly, 21%; by lightning, 3%; drowning, 3%; long illness, 1%; old age, 4%; consumption, 3%; when conscious, 8%; unconscious, 5%; with no pain, 9%; ready to meet God, 5%; heroically or in some cause, 3%; surrounded by friends (grandchildren mentioned by two young girls), 23%; at home, 6%; away from those who would feel badly, 1%; at sea, 2%; no preference, 1%. Newsholme's[1] notion that the most of people would prefer to die of old age does not seem to be borne out by these returns.

Rubric 9. The First Impressions of Death, the Grave, etc. On this topic the returns are remarkably numerous, being 204 out of a total of 226. They are also very full of description, often descending to the minutest detail. 98 of the returns do not give the date of their earliest impression. This fact is of importance in comparing the relative numbers of the unfavorable and favorable mentions of table on pages 93-94, with the curves representing the results in the dated returns. It will be seen that the increased age has increased the unfavorable mentions.

The following condensation of a number of cases, where M. stands for male and F. for female, will give an idea of the material used:—

F.—1. Hearses pretty; wondered why we never went to drive in one; fond of mourning; wanted to have a black dress; grave a place where they put the body till the judgment day, when it was resurrected; never thought of worms. *F.*—2. Thought God came and took you out of the grave shortly after you were covered up; thought three or four days after a person was buried, he left the grave by an underground passage, and went to heaven in the night time when it was dark and no one saw him. *F.*—3. Thought it lovely to have a new dress and a long, black veil; always desired to have a doll with a full mourning suit. *F.*—4. The night a person was put in the grave an angel would come down from heaven and cut the soul out and fly back again. *F.*—5. Funerals unpleasant because every one wore black; coffins pretty with their dark wood and pretty handles. *F.*—6. Would look in the shop windows and pick out the prettiest coffin for grandpa when he died. *F.*—7.

[1] Vital Stat.

Hated to pass corpses, or even see them; coffins extremely repellent; shrouds dreadful. *F.*—8. Sad when I saw a hearse; feared the pall-bearers might drop the casket; hated coffins for fear of being buried alive. *F.*—9. Thought corpses were wax dolls; must be so nice to ride in a hearse, because one could look out at all sides and see things. *F.*—10. Never afraid of corpses, and always thought they looked so nice and lay so *still;* could not bear to see coffin lid shut; thought coffins were pretty, but hated them for having a cover, so the person could not see out when in it; disliked mourning; people still and sad. *F.*—11. Used to play funeral; one would lie on a lounge, and we would pretend she was sick and go to see her; after awhile she would die, and we would all go and cry over her, and then we would take her by the feet and shoulders and carry her into a corner. Although I always thought it was an awful thing, I often used to play I was dead (when quite alone), just to see how it would feel; I would stretch myself out on the floor, cross my hands, and hold my breath as long as I could; then I would imagine people coming in the room and looking at me in my coffin and talking about me. *F.*—12. Thought clergyman was the dead man. *F.*—13. Crying a pretence. *F.*—14. Relatives' duty to cry till funeral. *F.*—15. Funeral an impressive social function. *F.*—16. Played that the corpse came to life and scolded those who said mean things about it. *F.*—17. Had no idea whatever connected with coffins, shrouds, hearses or the soul; I never gave them one thought. *M.*—1. Hearse nicest wagon at the funeral; wanted to ride in it. *M.*—2. When about 10 I was allowed to ride on a hearse; I have always remembered this as one of the greatest pleasures of my childhood. *M.*—3. Lived near a cemetery, and we children used to play with skulls and bones which were dug out when new graves were made; had an antipathy to the cold of a dead body; at 12 I made an effort to overcome this ridiculous feeling by going up to and touching the corpse of a man who had committed suicide by hanging; I was unwilling to recognize the feeling of antipathy as natural to me. *M.*—4. Thought the women who cried at funerals were "taking on," to make a show and impress people. *M.*—5. Disliked funerals; liked hearse; disliked mourning; liked coffin; disliked grave. *M.*—6. Mortal dread of coffins; horrified by seeing an undertaker lie down in one. *M.*—7. Liked to see box lid lowered and earth shoveled in.

A good many mentioned that they tried to cry, and a great many spoke of curiosity as their dominant feeling.

One of the most striking things that comes out in this part of the material is the apparently unfounded way in which in the same individual some things connected with death, funerals, etc., are favorably regarded, and others put as positively disliked. Of the 98 undated returns, no less than 40 are favorable to some of the items given below, and unfavorable to others; 23 are wholly favorable to everything mentioned, 30 are wholly unfavorable, and 5 are neutral or indifferent. The following figures represent cases :

	Favorable.	Unfavorable.	Played.	Never Thought Of.
Coffin,	9	22	2	4
Funeral,	16	17	12	1
Hearse,	25	16	—	3

	Favorable.	Unfavorable.	Played.	Never Thought Of.
Wanted to ride in,	13	—	—	–
Mourning,	11	14	12	1
Corpse,	7	14	7	2
Grave,	2	14	included in funeral	1
Shrouds,	6	7	—	–

From the 106 dated reports of first impressions a set of curves has been drawn, in which the horizontal lines represent *cases*, mentions, etc., not per cents., and the vertical age in years. What is meant by a detailed and strong impression may be illustrated by the following:

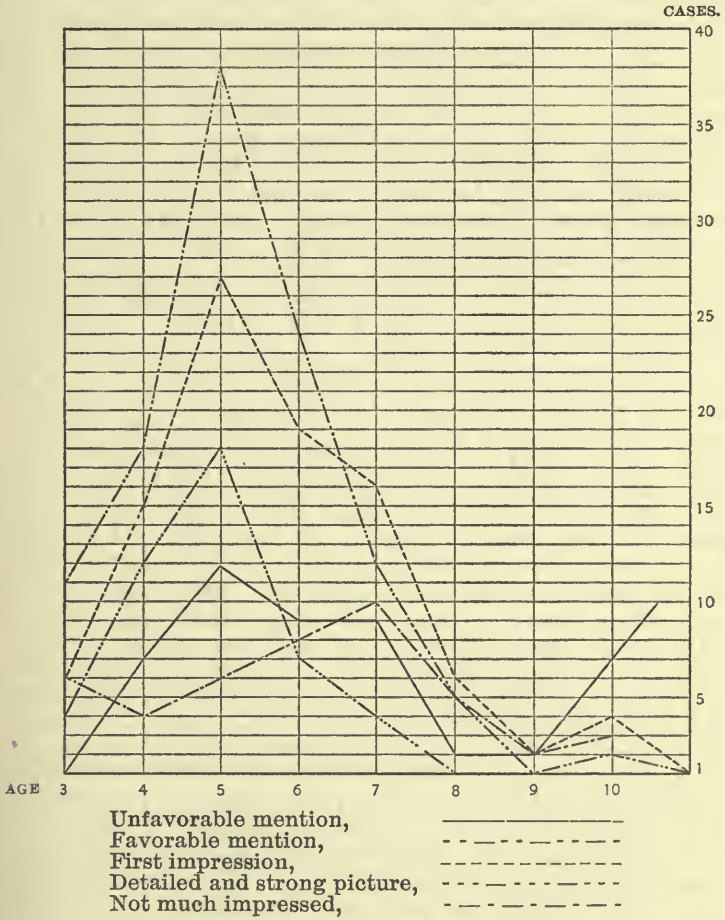
F. When I was 5 years old I received my first impression of death. An old Catholic lady coaxed me to come in and see her dead son in his coffin; I distinctly remember the room and the position of the coffin; she had candles burning on the table; around the coffin there sat about half a dozen women, who were showing their sympathy by weeping and moaning; the old lady took me by the hand and led me up to the coffin; I remember that he wore a shroud; I looked at the face and drew back, as his eyes were not completely closed; I cannot say I was afraid; I think it was more surprise than anything else.

Favorable and unfavorable "mentions" refer to the seven items in the table above, a much larger proportion referring to the dead body than before. It is evident that the number of "mentions" are in excess of the cases. Comparing the area enclosed by the "favorable mention" curve with that of the "unfavorable mention" one, it will be seen how much more numerous the first class is than the second. It will also be seen that the first class has a very decided apex at 5, while the apex of the "unfavorable mentions," although it occurs at 5, yet rises beyond the others at 10. The fact of the apex of this curve occurring at 5 is evidently due to the large proportion of all first impressions occurring at this age. These curves show most emphatically that the age for obtaining the first impression of death is generally at 5, and that if delayed till much after this age, it is much more likely to be an unfavorable one, sometimes giving rise to a horror which is never overcome.[1] The curves representing "strong and detailed impressions," and "not much impressed," support the above conclusion. The impression referred to is always of a very material or external character, and quite frequently visual. The grief of the mourners is not understood. Later on the external impression is not stamped with the same force upon the memory, but other things come in. The only

[1] Tolstoi's description of a young child's horror at seeing a corpse ("My Boyhood") is certainly not accurate in point of age if intended to represent a typical case.

mention of any grief being felt, is in this later period. It seems that the event meets with a wider psychic irradiation, a fringe which drafts off the concentration on the mere external facts and gives an internal emotion of grief and sym-

106 Dated Reports.



pathy, or sometimes horror and disgust. Both the more objective and the more subjective elements must play together in any future experience of death, and since the extravagances, the unnaturalness and morbidity frequently connected with the experience of death are highly subjective, it is surely of the greatest importance, pedagogically,

that the objective element obtain its due reinforcement at the proper age. The complaint of the little girl[1] on being refused permission by her mother to look at a corpse, that she "was six years old and never saw a dead person," has evidently its justification in the psychological constitution of the individual.

The following cases, both dated and undated, taken almost at random, will illustrate these conclusions :

F.—1. At 5 my brother died; I cried because the others did; remember great joy on driving to the cemetery at the signs of spring all about; I remember the patches of green grass or winter wheat, and bits of blue sky, but not the burial. *F.*—2. First acquaintance with death at 5, when a baby brother died; I recall how he looked now as he lay in his little white casket; I was not at all afraid, but rather liked the idea of looking at him; he looked to me as if he had fallen asleep among flowers. *F.*—3 (undated). One noon several of the girls from school went with me to see a boy who was going to be buried in the afternoon; I always liked to kiss every corpse, and I did so this day; when I did it all the girls did the same; when they came out of the house they were very angry with me for kissing him; they said if I did not commence it they would not have done it; they told me I had no right to do it, because he had the jaundice and we might get it. *F.*—4. Thought dead people were only asleep, and if one touched them or made a noise, or even talked, they would awaken; but I did not think they would hurt anyone, but only scream, and look and act like a crazy person. *F.*—5. At 6 first saw a little dead girl; was not afraid of the corpse, but was frightened at the darkness and stillness of the room. *F.*—6. First acquaintance with death at 5, when my grandfather died; remember well the darkened room, the coffin, the crying people; it was so strange that I rather liked it; I thought grandpa must like to be in such a handsome coffin, but would get out again when he wished to; I was impressed most by the odor of tube roses, of which the pillows were made; I have never since seen or smelt a tube rose without thinking of grandpa's funeral. *F.*—7. At 4, a pupil in my Sunday school class; a collection was taken for flowers; I was the smallest and laid the flowers on the coffin; after this I always liked to see funerals and corpses. *F.*—8. Death at 3, sister; mother said, "Bessie is dead;" could not realize what she meant, and although forbidden to do so because of contagious disease, I stole into the room and started to talk to her; I commenced to realize when she did not answer, but thought that she (psychic self) had gone away and would soon be back, so I saved parts of all my sweetmeats for her. *F.*—9. Did not know what a corpse was till my loved grandmother died when I was 10; I would not go into the room, although my feeling was not fear; when I heard she was dead, I did not want anyone to see me cry; I kept back the tears until I was alone; then I flung myself on the floor and sobbed to think that I should never see her again; I did not think about the funeral, hearse, coffin, etc., but spent my time watching how each person who came in the room acted; all the time I was putting myself in mamma's place, wondering how she felt, and what I should do if *my* mother died.

[1] Mentioned in returns, and reinforced by another similar case.

M.—1. At 6, father and two brothers died; it did not seem so horrid as I had heard. *M.*—2. At 4 attended funeral; thought corpse was only asleep; the blinds were down, the people walked softly and whispered because they did not wish to wake the dead; the preacher's text was, "He is not dead, but sleepeth." *M.*—3. Have the most vivid recollections of my first acquaintance with death (6 years); went at the invitation of a playmate to see their baby that had died; my feeling was one of curiosity; I thought the baby looked nice with a large gold cross on its breast; I remember feeling wonder that some women were crying. *M.*—4. First impression of death at 7; was taken to the funeral of an old lady; often heard of dead folk, and shuddered to think of one, and after seeing her I always disliked them.

Rubric 10. Ascribed Life to the Dead. (*As Children.*) 84 cases. Of these 30 cases ascribe smother feelings to the dead; 25, thought that the dead were asleep (sometimes breathing gently); 25, that the dead felt cold (in shroud, on ice, etc.); 16, that they felt rain, damp, etc.; 12, that they felt cramped, tired, wanted to turn, strange that they did not sit up; 7, that they felt lonesome; 11, were afraid that the dead would be buried alive; 6, that they were only pretending; 10, were afraid the dead would awake, jump up and do horrid things, run after them, play some joke; 3, spoke to the dead; 8, were afraid the dead would feel the worms biting and crawling; 7 more, object to the grave on account of worms; 8, feared the dead could not see out of coffin, grave, etc.; 7 more, that the grave was dark; 4, thought that the dead made their way out of the grave, dug, sneaked out in dark, etc.; 2, that the dead communicated underground; 4, that it was funny to put the dead in a coffin when they were going to heaven; 1, would rather have the body go to heaven and the soul stay in the grave; 1, thought the body kept on growing and would become the shape of the coffin.

The following selection from the experience of H. B. (already quoted) will indicate the transitions in the feeling of death from one age to the other, and give a concrete case referring to several previous categories:

About 10 to 14 I was frightened at any one who died; it was something I could not explain, although I used to try to reason myself out of it; I would look at a companion who had died and say: "Well, that was Alice; she saved my life once from drowning; I know there is nothing to be afraid of;" but yet I would have a feeling of terror, and I would shudder when looking at her, and for days after I would be afraid to enter a room alone; I used to go to sleep with my head buried in bed-clothes, frightened that if I would look up I would see the spirit of Alice in the room; to this day I have a similar fear after anyone has died; but it would be different with my own loved ones; I often thought when I was a young wife that it was strange I had this horror; but I liked to dwell on and imagine how, if my husband was dead, I would throw myself on him and clasp him—that I would be jealous of anyone

else—that I would go in and lock the door, and no one should touch or handle, or share the vigils till he left the house forever; I used to lie awake nights sometimes and think this way; I have had no experience of death in my family, but I know this is the way I would feel and act; but all other bodies would fill me with a nameless terror, all but my own loved ones—even I think I would be afraid of my own dear father; not what he is at present, but all that he has been in the past—the life of the man would rise up and terrify me.

Even at the present day when I see a hearse or crape, a shudder arises, and yet I am filled with a pity for the dead body that is going out; a feeling of suffocation and smothering, that the dead body must feel rebellious, overcomes me.

This return naturally introduces

Rubric 11. Dwelling on Death and Suicide. This is also a very well-filled category, 67% of the whole reporting. Of these only 7% of the whole state that they never dwelt on death or suicide, the remaining 60% giving answers like the following:

F.—1. About 15 I dwelt on death to the greatest extent; often thought of stepping in front of a passing train, drowning, taking poison, jumping from a window; often tried to decide if I committed suicide what way I would do it; often imagined how others would feel if I were found dead; once I imagined they were just lowering the coffin when I raised the lid; these feelings were associated at various times with all three—anger, love and religion; I thought most of these things about 15 or 16 and during revival services; at an earlier age, when I was punished. *F.*—2. Between 13 and 14 I had special spells of dwelling on death; after revival meeting, where were generally preached hell and judgment day, I thought of nothing but death; I came home and divided my possessions; I could not sleep at night; I was worked up so it almost made me sick. *F.*—3. Was very angry because my mother would not let me go on a picnic (at 14); I lay awake a long time at night and imagined I was dead, and that my friends all came to see me as I lay in my coffin; I thought my mother cried and cried and wished she had let me go to the picnic; so I felt revenged. *F.*—4. At 14 to 15, when very angry I used to think I would go and hang myself, at other times that I would jump out of the third story window; then I would imagine the horrified looks and the sorrow of those with whom I was angry, of what they would say, and how they would excuse me and blame themselves. *F.*—5. When stopped from quarreling with my sister, I used to imagine that my mother cared more for her than she did for me; this made me think I would commit suicide and so get out of the way; then I thought mamma would feel so bad, and my sister would never look the same girl again, and people would say, "What a shame that one so young could take her own life." *F.*—6. Angered and mortified by my parents upbraiding me (most about 13), I thought if I should commit suicide or some accident should happen to me, what would they feel and think? but when I imagined them weeping, I couldn't stand it and got as far from the subject as possible. *F.*—7. Once very angry with my mother; I thought, Well, I'll just go and drown myself, and then maybe she will be sorry; but then I thought it will be too late, for I will be dead. *F.*—8. Often after going to bed (when a child) I would lie still and straight, fold my hands upon my breast and im-

agine I was dead; I would think how the people would feel and what they would say when they saw me.

M.—1. At 15, often had spells of dwelling on death; how if I should be found dead, what would my friends say? *M.*—2. When angry or in an exceedingly generous or sympathetic mood, imagined myself dead. *M.*—3. At a co-educational school, the question was asked by a young lady, how many had ever thought of committing suicide? There were 11 of us, ranging in age from 16 to 20, and they all confessed they had contemplated it; this lady had asked 50 in the school, and with the same result. *M.*—4. At 14 and 15 I was much attracted by the girls, but was too bashful to say much to them, but I used to plan heroic sacrifices of my life in order to save them or ensure their happiness, thinking they would appreciate me then.

The difference of emotional depth in face of the thought of death between these returns and those of early childhood (rubric 8) is exceedingly well marked. In some cases love and even sexual love is mentioned, but even when feelings of revenge and ill treatment are the principal correlates, the altruistic tendency is quite as evident. There is involved here all along the putting of oneself in the other's place, and an assumption of love on their part which is appreciated by and reveled in by the miserable imaginer. By this logic of the emotions the heart gets back the love from which it seems excluded, and thus helps to cure its psychic wounds. The more intellectual radiation or reflection of F.—7, although it would seem to lie directly on the surface, indeed perhaps because it does lie simply on the surface, has only been mentioned once. The idea, too, that these imaginations are only a mere play, and that they would not really like to die, etc., is very rare indeed.

How common such experiences are, and how they culminate in early adolescence, with the awakening of the sexual and altruistic nature, may be shown by the following table:

Percentage who	No record.	In 'teens.	Below 'teens.	No date.
Dwelt on death (imagined, etc.)	0	62	11	27
Dwelt on suicide	69	27	1	3
Connect with anger	60	26	3	11
Connect with love	94	5	0	1
Connect with ill treatment	55	28	8	9
Thought others would be sorry for ill treatment	76	12	8	4
Thought how others would feel	38	38	4	20
Imagined with pleasure	92	6	0	2
Refer to as past (adults)	24	71	0	0
Say not yet past, 5%				

Rubric 12. Present Mention of Suicide. (Adults.) 65 cases. Suicide never justifiable, 34%; suicide permissible in certain circumstances, 60%; sickness or insanity were mentioned as an excuse by 12%; loss of money or like misfortune by 10%; wife running in debt, 3% (females); to get insurance for starving family a man may suicide, 1% (females); going to be hanged, 3%; sacrifice, pity (Jesus for example), 6%; loss of friends, 4%; frequently think of it, 4%; always prepared for suicide, 4%; only lack of courage prevents, 3%.

Examples of material:

F.—1. Age, 33. Since 16 have known I might become blind, and am prepared if this should occur to end my life. It has no more meaning to me than any ordinary preparation for any work. I think suicide is justifiable when circumstances make the continuance of life injurious to the health or life of others. If a person is justified in giving his life to save a drowning person, he is justified in preventing a long sacrifice of a useful life for a failure. The responsibility of ending one's life is less than that of producing life under ordinary conditions. F.—2. Age, 19. Suicide justifiable if it were the only way some real good might be done to others. Enoch Arden, *e. g.*, if his wife had discovered him. F.—3. Age, 36. English women in India at the time of the Sepoy rebellion.

M.—1. Age, 17. Justifiable if friends are against you in everything you undertake. M.—2. Age, 25. About 23 was subject to a periodical desire for death. I noticed that these spells usually preceded the expected arrival of a letter from a certain young lady. Usually when thinking of death now, it has a fascination I have to resist by force for fear of yielding to it. M.—3. Age, 30. To counterbalance effect of predisposition to depression, when taking life insurance I avoided those which gave payments in case of suicide. M.—4. Age, 35. Believing, as I do, that the end of life consists in the development of character in self and others, suicide does not appear justifiable to me. This does not prevent me from feeling at times that death would be a welcome relief from the difficulties of life.

Rubric 13. Feelings when Thinking of the Shortness of Life. (Adults.) 57 cases. Make good resolutions, 20%; think of wasted time, 12%; will be longer in the next world, 12%; life hardly worth living, 10%; sad and disgusted, 6%; troubles grow insignificant, 6%; life becomes insignificant, 4%; think of God as judge, 2%; feel glad, 4%; feel like laying up treasures in heaven, 4%; feeling of grim humor, 2%; a brake on all endeavor, 2%; wish I had never been born, 4%; never thought about it, 10%.

Rubric 14. Diseases, etc., Feared as Children. 129 cases. Small-pox by 30%; lockjaw by 28% (9% imagine getting it, 3% were ready with wood, etc., to put between their jaws); consumption, 27%; hydrophobia, 21%; railroad accidents, 18%; diphtheria, 16%; drowning, 15%; fire, 12%; leprosy, 8% (imagine getting, 3%); earthquakes, 7%; cyclones, tornadoes, 4%; lightning, 6%; pneumonia, 6%; cancer, 5%;

yellow fever, 5%; end of the world, 4%; feared to be last one alive, 2%; miscellaneous accidents, 6%.

The intensity of fears follows the following order: small-pox, feared *most* by 18% ; leprosy by 7% ; hydrophobia by 7%; consumption by 7%; lockjaw by 5%; diphtheria by 4%; cancer, 3%; yellow fever, 3%; railroad accidents, drowning, fire, each, 2%; earthquakes, cyclones, and end of the world, each, 1%.

The reasons given for the fears were: stories heard (newspapers, Bible, etc.), by 14% ; isolation by 10% ; become like lower animals, 7%; disfiguring marks, 6%; smothering, 6%; starvation, 5%; sure death, 3%; future life, 1%.

F.—1. I used to think I would die of consumption because I was very thin. *F.*—2. Feared being struck by lightning. I could imagine the zig-zag flashes cutting a way through the body like a spear and finally darting out, leaving its victim as dazzling light and completely isolated from everything. *F.*—3. Often (more about 7) if my jaws would not move as I thought they ought to, I feared I was going to have lockjaw, and starve to death. *F.*—4. Feared most enlargement of the heart, that it would keep on growing until it burst my body open and I would die. *F.*—5. Leprosy most. Afraid fingers would fall off. *F.*—6. Would worry myself almost sick when traveling, for fear the cars would run off the track. *F.*—7. Afraid of yellow fever. Heard father tell of many people dying from this disease. Would think how dreadful it would be if the people in our neighborhood would get it and would all die, and there would be no one left to bury us. Was afraid of hydrophobia, small-pox, diphtheria, scarlet fever, lockjaw, mumps, typhoid fever, being killed by runaway horses, hurricanes, war, earthquakes, thunder and lightning, of the water in the river rising and drowning us all, of fire.[1] At night I used to imagine I heard the fire cracking and snapping, and expected to see it coming up through the floor, but I never said anything about it.

M.—1. Feared greatly scarlet fever, also mortally afraid of consumption and catarrh. When traveling would think of train jumping the track. One of my greatest fears was lightning. I thought the souls of those struck went to heaven on the bolt of lightning.

Rubric 15. Experience when near Death from Accident or Disease. 25 cases. This rubric is of special interest on account of the recent article by V. Egger[2] on the consciousness of the dying, which has brought out some correspondence from other authors. M. Egger holds the view that the idea of death strongly stimulates the idea of self. The sense of merit which he admits is frequent in face of death is, he says, simply an epitome of the self. If we are to give any special meaning to the term self, this view is not borne out by the mass of these returns, some slight irrelevant idea, or the thought of others being most frequent. The sense of

[1] Most of these given in detail.
[2] *Rev. Phil.*, Jan., '96.

merit, if from one standpoint an epitome of the self, from another standpoint demands the recognition of others. This last element is most apt to be in the focus of consciousness. On the whole the most of the cases indicate the formation of a fetich or objective symbol somewhat de-centralized from a strong emotion, with which it is nevertheless sub-consciously associated.[1] This fetich is most apt to be some objective fact or sensation.

Drowning. *M.*—1. Thought of nothing but getting out, and if drowned would anybody be sorry, and would I have a big funeral? *M.*—2. All the bad deeds of my life flashed before me (14 years). *M.*—3. Nearly drowned. Thought of a great many things and suffered no pain, but hard or impossible to describe. *M.*—4. Nearly drowned while swimming at 14, but had no feelings about it. M.—5. Once nearly drowned (about 8 years). My experience was delightful, soothing, panoramic, and the tug of the rescuer was a harsh note, provoking a feeling of anger at the intrusion. *F.*—1. Once near to death by drowning; was physically afraid and trembled violently, but did not scream. The year before I had not taken algebra, as most of my class had done, and I thought, "Now it does not make any difference anyhow." *F.*—2. Nearly drowned last summer (age, 19); my head and brain seemed to be in absolute confusion; came to the surface once and thought, "Well, if my body is lost, my soul won't be."

Other accidents. *M.*—6. Nearly run over by train (under 20); did not think about anything till after, then pictured the possibility of death—body met at the station, etc.; then a rigid course of introspection to see what good I had done, what opportunities for so doing had been neglected, what evil I had done, and whether I would have gone to heaven or to hell; last, a renewed determination to reconsecrate my all to His service. *M.*—7. Near falling from apex of barn; felt no fear at the time, but was more thoughtful for a few weeks after. Nearly killed by a balking horse; only thought was, "Guess they'll have to get a new teacher." *M.*—8. At age of 24, half way up perpendicular cliff of 400 feet, commenced to reel with sun, heat and exhaustion, and felt like falling; have always been given to quoting poetry in predicaments; here flashed into my brain and saved me the words of Gunzalo, "Now would I give a thousand leagues of sea for one acre of barren ground." I somewhat queerly smiled. *F.*—3. Nearly run over; imaginatively impressed by the horse's hoofs for a week or more. *M.*—8. Shot in battle. Felt perfectly happy.

Illness. *M.*—9. Sick with la grippe (20); thought of meeting God, and did not feel equal to the task, yet, being so ill, it did not matter much to me whether I got better or not; when I got well I felt grateful to God. *M.*—5. (Same as above.) Near death from illness at 22; the danger disturbed me very little; I said, "I want to live long enough to do something in the world, but if Providence vetoes that wish—'Let 'er go, Gallagher!'" The half flippancy of my attitude surprised and shocked me afterwards. *M.*—10. At 22, after an attack of peritonitis, had occlusion of the intestines; my medical knowledge (physician) told me what it meant; it was probable I would die. This did not worry me, but I felt it would be the

[1] Cf. section on Fetichism in author's article, "Sex and Art," Am. Jour. Psy., Jan., 1896.

saddest thing for my parents, who had given so much of their time and fortune to me; the weaker I grew the less I worried about myself, and only the sadness mentioned remained to some extent. *F.*—4. Near to death lately (36 years); I was more blissfully happy than I had ever felt. *F.*—5. At 24 had typhoid fever; felt very weak; wanted to be let alone; felt it was easier to die than to gain strength. *F.*—6. Been at the point of death several times as result of *angina pectoris* and administration of ether; went (at 28) to a conceited young physician in a strange town to have ether administered, saying nothing about susceptibility; nearly died; first thought on returning to consciousness was, "That young fellow has probably learned a valuable lesson." Once had *angina pectoris* at altitude of 7,000 feet; during intervals of consciousness worried over a small bill that was left unpaid; thought Gabriel would have a good time hunting me up if they buried me in the mountains. During these gaps I have always noticed that all my senses, except the muscular, were very acute.

Rubric 16. The Child's Notion of the Soul. 102 cases. Substance, etc. Thought it gaseous, 26 cases; had wings, 17; light, 9; bright, 8; white, 9; invisible, 7; a bird (sometimes dove), 6; a bright light, 3; an angel, or like an angel, 6; no qualities, negative of all, 2; same as conscience, 2; bluish, 2; jelly-like, 1; a something, 1; brown, soft, about the size of a hickory nut, 1; a piece of flesh as big as hand, laid on shelves in heaven, 1; a thin white cloth, with black spots on for evil deeds, and flew around like paper, 1; a pure white ball of cotton, 1; oblong, dark, slate colored, lying across body, 1; small, hard, like wood, 1; an oblong, yellow, thin box, 1; part of Christ, 1; a cloud, 1; could stick fingers through, 1.

Location. In breast, 13; in heart, 7; around heart, 4; in head, 6; all over body, 10; not separate from body, 8.

Shape. Same shape as body, 20; heart-shaped, 10; same shape as body, but smaller, 7; body could be pulled off it, 1.

Capacities, etc. Floated, flew, etc., from body to heaven, 26; went from grave to heaven, 10; God or angels took it out of the body or grave, 7; joined new body in heaven, 1; joined old body in heaven, 1; watched for emanation, 3.

Never thought of the soul, had no idea of it, 14; have yet (as adults) no idea of it or think about it, 3 (females).

Illustrative cases. *F.*—1. Had no idea of the soul as being separate from the body; thought when the person died he remained in the grave for a while, and then got out some way and went up to heaven; it used to puzzle me how they got out without being seen and got their wings in order to fly to heaven. *F.*—2. Soul gaseous and bluish; of no definite shape; went through the body and air to heaven in the sky; all happened in an instant; when it reached heaven it took its place in my body again, as I imagined myself in heaven in bodily form; never thought my earthly body was in the grave. *M.*—1. Soul came out of the mouth, and if the head were put in something that would fit it very tight, the soul would not be able to leave the body and the person would not die.

Rubric 17. Belief in Immortality, 123 returns.

Percentage who	In childhood.	16-20 years.	21-40 years.	40-on.
Believe in future life	95	75	63	60
Mention childhood only	—	18	6	10
Do not believe in future life	5	7	31	30
Meet friends in heaven	29	29	27	20
Friends watch over us here, etc.	10	15	18	20
Accept or refer to hell	6	12	6	10?
Refuse to accept hell	2	4	—	—
No reference to hell	92	84	94	90
Heaven, city-like	15	4	—	—
Heaven, country-like	10	4	—	—
Heaven, a room	4	—	—	—
Heaven represented by throne	10	—	—	—
Thoughts run on after death forever	1	5	4	10?
Thoughts limited, difficult, close with judgment day	4	29	9	—
Heaven in sky, etc.	10	—	—	—

As the right hand column contains only 10 cases (more old people speaking of this life than the next. Cf. Rubric 7), the results are not very certain, except when they continue tendencies already shown in the first three columns. In the first column all the returns are represented.

Illustrative cases. *F.*—1. As a child I thought heaven was a place where they did nothing but sing, and as I could not sing I did not want to go there.

F.—2. Age, 22. Have a feeling that at times our friends hover around us; often felt that my mother was near me.

F.—3. Heaven (as child) a beautiful bright place, with carpet on the floor and no dirt.

F.—4. Somewhere between earth and heaven there were two paths, one leading up to a gate, another leading away from it; thought the soul in the form of a mist came up the path to the gate; there stood the judge; if good on earth they could go in; if not, they must go by the other path until they came to a large hole, and the soul fell through this into hell.

F.—5. Age, 17½. Thoughts are not very clear about the after life. . . . Hardly think we are to go there and just fly around like birds, but rather everyone will do the things they love best in the way of art or music, or anything of that kind; each will love all equally, and so there will be perfect happiness. . . . Can't realize that happiness goes on forever, and ever never changing; seems as though there must be an end to it sometime.

F.—6. Age, 21. Used to think, and do still, when I do not look at it scientifically, that heaven is up above the blue of the sky.

F.—7. Used to wonder what a person who was twice married would do in heaven.

F.—8. Age, 21. Idea of living on forever with my own personlity unbearable; I worried most about this at 10, but at 20 I heard an address on immortality; the feeling of its unbearableness came back; it was as if I simply could not endure it—better total annihilation, anything, than this continual going on and on; at present I do not believe in a future life.

F.—9. Age, 20. I used to think of the one who died as still in the grave, while taught the contrary; believe the soul departs to be with Christ.

F.—10. Age, 17. Always thought meet friends hereafter, bright and sparkling (fixed), crowded with people dressed in white, with gold stars on head; every one in heaven very gay.

F.—11. Age, 18. Believe fixedly in an eternal future in the presence of God; I think when a person is dead his thoughts are at an end, *i. e., he does not think the way he used to*, but have no doubt the mind goes on in another life.

F.—12. Age, 36. Little feeling about friends who have died; feel that death ends all; if they have progressed we shall be outgrown; if they remain stationary they are outgrown.

F.—13. Age, 17. Imagined angels flitting about in long robes and watching the people on earth and carrying dead people to heaven; I *always want to think* that those who have died are watching over, protecting and guiding those on earth.

F.—14. Age, 18. Thought only a very few went to heaven, those who had been very good; thought heaven was like a large church, and that the people were clothed in white and sang to God, and He communicated with them; I think now that when we go to heaven all things which by faith we accept will be openly revealed to us by God, only in another way, and not as we now see them; the future we are told by God will be one of joy, but that joy will be different from what we now consider joy.

F.—15. Age, 19. Used to think every one who died went to heaven; don't now; angels spent their time singing, sitting around a throne and listening to Jesus; thought they looked after us, and were pleased when we did right (14 to 19); think of friends as happy and not far away.

F.—16. Age, 17. As a child I never truly wished to go to heaven, although I tried to think so; though I like singing I thought it must be tiresome to sing forever; now I think it is a place where we will be supremely happy, do everything we want to, but our wants will be so changed that we will wish for only that which is right; sometimes I have doubts concerning heaven, etc., but I should never care to speak of them to anyone whom I knew could not answer me, for if they could not it might strengthen these doubts, and would surely do another no good; I cannot in the least grasp the idea of eternity, and seem to think of it as only a short period.

F.—17. Age, 19. As a child believed in future life, etc., but at 15, when I began to think of such things, I had my doubts for a time; now my deepest thoughts and feelings tell me there is a future life; thoughts run only shortly after judgment day; heaven a great glittering palace paved with gold and jewels; souls looked just as they did on earth, etc.; I now feel uncertain what form my friends will have, or how we shall know them.

F.—18. Age, 17. Always believed in heaven; think of the body

in the grave for only a short time, then of the judgment day; I imagine when I die everyone else will die too, and judgment day will be soon after; heaven not very large, about like my room, only there was no floor, only clouds and God's throne, which was made of gold; people as on earth only floating around; there are times when I think heaven must be dull, and am puzzled when I think of the length of eternity.

F.—19. Age, 18. Gate of heaven large, beautiful, pure white, so bright it hurt your eyes to look at it; guarded by two angels, one outside with a large sword, and the other inside with the key which unlocked the gate; when a person died his soul flew to the gate, etc.; if the person had been bad, refused admittance, and the clouds opened up and he fell into hell.

F.—20. Age, 18. I imagined heaven was a big place, and that it was made of gold and marble; in the middle of it was a large throne in the shape of a circle; it was made of steps; on this throne sat God and Christ; before God there was a big book, and in this He had the name of every one in the world; when they did anything wrong He would put a mark opposite their name, and when they had so many marks, either good or bad, they died; Christ pleaded with God to let them come to heaven; on the steps of the throne sat a lot of angels playing on horns and harps; all around the throne were coffins, and in each sat an angel; all were singing, and they never stopped.

F.—21. Age, 17. I never *will* think and never did think of a future life, because the answer to all questions which arise is, "I do not know; no one knows;" after death my thoughts run only to the funeral; I never can think of what will happen to the soul, because I do not believe there can be a hell, although my religion teaches it, and I cannot imagine heaven.

F.—22. Age, 17½. My present ideas are entirely different; I think now the soul goes to paradise, and will go to heaven after the judgment day; paradise is very much like heaven, only not quite as beautiful; in heaven there is a river, and beautiful trees and flowers on its banks; but I seldom try to think just how heaven looks, because I know that "eye hath not seen, nor ear heard, neither hath it entered into the heart of man the things that God hath prepared for them that love Him;"[1] I pretend that I am sitting on the bank of the river with Jesus alone and telling Him how happy I am, and He is telling me why He sent certain troubles to me, and how they made me better; I know I will have a harp and can sing praises to Him; my thoughts thus run away into eternity; . . . . . I think the angels will minister to us there as they do now; . . . there is one question that bothers me, and that is, will mamma or my step-mother be papa's wife there? and what the one will do who isn't; . . . . I send messages to my mamma when I say my prayers, for I know that I can talk to God, and He can talk to mamma. (Father a clergyman.)

M.—1. Age, 33. Belief in future life and in recognition after death have been strengthened by the death of my little boy; I know that this is no intellectual evidence, but it is evidence that any heart will weigh well before rejecting; surely love of parent for child is a *real* thing, as real as the things we touch or taste; . . . . I see no reason why my love for my dead boy, and my desire to be reunited to him,

[1] Yet she often imagines that she will talk to Jesus and He to her, etc.

may not postulate the very existence of the objects towards which they are directed.

M.—2. Age, 65. Feelings have changed very much in regard to the future state (a phrenologist told me they would); can not think now that the soul can exist separate from the body, which will be decomposed in nature's laboratory.

M.—3. Age, 77. I have always believed in a future life—a blessed life for the true Christian, and a state of wretchedness for the impure in heart.

M.—4. Age, 35. Feel as if departed friends were near at hand looking down from above or just behind me, and interested in everything I do, more so than when alive; I like to think of them, and wonder what they think of what has happened since they died.

M.—5. Age, 35. Thought how sad it was to leave this world; never could get up interest enough in the future world to make me want to know more about it.

M.—6. Age, 25. In childhood immortality a necessary belief, and would have preferred hell to annihilation; at present, belief in immortality plays a very small part in my experience or motives; I leave it indefinite, though I rather *feel* it is true.

M.—7. Age, 25. As a child had the usual orthodox idea of a future life; later I lost belief in a future life, and have no desire to believe in it now for myself or for my friends.

M.—8. Age, 31. Fluctuate between the speculation that our elements are dissipated in death and a hazy hope that if we achieve self-knowledge in this state we may survive without losing identity; have lost only one friend by death, and I confess that I *feel* he survives in spirit, but I do not believe it (I do not mean that I believe in the contrary).

M.—9. Age, 26. During the funeral of my father I felt for the first time a certainty of meeting him again; about 17 the question of immortality was a favorite subject of reflection and reading; I became more and more satisfied that there was a life beyond, although nobody could demonstrate it; this was a spiritual but visualized existence; I saw myself with dear friends and with the great and good of all ages; wondered if Socrates and Homer would care enough for me to allow me to be near them; the death of a dear friend about year ago has profoundly affected my life; it seems as if a part of myself is gone, and that I shall never recover my wholeness until I am with him again; my disposition has changed, and I have lost confidence in my own abilities, but I have a deeper sympathy, and love friends more.

M.—10. Age, 30. The chief objection to the belief in immortality made itself felt in the fact that abortions, premature births, and deaths *intra partum*, do not cause the feeling of immortality; . . . the origin of life has been the greatest objection to my belief in immortality; my own life and my experience with so many dying and dead people since, have only confirmed my attitude, with which I feel perfectly happy, and which seems to me to lead me to a better and more rational life than any other doctrine; the only regret that I have is that I was allowed to work it out by myself with much loss of time and energy, and could not avail myself earlier of it.

M.—11. ———. No definite notion of future life; "forever," "eternity," seemed absolutely impossible; the idea painful; eternity presented itself visually as a vast expanse of unobstructed territory, bounded on the outer edges by a rim of forest trees.

M.—12. Age, 37. Never had belief in the heaven of the Sunday school pictures; I held the fables of literature in precisely the same seriousness as the stories of the Sunday school teachers; they seemed to me to be beautiful and good, but I hardly knew whether grown-up people meant us to really believe them; I never heard religion spoken of irreverently as a child.

M.—13. Age, 34. Always believed in future life, only momentary doubts or fluctuations; have studied, thought and preached on the subject, but think there is no proof; I *feel* that it must be true from my faith in God; can't imagine *time* in future state; never fancied much about heaven; expect to be greatly surprised by the nature of spirit life, but expect reason is immortal and the same; expect to see friends with *mind* only, and to *think* with them and enjoy their spirits.

M.—14. Age, 35. Have given up early idea of future life, but I think somehow spirit may be eternal, but I don't know whether the finite spirit will preserve its identity in the future state, or whether in some way it may be resolved into the infinite spirit; I like to think of both these possibilities, and of a third, viz., that the influence of one's life will continue to affect future generations of mankind.

M.—15. Age, 20. Sleep in grave till resurrection, and yet in some way believe to some extent that persons who are dead can know what we are doing; have heard, *e. g.*, a mother's parting words to her boy, "I will watch over you from heaven, my son;" heaven bright, no night, everybody joyous, golden streets; sort of ancient houses to live in, all through very beautiful; angels flew around all over world at command of Christ, not doing anything else, singing and playing a kind of harp; often imagined myself in heaven and looking down on earth and see the people I knew walking around.

M.—16. Age, 19. Feel death is a change for the better, but of that which follows death I find it impossible for me to think; I think we will meet our friends after death; I used to think heaven was a beautiful place, where you spent your time enjoying the different pleasures of life; I feel that our friends are around us endeavoring to aid us through life.

M.—17. Age, 26. Till 14 believed vaguely but confidently in a God and a hereafter; to-day, "If there is a God, the man who does the best he knows how here may expect some kind of a future life, in which he will know God better, and this existence will be in many ways better than the present; if there is no being above us, yet it will be better for himself and for others if each person does the best he knows how."

From a general view of the results of the questionnaire, we cannot fail to realize what an important element in the consciousness of mankind is the question of death and the problems which naturally arise from it. At first appreciated rather superficially and coldly by the child, the development of adolescence with its emotional crescendo adds an immense radiation of feeling to the objective facts, and at this age, rather than in later life, or even in old age, is found the most frequent dwelling upon these subjects. An ideal curve of the averaged thoughts and feelings on the subject of death and its radiations, during a lifetime, might be drawn, as rising to

the age of 5; dropping slightly and rising again to a much greater height at 14 (table), continuing with a slight fall for five or six years, falling as the practical side of life claims attention, to rise again slowly with increasing age. (Rubric 8.)

Immortality and the Funeral. With the fully developed concrete conception of death, there is evidently deeply associated on the one side a fringe of radiating ideas, and on the other the most elemental emotions of our constitution. At one moment an organized body, energetic, incalculable, awakening all kinds of reactions in our minds, is in the next simply a mass of senseless clay. All our feeling of continuity, of persistence of energy, as well as our feelings of love and sympathy, are shocked and outraged in proportion as we realize the facts. Death, the rude irony of its comment on individual life, its cruel separations, has been the tragic background to all the self-conscious development of man. "Why was I born to go through it all?" "I cannot bear to think of it," "I would rather never have been born,"—are typical of a number of our answers on this subject.

From the smothered sob which it has been said lies at the root of all religion[1] to the mother who still hears her dead child calling for her, or wraps a stick in baby clothes and carries it next her breast, death has shown itself to thousands as the very type of evil, the great imperishable blot on life. If we would live, however, it is necessary to be reconciled in some way to this great fact. Mystics have denied or glorified it, poets have covered it with tender words, calling it sleep, and crowning it with flowers; stoics have harshly dismissed the idea, or bitterly welcomed the thing itself as at least the end of its own fear. All of these tendencies are shown in our returns, but among those answering there is no reconcilement more frequently mentioned than the idea of the future life. In this respect the last two rubrics are more important than any of the others. In the ideas on the soul and immortality, we have summed up or represented elements which exist under many of the other heads. The association of growing old with death and the future life is one that is quite frequent. (Rubric 1.)[2] When a belief in immortality is reached, it evidently conditions the conception of suicide. The grave is not rarely looked on as the gate to heaven. The ceremony of the funeral, the weeping, etc., is looked on as "funny" by many children, and with astonishment by one

[1] Cf. "God is an unutterable sigh lying in the depths of the heart." Sebastian Frank von Wörd, quoted by Feuerbuch, "The Essence of Christianity," p. 121.

[2] "Let age approve of youth, and death complete the same." Browning's "Rabbi Ben Ezra."

adult of our returns, in view of the belief that the person has gone to heaven. The ceremonies of the funeral itself are frequently conditioned by ideas of the future life. The ancient Christians "testified their abhorrence of pagan customs of cremation by depositing the entire body in the ground."[1] Church burial has a similar significance. In Rome on their arrival at the church vault, bodies have their fine trappings taken off, and are piled one over the other, without a rag to cover them, until the vault is filled, when it is bricked up and left for fifty years.[2] From the mere fact of the wealth of material which it subsumes, the conception of immortality must be regarded from the psychological standpoint as at least a far-reaching synthesis of the imagination.

Perhaps because of its many sided origin there are very few ideas which have been more subject to various interpretations, and even to double meanings than that of immortality. Many seem to use it simply as a metaphor (as it may be Dante used heaven and Beatrice) for the undying ideals of the race, while others believe that not a nail or eyelash shall be lost when the body is awakened in a future world.

Much philosophy seems to have this idea as an all-transforming *arrière pensée*. Neoplatonism and Thomism, with the modern forms of scholasticism, are in evidence here. Plato has perhaps been unjustly drafted in to support the theory of individual immortality, although there are many passages suggestive of this idea, as Pfleiderer shows. According to Teischmüller,[3] however, Plato's ideas on this point are the same as those of Aristotle, although in a less developed state. The problem of Aristotle was of course concerned with universal immortality, the individual psyche dying with the body. With Plato senescence, death and immortality were so closely connected as to be identical in certain phases. Philosophy, as has often been noted, was to him a continual meditation on death. This meant that philosophy was a senescing or discarding of the material elements of individuation by reflection or meditation (method of generalization), which resulted at last in the "idea," which is immortal. To this, of course, there is nothing to be objected. It still takes place every day (if time can be applied). But for the individual as such, it is quite as justifiable to say that this immortal "idea" is death as life.

Kant, as is well known, based the necessity of immortality

[1] Tegg, "The Last Act," p. 68.
[2] Tegg, *op. cit.*, p. 125.
[3] *Geschichte der Begriffe.*

on the feeling for justice and self-completion, and in order to satisfy this demand he postulated the existence of God. Runze[1] points out that this conception of justice has been a more permanent historical motive than either the wish to live or the intellectual difficulties arising out of the conception of death. In days when enmity was wider spread, we find hell more popular, and almost a necessity to present satisfaction. In some cases, indeed, the joys of heaven were to consist partly in listening to the howls of the wicked, *i. e.*, other people who are offensive to the imaginer. The period of the foreign oppression in Judea before Christ, and the middle ages with their numerous wars and pestilences in presenting death in its most cruel and unjust forms, naturally resulted in the radiated conceptions of the future life taking a revengeful form. Jonathan Edwards in "The End of the Wicked Contemplated by the Righteous; or the Torments of the Wicked in Hell no Occasion of Grief to the Saints in Heaven," says, "When they have this sight it will excite them to joyful praises." "The damned and their miseries, their sufferings and the wrath of God poured out upon them will be an occasion of joy to them." Andrew Welwood (1749) says, picturing the future, "I am overjoyed in hearing the everlasting howlings of the haters of the Almighty. What a pleasant melody are they in mine ears! O, eternal hallelujahs to Jehovah and the Lamb! O, sweet! sweet! my heart is satisfied. We committed our cause to Thee that judgeth righteously, and behold Thou hast fully pleaded our cause and shall make the smoke of their torment forever and ever to ascend in our sight."

The philosophy of Fichte is very full of assertions and arguments in favor of individual immortality. The theory of Monads (Leibnitz), and modifications of it as held by Lotze, Krause, Pfleiderer, etc., lends itself naturally, as does the most of dualism, to the idea of a future life. The philosophy of Hegel, like that of Aristotle, seems to dissolve the individual at death.

Mosaism is remarkable in the lack of support it gives to the future life, as, indeed, is the most of the Old Testament. Contact with the Persian ideas during the captivity seems to have awakened this longing in the later Judaism.[2]

The teaching of Christ was certainly not markedly eschatological, the most characteristic passages having been drawn from Him only in response to caviling objectors. "The king-

[1] *Op. cit.*

[2] The oft-quoted passage from Job is translated by Rünze, *op. cit.*, as follows: Though after being flayed, worms destroy, yet in my bare (or skinless) flesh will I recognize (or acknowledge) God.

dom of heaven is now among you." The oneness of man and God was perhaps the pressing message of His best period.[1] To this "here and now" doctrine the Christianity of the middle ages presents a striking contrast.

Recent orthodox Christian writers show an increasing tendency to drop the notion of a direct continuance of the soul at death as due to Greek thought rather than to Christ, and to rely entirely upon the resurrection, which is to occur at the end of the world, and in which both soul and body are to be recreated. This, as Rev. Dr. Laidlaw,[2] *e. g.*, claims, is a view in harmony with modern psychology and with the revelations of the Bible.

On the other hand, from the standpoint of individual feeling, a considerable support is offered to the idea of immortality. In moments of greatest peace and happiness, an *Ewigkeit*, a feeling of eternal here and now comes over the soul, in which we find ourselves entirely absorbed with the present, and indifferent to or careless of death. Such a consciousness is fostered by all the higher services of art, religion, and the enthusiasms of love and noble work. It is not in these periods a question of the future, but the present is all sufficient and eternal in itself.

But when this feeling does not exist, and when we adopt the lower *jenseit* point of view, with this natural dualism is it not right and reasonable to carry with us a corrective derived from the higher state of feeling and project the idea of eternity into time? This Platonic lie, this illusion rather than delusion[3] has at least been the means of safety and psychic wholeness to thousands of the human race. Not from the technically philosophical standpoint, but from the artistic one of gaining the best and most harmonious effect of the elements within our control, from the standpoint of feeling and health, does this conception find one of its best supports.

In harmony with this view it is necessary to point out that the great fact which all these notions of immortality are intended to explain, and which they at least succeed in radiating, is the human experience of death. As Tylor[4] says, "Death is the event which in all stages of culture brings thought to bear most intensely . . . on the problems of psychology." As shown in our returns, death is on its first presentation to the mind almost unintelligible, and necessarily suggests some conception of continuity. (Rubric 9.) This is no doubt due in part to the presence of the dead

[1] Cf. Keim's "Life of Christ."
[2] "The Bible Doctrine of Man," 1894.
[3] Cf. the standpoint of Alden in "A Study of Death."
[4] "Prim. Culture," Vol. II, p. 448.

body, so strangely similar to its living counterpart. If death had involved a sudden material annihilation, the suggestion of continuity would no doubt have found much less hold upon the imagination. The conceptions of the lower races and the original ideas of children are triangulated almost entirely from the sensuous presentation of the dead body.

But with higher brain development and greater powers of representation, although still founded upon the primitive basis which normally should remain a part of the most advanced individual, there comes in another more important element. The dead body is not the only thing which has to disappear. We, who are yet alive, and have come in contact with the departed, carry with us impressed upon our minds certain ideas, trains of associations, complex reactions, which are capable of healthy action only in connection with the enemy, friend, hero, or loved one, who is now no more. It is necessary that this associative knot, or the brain region underlying it, should be gradually released and its energy radiated into other paths. Here the conception of immortality in suggesting the analogy of a journey, etc., assists in producing this result. The conception of meeting friends in heaven, which, as our returns show, is such an important content of the idea of future life, is felt in greater force immediately after their death, and gradually diminishes with time. The difficulty of running on in thought beyond a very few immediate events, such as the welcome, the judgment, etc., which, as our returns show, is in a proportion of 4 to 1, shows another side of this same question. On the whole, immortality, as reported in the present data at least, is a great deal less concrete than the present life. It is in fact a weakened repetition of the present, and as a weakened repetition tends to irradiate, dissipate, or discharge, the ideas which necessarily arise in the mind because the physical substrate or psychic mechanism, once formed, is but slowly modified in response to new conditions. This senescence and death of our own qualities are the natural consequence of the death of those whom we have known. Even if the idea should not gradually disappear, as we shall see later, it is at least (to say nothing of the ontology of the matter) a better economy of vital forces that it should be localized in the future and some distant place than that it should be ready to appear at any place and time.

But it is equally necessary to note that the idea of immortality has never been a perfect means of irradiation. There is still a very large residue of feeling, sometimes the greater moiety, which lingers round the body. The natural ascription of life to the dead still retains its hold upon us, even in face of a belief in immortality.

Here we may note as a very basal radiation of the experience of death the ceremony of the funeral. This ceremony, ostensibly undertaken for the benefit of the dead, just for this reason, in reality succeeds in focusing the associations connected with the departed in a suitable manner upon certain definite objective events. The bald intellectual perception or recognition of death does not sufficiently impress us with the reality of departure. The oration, which sums up the life and virtues of the deceased, the slow hypnotic movements, the solemn music, the measured tread, as well as the necessary expense which these entail, impress the imagination with the reality of the whole event, have a cathartic effect upon the emotions, and thus give a certain discharge to and assist in "reefing in" the associated ideas which naturally linger round the bodily presence of the dead. When these rites are the keys of large emotions, such as love, the irradiation is all the more important, and is powerfully assisted by the natural ritual of tears and sobs.

When for any reason this irradiation or discharge has not been accomplished, the centres or pathways connected with the old life, although out of connection with the present, are more liable to remain active, and thus become morbid and reactionary.

Here we enter upon ground which has of late awakened the greatest interest. The phenomena of second life treated by Benedikt (pamphlet), the auto-mimesis of W. Smith Baker, as well as a good deal of the current imitation theory of Royce and Baldwin, the double personality of Binet, Janet and Charcot, the hypnotic therapy of Krafft-Ebing, Hammond, Mœbius and Strümpel, the Dr. Jekyl and Mr. Hyde of some moralists, the conversion theory of Dr. James Leuba, and still more illustrative for our purposes the articles of Breur and Freud,[1] have their origin in similar conditions. These latter authors claim that the ordinary hysteria is quite analogous to the severer traumatic forms, both depending upon the non-healing of psychic wounds. Retention-hysteria is a term used by Freud to designate cases where often by strong compulsion of the will, the mind is so strained that although an objectionable idea is banished from consciousness, it has in reality been retained unconsciously and is the more dangerous since out of control of the other normal reactions. As he shows by many cases, this idea is capable of coming up in another form as a fixed idea or impulsive act, which seems to the patient to be entirely objective, and whose connection with his former conduct and experience may be quite unknown to him, but capable under hypnotic treatment

[1] *Neurologisches Centralblatt*, '93, Nos. 1, 2; '94, Nos. 10, 11.

of being revealed to the investigator, and frequently susceptible of cure. Cases of this kind are not infrequent, and especially in connection with the sexual life, whose morbid phenomena are so largely a matter of faulty radiation. A couple of his cases may be cited. One, of an employee who, after receiving ill treatment from his chief, had hysterical attacks, during which he did not speak or show any signs of hallucination, and of which he had no memory after passing through them. Hypnotized, however, and the attack thus occasioned, he revealed that during this time he lived through the scene where his master had attacked him on the street and struck him with a stick, while he was without means of obtaining justice or redress. Another, of a young wife who came to the physician complaining of an irresistible impulse to stab her 6-year-old only son and throw herself over the banister. She evidently honestly described herself to her physician as not being a woman of amorous tendencies, and as satisfied with her married life, but under hypnotization complained bitterly of the unhappiness occasioned by unsatisfied desires, and in this way accounted for her impulse to suicide.

In many of these cases the suggestion, while in the hypnotic state, of justification, or of carrying out in some way a natural reaction of the emotional condition, has been found to remove the morbid phenomena altogether. This cathartic method of treatment evidently points to the existence of a sort of morbid "pocket," or detached associational group, which thus becomes connected with a curative outlet for its activity.

Three of our returns on the subject of death report comparable phenomena. One, of a gentleman, afterwards a medical man, who claims to have seen the ghost or image of his uncle appear to him at night just before going to bed and when he was not thinking of him at all, although he had shortly before heard of his death. Another, after traveling some distance to see his mother, was too late for the funeral, but is positive that in broad daylight he saw his mother coming along the path towards him.[1] The third case is that of a gentleman who had just returned to his own home many hundred miles from the bedside of his mother, who was not expected to die for some time. She, however, died suddenly shortly after his return, and he was unable to be present at the funeral. Several nights after receiving word of her death, and without any special dwelling upon the subject, he was troubled with heart-rending dreams, in which he represented the body of his mother being torn from the bed on which he

[1] Cf. the file of similar cases reported by the Soc. for Psy. Research.

had last seen her, and dragged shamefully around the room. It may not be too much to suggest that in the cases described, since they were single cases in the experience of the individuals, the funeral might very probably have tended towards the prevention of these slightly morbid phenomena. Hedge[1] thinks that a study of the records of apparitions shows that they occur generally in daylight, and "that the best authenticated cases are those of living persons or persons *in articulo mortis*, or recently departed, and not of persons long deceased."

The naïve ideas of primitive people as revealed both in their conception of the soul and in their burial customs, which are much more than with us associated together, are most easily explained on the supposition of some such psychic mechanism as we have described. The Matambo (negro) widows, for example, "have themselves ducked in the river or pond to drown off the souls of their departed husbands who might still be hanging about them, clinging closest to their best loved wives."[2] After this ceremony they marry again. Some tribes drive a nail through the skull to keep the body down.[3] The burning of effigies when a man has died at sea or at a distance, is a common practice. In the graveyards in New England gravestones may often be seen in memory of those who have died at sea. Frazer[4] gives an account of an old historical custom that when a man turns up later on, he is not permitted to enter at the door, but must come down the chimney, and is clothed and fed like an infant for some time after. With the Iroquois a speech of condolence is made to the body of the dead chief, after which occurs the installation of his successor.[5] With the Algonquins a public address is also made to the body at burial.[6] Some Indians believe that the tears shed for the departed go to the other world. A child burdened down by the weight of a full tear-mug appears to her mother and begs her to cry no more.[7] The material buried with the dead are generally supposed to make him contented with his future life, and thus relieve the living from anxiety. The hell shoon of northern races were intended to expedite the departed in

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[1] "Ghost Seeing," *N. A. Rev.*, 133:286.
[2] Tylor, *op. cit.*, Vol. II, p. 23.
[3] James G. Frazer, "The Primitive Ghost and His Relatives," *Pop. Science Mo.*, XXVII, 668.
[4] *Loc. cit.*
[5] Horatio Hale, "The Iroquois Book of Rites," Phil., 1883, p. 60.
[6] Tylor, *op. cit.*, Vol. I, p. 481.
[7] Bastian, "*Eth. Forschungen*," Bd. II, p. 333.

his long journey, and thus helped to impress the imagination with his increasing distance from the living. With closer observation and a better discrimination of objective and subjective facts, these customs become more consciously symbolical, and thus show themselves all the better as radiations. Tylor[1] thinks that the custom of offering gifts to the dead has decayed. The modern Hindoo, for example, presents a small piece of woolen yarn to his dead parent and says, "May this apparel made of woolen yarn be acceptable to thee." The Chinese have reduced their sacrifices to a paper basis. For the benefit of their parents, especially, they burn mock money, "paper houses replete with every luxury,"[2] and other representations of everything supposed to be necessary for future existence. Paper is used to make the boats, which are furnished with candles, sent to sea and watched till they disappear, at the Japanese Festival of the Dead, or Feast of Lanterns.[3] Tylor says[4] that in "modern centuries the Japanese borrow money in this life to be repaid with heavy interest in the next." An inartistic custom of this kind must tend to break up the whole ritual.

At the present day the windows are left open after death for the soul to pass, and the body is carried out feet foremost, or with his face away from the door, a custom, of which although the meaning is now generally unknown, originated in the idea of preventing the dead from seeing the way back again. For the same reason in Ireland the body is frequently carried to the grave by a circuitous route. Among certain negro tribes a hole is made in the wall, out of which the body is carried, and which is afterwards carefully stopped up. Sometimes the body is run rapidly round the house three or four times, after which his ideas of locality are supposed to be uncertain.

When these discharging radiations did not occur, the association knot made itself felt in the seeing of ghosts and other similar phenomena. The ghost of a body which was unburied, or buried without the funeral rites, was believed by many nations to haunt the relatives of the deceased. According to the classical story, Eukrates' wife appeared and demanded the sandal which had not been burnt. The story of Periander and Melissa is similar to this. With the Iroquois, the soul remains in the neighborhood of the corpse and is restless till burial. In Brazil, the soul haunts the survivors

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[1] *Op. cit.*, p. 492.
[2] Tylor, *op. cit.*, p. 493.
[3] "Lafcadio Hearn," *Atlantic Monthly*, 68:382.
[4] *Op. cit.*, Vol. I, p. 491.

till burial. With the Acheron, the unburied wander restlessly around. With the Slaves, the soul flies around till the body is burnt.[1]

Those who had made a great impression on the community were of course the most difficult to keep down, and special ceremonies had to be undertaken. The followers of Attila, for example, turned aside the course of a river, buried him in the middle of it, and turned on the water. Murderers, even in recent times, were pinioned to the ground by a stake driven through the body.

The very frequent conception of three or four different souls shows the difficulty of radiation under one idea. These souls come in just where the old associations connected with the dead would be touched upon by various objective facts or conditions of the environment. With the Siamese one soul stays in the house, one in the cloister, one in the wood, and one wanders around. With the Fijians, the shade goes to the under world, the bright spirit remains by the body. With the Dakotas, one soul remains in the village, one in the air, one goes to the spirit land, and one remains by the body. With the Khouo, one soul dies with the decay of the body, one remains in the race to be born again, one is taken by Bura, and one wanders around. With the Malagese, one goes in the air, one dies, and one haunts the grave.[2] The Latin, *spiritus, manes, umbra;* the Greek, *psyche, nous, pneuma*, and the Egyptian, *ba, akh, ka, khaba*, or soul, spirit, life principle, shade, played a similar part in their mythologies.

Death, Altruism and Sex. As the returns from the questionnaire show in the most emphatic manner, the conception of death does not awaken in the most of cases a very deep individualistic or self-centred consciousness. The centre of the idea of death and its radiations is outside of what is ordinarily called the self, and essentially altruistic. In dwelling on death (Rubric 11), and also in contemplating suicide, it is the feelings of others which are most frequently in the focus of consciousness, although behind this there is of course the motivation of personal feelings. The age of this dwelling is also significant. The first idea of death in the child (Rubric 9) is, as with early man, the death of others. Our instinctive feelings of self-preservation really do not bring in the idea of death at all, but are hereditarily much deeper and more ancient than this peculiarly human

[1] Bastian, *op. cit.*, Bd. II, p. 331.
[2] Bastian, *op. cit.*, Bd. II, p. 331, etc.

conception. We save ourselves first by an uncontrollable reflex and its accompanying or discharging fear. The idea of death and its irradiations come later.

The ideas of primitive folk bear the same character. The ghost is feared to a much greater extent than is the idea of death for self. In most of cases, indeed, death is met quite fearlessly, or at least without the ability to realize its meaning. Stanley tells of offering to buy a negro who was penned up and being fed and otherwise indulged, but who was to be killed and eaten some weeks later. The negro, however, refused to go with him, preferring the present good treatment for a short time to working for his living. When the conception of death is first realized, it is generally not primarily in connection with self as such, but in connection with those reactions, part of ourselves of course, which refer to other people.[1] In many early races, immortality was not conceived possible for the mass of the people, but these believed faithfully in the immortality of their kings and rulers, who of course were those who had impressed them most, and who thus really were the occasion of brain arrangements or their psychical equivalents, which were but slowly side-tracked or irradiated.

The disinclination to quit life seems to be the greatest when the deep altruistic tendencies arising from the sexual life are at their strongest. Tables of suicides show that this crime becomes more frequent at and after the grand climacteric. Old men who still desire to live, are those who have preserved the upper irradiations of the reproductive life in love and sympathy for their fellows.[2] As the late Lord Shaftesbury said of himself, the ceasing of the opportunity to do good for others is the principal motive for fearing death in many old people of the best type. Characters of another kind seem to lose their interest in life with advancing age, and have little reluctance to die.

A deep reference to the sexual and reproductive life pervades much of the ideas of ancient people on this subject. A few cases have already been cited where immortality of one part, at least, meant survival in the race. The Indians of California explain atavism by saying that the soul of the ancestor has come back. Phalli were dried and buried with

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[1] The very idea of self may in some cases be largely made up of extra individualistic reactions, or a conception of self may be regarded as a function of others. The fondness of the epistemologists for pointing out the relativity of these conceptions points in this direction (as a matter of origin).

[2] Cf. author's article on "Sex and Art."

mummies in Egypt. Bastian[1] identifies the Roman Lares and genii. The Lares were originally rude images of male and female organs of generation. The genii were of course disembodied souls. Forlong ("Rivers of Faith") shows the identity of ancestor worship with phallicism in its earliest forms. Ancestor worship, as we have seen, is merged in the belief in ghosts, etc., from which Spencer develops religion. Bodies are frequently buried in the same posture in which the embryo is found in the womb. According to the Susus, the spirit sometimes takes up its abode in a grandchild.[2] Frequently a relative receives the soul. With the Romans the son, or failing him the nearest relative, stood over the body of the dying man to receive his last breath. Many tribes hold the baby of a dying mother over her mouth for the same reason. Celibacy was frequently regarded as a crime in reference to the certainty of death.[3] The first inscription of the Egyptian papyri, perhaps the oldest writing in the world, contains the advice to marry early and have a son.[4] The Greeks buried their youth at night, "for so dreadful a calamity was this (the death of youth) accounted that they thought it indecent and even impious to reveal it in the face of the sun."[5] The three hundred Lacedemonians chosen by Leonidas were all of them fathers with sons living.[6] When "the human plant had flowered," death was not regarded as a shame. This may be compared with the experience of H. B., pp. 90f.

The sexual life, which, as we saw underlies and punctuates the other periods of life, is of very great importance for the last. Not only by the social ties which its proper function calls into being, thus developing the higher sexual radiations of love and sympathy, but on the lower ranges of physiology as well, does the adequate discharge at their proper period of these great hereditary emotions tend to produce a healthy and happy old age. The return of the ghost of the sexual life after it should be properly laid, is even more troublesome and injurious than is the reappearance of our friends or enemies. Here, as well as in the face of the immediate observation of death, is the cathartic rather than the repressive method calculated to produce the best effect. When the sexual functions have been denied or insufficiently radiated

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[1] *Op. cit.*, Bd. II, p. 330.
[2] Bastian, *op. cit.*, p. 331.
[3] Cf. Renouf, "The Religion of Ancient Egypt," p. 148.
[4] Amelineau, "La Morale Égyptienne." Cf. also Ecclesiastes.
[5] Tegg, "The Last Act," p. 32.
[6] Renouf, *op. cit.*, p. 148.

(and their normal gratification is the easiest and most natural condition of their radiation), there is plenty of evidence to show the danger of a recrudescence in old age of the sexual passion in morbid forms of the most unhealthy type.[1] Many senile exhibitionists, perverts, etc., as well as Clouston's[2] old maid's insanity, come under this rubric.

The feeling of guilt, just the obverse of the demand for justice which is such a strong motive in the longing for immortality, is shown nowhere more frequently than in connection with aberrations of the sexual life. The developmental insanity of pubescence connected with failure of the sexual life, is frequently marked by excessive feeling of guilt and often by fear, sometimes of damnation. Many cases of senile dementia also present this character.[3] With the dropping out of the sexual life and with its failure to lay up treasure for itself in the higher regions of the brain, there may thus be either recrudescence of the lower, or complete loss of all the emotions of love, either generative or regenerative, and their substitution by feelings of guilt and fear.

The slighter phenomena of the grand climacteric, the increase of fears, disposition to starts, flushings, burnings, kleptomania, are significant here. When this period is safely passed, however, it often results in a wider, more intellectual, if not a deeper interest in the race. Many have noticed the number of women at this age who fill lecture halls, conduct meetings, and push causes of every kind.

The history of the idea of immortality as contained in phallicism and other ancient religions, bears the strongest evidence as to the connection of the ideas of sex and death.

To conclude, as biologically death and sex come in together, so in the higher psychical life their irradiations are the most closely associated. Sex and reproduction, first a means of overcoming death, sacrifices in doing so the continuity of individual life, but intensifies it by the whole course of evolution. So in the soul-life, love is greater than death, not mystically, but simply as a matter of fact, while the conception of death serves to intensify the psychical life, and give a foil and sense of earnestness[4] to all our enthusiasms. This great background thought has framed not only the deepest love, but also the greatest productions of art, religion and

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[1] Schopenhauer went so far as to say that pederasty was allowable for old age.

[2] "Mental Diseases."

[3] A number of cases of this kind were observed by the present writer at the clinics of Dr. Meyer of the Worcester Hospital for the Insane.

[4] Cf. Hawthorne's "The Marble Fawn."

philosophy. God and immortality have risen in obedience to the infinite yearnings with which it stirs the soul. Whatever ontological truth may lie behind these ideas, and that is a question which we have not entered upon here, it remains for us to use these great ideas to the full as the psychological functions which we have attempted to show they are, and to bring thus into the here and now of one life-time the best and highest realization of which it is at present capable. In any case the deep life of love, with the care for offspring, and the natural and spiritual continuity or immortality which they ensure, is the tidal wave upon which all these ideas are upborne, and which, showing itself before maturity and lingering often in its highest radiations into age, in its best function and discharge unites into one whole the different periods of life. The principal danger to be avoided, is hardening into a blind fetichism radiations, which are only vital as they recognize the source from which they spring. In the best conditions, however, these radiations help to harmonize the different periods of life. Youth, maturity, old age, are the sub-major, major and minor chords, of which the eternal dominant note is love.

It is impossible for me to close this paper without acknowledging in the warmest way the continued help and sympathy of Pres. G. Stanley Hall in the prosecution of this study, the subject of which was suggested to me in the course of one of his lectures, while his whole treatment of ancient philosophy and Christianity during the present year has been of the greatest service in its elaboration. To Drs. Hodge, Sanford, Burnham and Chamberlain, I am also much indebted for many kind suggestions concerning the literature in their fields. As to the indispensable coöperation of the many friends who have answered the questionnaire, I have already spoken.

PSYCHOLOGICAL LITERATURE.

I.—NEUROLOGICAL.

Studien über Klinik und Pathologie der Idiotie nebst Untersuchungen über die normale Anatomie der Hirnrinde. CARL HAMMARBERG. Pp. 126, VII plates, 49 figs. K. F. Köhler, Leipzig. (Translated from the Swedish after the author's death by Walter Berger and published by Prof. S. E. Henschen.)

After all the preliminary weighing and measuring, speculating on ventricles and *spiritus animalis*, on *corpora callosa*, pineal bodies and souls, after all the fumbling with "bumps," measuring of lobes and tracing out of convolutions, this research really clinches with the problem of the correlation of mental and cerebral differences. Still all the other work has led up to this, and the researches of Kaes on the comparative medullation of the brain approaches it very closely. Flechsig has shown that in general no tract of fibers begins to function until the sheaths become medullated, so that the number of medullated fibers must be looked upon as an index to the complexity of functioning pathways in the central nervous system. But, important as the medullated fiber is, it arises in the main from a nerve cell, or, speaking more exactly, is only one part of a nerve cell, the most essential part, it may be, from the side of nervous conduction. The fiber arises from and draws for its sustenance upon the cell body. Hence the study which approaches nearest the core and source of all things physical in the brain must deal with the body of the nerve cell, as does this investigation of Hammarberg's.

The author's purpose is practically to compare a series of human brains as to number, size and character of processes of cells, and he must first settle upon a method which will insure reliable results. To this end he examines brains in the fresh state, and compares specimens so obtained with portions of the same brain prepared by various histological methods. Although hardening in alcohol is found to produce a shrinkage of twenty per cent., this seems to be uniform as between different brains, and no further variations occur during the other processes of embedding in paraffine, sectioning and staining. He therefore adopts this method of hardening and sectioning, and stains in methyl blue. Having sections of uniform thickness he next proceeds to count the cells in a 0.1 mm. cube, making this number the basis of his comparison. Here we seek in vain for figures which give exactly the numbers of cells in comparable regions of the brain for the author's entire series. We are told merely that for normal brains for the same areas the counts correspond, and for abnormal brains the method gave constant and comparable results. *(Constante und mit einander völlig vergleichbare Resultate liefert.)*

Hammarberg next passes, in Section II, to the critical description, region by region, of his normal material, consisting of twelve human brains ranging in age from a five months embryo to fifty years. This is prefaced by a discussion of the types of cortical lamination of the authors. He does not in the main subscribe to the usually described types, but says "*im Grossen und Ganzen*" that a motor and sensory type of cortex is fairly indicated. The motor cortex is characterized by the almost complete absence of the fourth layer, its place being usurped, as it were, by the layer of large pyramidal cells. The sensory type is distinguished by a clearly defined fourth layer, with a layer of large pyramids between it and the fifth layer. The author lays no emphasis on even this distinction, final appeal being not to types of arrangement, but to the actual specimens from the different regions of the cortex.

Beginning with the frontal region, the author discusses each important gyrus in a way to cover practically the entire cortex. In his first twelve figures he gives us camera drawings of every cell *in situ* under a magnification of 200 diameters for twelve typical locations in a normal brain. We also have supplied among the figures of normal material single cells of each type drawn in detail under a higher magnification. In the text is stated the exact number of cells in the different layers of each region, and in each figure is given the size of the characteristic cells. The number of cells in a cubic 0.1 mm. is generally from ten to twenty, but may vary from five or six to even as many as ninety.

The third section of the paper consists in a similar analysis of nine defective brains. According to Ziemssen's classification cases I to IV are idiotic (conception and conciousness absent, with impossibility of psychic development). Cases V and VI are low grade imbecile, and VII, VIII and IX are medium to high grade imbeciles. The cases range in age from twenty-two months to twenty-six years. Hammarberg's method of treating a case may best be outlined by following one of the cases through.

Case II, aged fourteen years, hospital record from June 30, 1887, to date of death from acute pneumonia February 28, 1889. Nothing is known as to heredity. Patient has received no wounds, and has never had the usual diseases of children. Idiocy was noticed very early from the fact that the patient showed no signs of attention to anything that went on about her. She never learned to sit or walk or to grasp anything. Then follows a physician's examination of the case, psychological and anthropological as well as medical, made in 1886. The patient is of normal height for her age, but bedridden, and has not the slightest ability to help herself in any way, except to cry when hungry; all traces of speech, recognition of things or persons totally wanting. Each of the cranial nerves is next tested. I, concerning olfactory sensations, nothing is known. II, III, IV, VI give evidence of normal function by movements of the eyes and pupil. V, is functional, as evidenced by sensation in the face region. VII, not paretic. VIII, hearing comparatively acute. IX, nothing is known as to taste. X, XI, XII show no abnormal reactions. Sensibility seems to be normal over the whole body. On the motor side there is paresis of the upper and paralysis of the lower extremities. Reflexes are strong. There are no marked contractures. The muscles of the face and fingers twitch at times and clonic spasms also occur, lasting for a few minutes and being followed by sleep. Condition of patient remains unaltered during the twenty months of hospital life.

From results of autopsy we learn that the dura was adherent, the

sutures of the skull were not closed, the ventricles enlarged and full of fluid, that the brain hardened, weighed 442 grammes, and that the hemispheres were unsymmetrical, the right weighing 138, the left 218 grammes. We are disappointed in not finding data as to size and condition of blood vessels, as to body weight and stature, and as to the fresh weight of the brain. Several pages follow giving the gross anatomy of each region and part of the brain, and five figures showing different views are sufficient to render the explanations clear. Among other things, the insula is lacking or represented by two accessory frontal gyri on the surface, the corpus callosum is membranous and the fornix is defective, a number of important sulci are not represented and considerable areas are unconvoluted. Cerebellum, which is frequently small in such cases, together with the basal ganglia, shows no abnormality. Though the cerebellum is symmetrical, the pons is asymmetrical, following the cerebrum in this respect. The microscopical examination extends likewise to all parts of the brain and is supplemented by several figures in the plates. Instead of the normal number of cells, we find two, three or four, never more than ten, to the cubic 0.1 mm., and the figures show, instead of the large well-developed cells of the normal brain, slender spindles or granules. The cortex consists in several regions of but a single layer of embryonic cells, with no trace of the ordinary differentiation. In other parts it is two layered, a superficial layer of cells partially grown into the pyramidal shape and a deeper layer of simple spindle-shaped cells.

The discussion of each case is closed by an *Epikrise*, in which all the clinical symptoms are balanced in review with all the pathological findings, and a *Diagnose* giving the author's explanations. With this case the total absence of all psychic functions can not be attributed to any or all of the gross findings, microcephalus, asymmetry of hemispheres, absence of corpus callosum, etc. It can be explained only by the condition of the cortical elements. For large areas these have not developed beyond the sixth month of fœtal life; in others they have apparently ceased growing during the eighth month, and only in one limited area, the hippocampal, have the cells assumed the adult form, though even here in point of number and size they fall far below the normal. Up to the sixth month, then, development appears to have been normal, and at this time something occurred, (the author is not able to say what, in this case or in any of his others) which stopped growth in large regions of the cortex and greatly hindered it in the rest. The case is one of arrested development, and in this fact all the sensory, motor and psychic symptoms find their complete explanation.

This will serve as a type both as to character of findings and manner of treatment. In general an arrest of development is diagnosed. In one case, however, active degeneration processes have complicated the usual course of arrest. Several of the imbeciles approach the normal somewhat closely, but in all cases by the author's methods no difficulty is encountered in demonstrating abnormalities in the cortex, in the number, size or type of the cells, and these serve to explain the psychic condition.

In arrangement of matter in the text, the paper leaves much to be desired. No one can read it without feeling that the material has not been utilized to the full, and while the strictly logical arrangement is followed for each case, a logical presentation of the results of the whole group is sadly lacking. No tables are given, and to compare the data of size and number of cells in the different brains, the reader is compelled to hunt through the scattered notes of all

the individual cases. However, these are trivial matters compared with the greatness of the labor and the value of the work. The author died suddenly in the full vigor of opening manhood and in the midst of his great work, one of his last requests being that his work be published in one of the world's great languages. To this sad fact must be attributed the shortcomings in the text.

No such criticism can attach to the plates, most of which bear the legend, "C. Hammarberg del." These certainly constitute one of the great contributions to neurological science. So conscientiously has this work been done that the observer seems to be looking at the very cells of the brains of the normal men and idiots and imbeciles. In one class he sees the rich development of the cortical elements and compares this with the stunted growth in the defectives. Nothing could be clearer and more convincing than this comparison, and nothing could more forcibly present the all important question: What are the causes of the differences observed and what the essential conditions which have favored growth in the one instance and arrested it in the other?

C. F. H.

Contributions to the Structure and Development of the Vertebrate Head. Wm. A. Locy. Journal of Morphology, XI, 497-594, Plates XXVI-XXX, 11 cuts in text, 124 Figs. Boston, 1896.

Since Oken and Goethe first outlined the theory that the vertebrate head represented a number of coalesced and modified vertebræ with their contents and appendages, the subject has attracted attention as one likely to throw some light on the ancestry of the vertebrate phylum. Owen's work was directed largely toward the skull, with the idea that the bones furnished the most trustworthy outlines of segmentation; now these are considered as "external features, of no segmental importance whatsoever." Huxley, with his usual keen insight, turned the discussion toward organs of real segmental importance, the cranial nerves and gill clefts. And again with Balfour's classical work, attention turned toward the mesoblastic somites, of which he clearly identified eight in the region of the head. On the strength of Balfour's work chiefly, the tendency has prevailed among embryologists to consider the mesoblastic segments the primary divisions to which the nervous axis has come secondarily to conform. This is the view quite generally expressed in the various vertebrate embryologies. Thus the nervous system is moulded by its environment mechanically, as it were, and at the outset must therefore waive its claim to being the "master organ" of the body. It is thus seen to be of considerable psychological and physiological importance that Locy brings out the fact that the first traces of segmentation appear in the neural plate and not in the mesoblast, and thus the nervous system assumes its position from the first.

In three former papers (reviewed in this Journal, VI, 448), Locy states the main fact, viz., that he finds eleven neural segments clearly outlined in the expanded portion of the neural plate in one of the sharks, in *Amblystoma Diemyctylus* and in *Torpedo ocellata*. The present paper marshals all the facts which the author has been able to gather, and presents them in the clearest possible form, and lavishly illustrated. The chick and frog are also found to have the same number of head segments, though very obscure in the frog. In the chick they may be observed as soon as the neural folds are formed, and for some time after the mesoblastic somites begin to develop. That they are not artefacts is witnessed by the

fact that they are uniformly found in material after different methods of preservation, and especially by the fact that the segments can be seen in the fresh living embryos.

The entire number of segments in the brain region is given as fourteen, with a possible fifteenth represented in the median unpaired tip at the extreme front. Between these primitive segments and the cranial nerves the relations are not definitely ascertainable at present. A "tentative estimate of numerical relations" is as follows: I. First neuromere of fore-brain, olfactory. II. Second neuromere of fore-brain, optic. III. Third neuromere of fore-brain, possibly nerve to pineal sense-organ. IV. First neuromere of mid-brain, oculomotor. V. Second neuromere of mid-brain, trochlearis. VI. First neuromere of hind-brain, anterior root of trigeminus. VII. Second neuromere of hind-brain, main root of trigeminus. VIII. Third neuromere of hind-brain, no nerve root, in early stages. IX. Facialis. X. Auditory. XI. Glossopharyngeal. XII, XIII, XIV. Roots of vagus.

A summary of nine headings closes the first part of the paper. Abbreviated these are as follows: 1. The neuromeres are not artefacts. 2. "Neuromeric segmentation" appears "long before there are any segmental divisions of the mesoderm," and is therefore "more primitive than mesodermic segmentation." 3. The structure of the segments proves them to be characteristic cell groups and not mere "mechanical undulations." 4. The entire embryo is similarly segmented, passing thus through an arthrometric condition similar to that of arthropods and worms. 5. Eleven segments are clearly defined in front of the vagus region, or fourteen in all (nine in the hind-brain, two in the mid-brain and three in the fore-brain). 6. There is evidence to show that the spinal cord is being encroached upon by the brain, seven segments appearing first in the hind-brain, two more differentiating later. 7. The segmentation is clearest in the epiblast and least clear in the mesoblast. 8. The segments are related to cranial and spinal nerves and sense organs. 9. The neuromeres are greatly modified and early obliterated in front, persist until after the development of the cranial nerves in the hind-brain region, and then they fade away.

The second part of the paper is devoted to a discussion of the sense organs, by which the author's former position is strengthened. It is especially useful as a presentation of the evidence which indicates that the sense organs of the head region arise in a serially homologous manner, from the nasal pits and optic vesicles to the auditory and lateral line organs.

C. F. H.

Notes of a Case of Dual Brain Action. LEWIS C. BRUCE. Brain, LXIX, 1895, pp. 54-65.

The peculiar interest attaching to this case relates to the definite evidence presented to prove that the right and left cerebral hemispheres controlled the individual in different and characteristic ways. The subject is a Welsh sailor, insane fifteen years, noted for exhibiting two distinct states. These the author distinguishes briefly as the "English" and "Welsh" state. In the Welsh state he was "absolutely demented," and did not understand a word that was said to him, but frequently jabbered incoherent Welsh. From this state he passed quite suddenly into the English state, in which "he was restless, talkative, destructive and mischievous," and expresses himself in English, and understands what is said to him. In the Welsh state he "used the left hand exclusively" and

wrote "mirror script;" in the English state he was right-handed, and wrote from left to right in the ordinary way. In passing from one to the other he was often ambidextrous and spoke both Welsh and English. In the English state he is fairly intelligent, draws pictures of ships and tells stories of his former life. His memory is a complete blank for all events that have occurred to him during the Welsh state, while he remembers clearly things that happened during previous English states. The right and left-handedness make this one of the clearest cases of dual brain action on record. The pulse was different in the two states, full with high tension in the English, and weak with lower tension during the Welsh state.

C. F. H.

Mental Stupor as a Pathological Entity. JAMES R. WHITWELL. Brain, LXIX, 1895. Pp. 67-73.

The author's observations on a group of cases in which "mental and nervous lethargy and torpor," . . . . and "no sign of originating mental power" are characteristic features, tend to support the theory that the condition is caused by deficient development of the vascular system. He finds in general a disproportionately small heart or aorta or basal cerebral vessels, one or all three, which suggests that the vascular system has "ceased developing at the stage of evolution or about puberty or adolescence." Either this lack of proportion between vascular and cerebral systems is present or the stupor is intermittent, "caused by or associated with temporary spasm of the peripheral vessels during the period of mental stupor, this spasm relaxing during the period of lucidity." In the general thesis this line of reasoning resembles a theory now practically abandoned, viz., that early anchylosis of the skull sutures prevents development of the brain.

C. F. H.

On the Accelerator and Inhibitory Nerves to the Crab's Heart. F. S. CONANT and H. L. CLARK. Journal of Experimental Medicine, Vol. I, pp. 340-46. Baltimore, 1896.

It is somewhat surprising to find the nervous control of the heart in crustacea practically as complete as in the vertebrates. The crab experimented upon was the common edible crab, *Callinectes hastatus*, and, while others have demonstrated accelerator and inhibitory effects on the stimulation of various nerves in the crustacean, the exact anatomical relations, together with the physiological function of each nerve, have not been clearly made out by previous observers. All the cardiac nerves arise from the anterior part of the thoracic ganglion. The most anterior pair of heart nerves are inhibitory. Behind these, opposite the origin of the nerves to the third maxillipeds and first ambulatory leg, arise two pairs of accelerator nerves. Besides these, as in the higher animals, a ganglionic plexus is present in the pericardial wall. This nervous supply is able, with the heart isolated, to carry on the rhythmical beat normally, as in higher vertebrates. Stimulation of the cerebral ganglia invariably caused inhibition. Actual tracings were obtained by delicate tambours, which give the main results with graphic clearness.

C. F. H.

A Case of Circumscribed Unilateral and Elective Sensory Paralysis. LEWELLYN F. BAKER. Journal of Experimental Medicine, Vol. I, pp. 348-60.

Owing probably to a cervical rib pressing upon some of the posterior fibres of the brachial plexus, cutaneous sensibility is deficient

over the area of distribution of the median brachial and antibrachial nerves of the author's left arm. A most thorough survey of this region by the methods and under the direction of Professor v. Frey shows that "in this area the sensations for warmth, cold, pressure and touch are absent." There is also a slight diminution in the number of pain spots. It is of especial interest to note that tickle is also absent from the affected region.

A Comparative Study of the Point of Acute Vision in the Vertebrates. J. R. SLONAKER. American Naturalist, Jan. 1st, 1896. Pp. 24-32, 4 Figs. in text.

A first step in any adequate comparative psychology must be a knowledge of animal sense organs. This has been secured recently by Tuckerman for organs of taste in vertebrates, but the discovery of sense organs so closely resembling taste buds by Langdon over the surface of the earth-worm must open up the subject again, and bring the realization that a wide region of terra incognita as to these structures exists in the invertebrates, and the recent investigations of Retzius renders it clear that to search the tongue and mouth cavity is not sufficient even for the vertebrates. The great work of Retzius stands as a classic for the ear and the most fruitful physiological studies have followed it. With the eye our knowledge has remained deficient, touching exactly the area of clearest vision, and this is just the point which should give us our first generalization, from what we know of human vision, as to the character of vision in the lower animals.

Mr. Slonaker's complete paper, soon to be published, of which the above is a partial abstract, gives the results of his examination of ninety-three different species, of which eighteen are mammals, forty-one birds, six reptiles, three amphibians and twenty-five fishes. In addition to the forms actually examined, the author has sifted the literature to date, and presents his results with those of other observers in convenient tabular form. The table gives species of animal, character of area and fovea and name of observer. Following this long table is a condensed statement, which will serve to give at a glance a notion of what part of the field has been covered.

No. of Species.	Number Areas Found.	Number Foveas Found.	Area.			Fovea.		
			One Circular.	Two Circular.	Band-like.	One Simple.	Two Simple.	Trough-like.
48 Mammals	10	38	28		8	15		
102 Birds	0	1	59	11	36	72	11	22
25 Reptiles	3 ?	17	20		3	6		2
13 Amphibians	3	11	3		7	2		
30 Fishes	10	25	20			5		

From the above we see that in mammals possession of a visual area of band-like or circular from is the rule. A farther differentiation

to a fovea occurs only in the primates. Birds are provided generally with a circular area with a foveal pit developed in its centre. As birds' eyes are placed laterally and the fovea is in the optical axis, it can serve only for monocular vision. A considerable number of birds, however, possess much more complicated mechanisms for clear vision. Besides the central area and fovea, many birds, notably, swallows, terns, hawks and others, are provided with two foveas, situated in their corresponding areas, one central for monocular vision, and one situated, in species having a lateral position of the eyes, as the swallow, close to the ora serrata on the temporal side. This arrangement probably renders parallel binocular vision possible with the eyes at rest, and in convergence gives the bird a binocular view of near objects. It is further shown that as the eyes approach the frontal position, as seen in the hawks, the temporal fovea comes to be placed relatively near the central, and when the frontal position is practically attained, as in the owl, we find a single central fovea serving for both binocular and monocular vision, as in man and the primates.

Following the tables the author gives a brief statement concerning each species examined, beginning with the mammals and going down the vertebrate series. In some cases his results differ from other observers, a notable case of difference occurring with reference to the "trough-like" fovea described and figured by Chevitz for several birds. Slonaker finds a dark line passing through the centre of certain band-like areas, giving somewhat the appearance of a trough in surface views. Sections across the area, however, in every instance reveal no trace of a depression. He is, therefore, warranted in questioning, for the present, the existence of a trough-like foveal depression.

The closing portion of the article is devoted to an outline on the physiological side of the character of vision as correllated with the retinal mechanism possessed by the animal. The writer's anatomical studies up to this point have led up to this subject, but have not afforded time as yet for its adequate investigation. The main generalization as to the character of foveal and retinal vision is borne out, viz., that for the perception of objects in motion an undifferentiated retina or slightly differentiated area is sufficient, and that when an animal's life comes to depend upon its ability to see clearly motionless objects, a fovea is developed.

C. F. H.

Die Alkoholfrage und ihre Bedeutung für Volkswohl und Volksgesundheit. Eine sozial-medizinische Studie für Aerzte und gebildete Laien. Von Dr. August Smith. Tübingen, 1895, pp. iv, 127; plates, 7.

As a result of a series of experiments suggested by Professor Kraepelin to test the influence of alcohol upon psychical processes, Dr. Smith, byadministering forty to eighty grammes of alcohol daily in small doses, obtained in his subjects a gradual decrease in ability to add, amounting in twelve days to about twenty per cent., while for memorizing, a final diminution of about seventy per cent. was observed after the same time. Cessation of the use of alcohol was accompanied by the immediate return to the normal, followed by an evidence of improvement due to practice. The return to alcohol after seven days gave an immediate and marked decrease.

In another research, associations were recorded and arranged according to Wundt's classification as inner, outer and "*sinnlich zusammenhanglose.*" The charted results show a marked percent-

age of increase of those of the second and third classes and a decrease in the occurrence of those of the first on days when alcohol (40-80 grammes) was administered, with the reverse on normal days. The book is an addition to an already long list of compilations and restatements of previously advanced arguments, sociological, ethical, psycological, physiological and pathological, against the use of alcohol. Special sections are devoted to statistics of mortality and disease, the symptoms and conditions of chronic alcoholism, and the consideration of prophylactic measures.

C. C. STEWART.

Experimentelle Untersuchungen über die Veränderungen der ganglienzellen bei der acuten Alcoholvergiftung. Von DR. MED. HEINRICH DEHIO. Centralbl. f. Nervenheilkunde und Psychiatrie. März-Heft, 1895.

In undertaking the experimental study of changes in nervous cells, Dehio has chosen alcohol because of our more or less complete knowledge of its psychological and clinical effects. Eight rabbits, of which two were controls and one, being diseased, was useless, formed the first series for experiment. Alcohol was administered by mouth and by sub-cutaneous injection, the latter method producing the greatest results in the shortest time. The usual dose was 7 to 10 c.c. of 96% alcohol reduced to 40%, followed, as consciousness returned, by a further dose of 5 c.c., until in all 20 or 25 c.c. had been given. Death occurred in from one hour to thirty-four hours, according to the amount of alcohol administered.

Slides were prepared by Nissl's methyl-blue method (nitric acid and Flemming not giving any reliable results). The effect of the alcohol poisoning was not observed with any certainty in those animals which died in the earlier stages of intoxication, and in the others was most easily demonstrable in Purkinje's cells of the cerebellum. The observed pathological changes in the cells are described for them alone. The fine-meshed network of the blue staining substance is replaced by fine, irregularly arranged granules of more or less constant size. The achromatin is colored faintly blue. Sometimes the whole cell, sometimes only a part, is affected. Nucleus, nucleolus and cell processes are unchanged. By no means all the cells are affected, often only a relatively small number.

Another series included three dogs: one control, one living five hours, and the third thirty hours. The one living five hours showed nothing, while the one intoxicated for thirty hours gave more pronounced results than the rabbits. C. C. STEWART.

II. ANTHROPOLOGICAL PSYCHOLOGY.

BY ALEX. F. CHAMBERLAIN, PH. D.

Die Denkschöpfung umgebender Welt aus kosmogonischen Vorstellungen in Cultur und Uncultur. A. BASTIAN. Berlin, 1896, 211 S. 8vo.

Another study in folk-psychology from the *doyen* of German ethnologists. This is a typical volume of Bastian's, and exhibits at once his merits and defects. It is a wilderness of facts, with imperfect references, and no index of tribes and peoples noticed. For all that, however, the book is an invaluable one to the psychologist and the student of the mind of primitive peoples.

Die Anfänge der Kunst. E. GROSSE. Leipzig, 1894, vii, 301 S. 8vo.

This volume of Dr. Grosse is a most welcome addition to the literature of primitive art. The eleven chapters are as follows: The object of the science of art; its way; primitive peoples; art; cosmetics; ornament; sculpture; the dance; poetry; music; conclusion. The author shows a firm grasp of the subject, and refers to important recent essays and studies of the art of the lower races of men. Dr. Grosse's general conclusion is worth quoting in his own words: "But the correspondence of the artistic creation of the rudest peoples and that of the most cultivated does not extend to breadth alone, but to depth also. However heterogeneous and inartistic the primitive art forms sometimes appear at first sight, yet so soon as we examine them more closely, we always discover that they are fashioned after the same laws which govern the highest creations of art. . . . In consideration of this fundamental correspondence, the differences between primitive and the higher art forms seem to be more of a quantitative than of a qualitative kind. The *Gefühle* of primitive art are narrower and ruder, its forms are poorer and clumsier, but, in its essential motives, means and ends, the art of primitive times is one with the art of all times."

An Ethnologist's View of History. An Address before the Annual Meeting of the New Jersey Historical Society, Trenton, N. J., Jan. 28, 1896. By D. G. BRINTON. Philadelphia, 1896, 24 pp. 8vo.

In this interesting paper the foremost of America's anthropological philosophers sets forth his objections to the current views of the philosophy of history, and argues for a higher and better interpretation based upon the teachings of ethnology. His chief conclusions are: Men do not live in material things, but in mental states; and solely as they affect these are the material things valuable or valueless. The chief impulses of nations and peoples are abstract ideas and ideals, unreal and unrealizable; and it is in the pursuit of these that the great as well as the small movements on the arena of national life and on the stage of history have taken place. *The conscious and deliberate pursuit of ideal aims is the highest causality in human history.* Man can be explained only by man, and can be so explained perfectly. Requisite to the comprehension of ethnic psychology, and, therefore, desirable to the ethnologist and the historian, are the poetic instinct and nobility of personal character.

Seven Venerable Ghosts. J. W. POWELL. Amer. Anthrop., Vol. IX (1896), pp. 67-91.

The "seven venerable ghosts" discussed by Major Powell are *matter*, *essence*, *space*, *force*, *time*, *spirit*, *cause*. To use his own words: "These are the seven ghosts of science: the ghost of substance, the ghost of essence, the ghost of space, the ghost of force, the ghost of mind, the ghost of time, the ghost of cause, — seven reified words, seven voids, seven nothings." The paper is written in Major Powell's well-known incisive style.

The Animistic Vampire in New England. GEO. R. STETSON. Amer. Anthrop. (Washington), Vol. IX (1896), pp. 1-13.

From this article, which résumés the vampire superstition, we learn that in New England "it is believed that consumption is not a physical, but a spiritual disease, obsession or visitation; that as long as the body of a dead consumptive relative has blood in its heart, it is proof that an occult influence steals from it for death,

and is at work drawing the blood of the living into the heart of the dead, and causing his rapid decline."

A Vigil of the Gods—a Navaho Ceremony. WASHINGTON MATTHEWS. Ibid., pp. 50-57.

A description by a most competent observer of "rites occurring on the fourth night of a great nine-days' ceremony, known among the Navaho as *kiedji hathal*, or the night-chant." The following observation of the author is worth noting: "This ceremony, like nearly all other ceremonies, ancient and modern, is connected with a legend or myth (several myths, indeed, in this case), and many of the acts in the ceremony are illustrative of the mythic events."

The Growth of Indian Mythologies. F. BOAS. Journal of American Folk-Lore, Vol. IX (1896), pp. 1-11.

In this essay the author outlines his theory of the growth of Indian mythologies as based upon studies of the traditions and tales of the Indian of the North Pacific coast of America. Dr. Boas' general conclusion is that "similarities of culture on our continent are always more likely to be due to diffusion than to independent development." Touching myths, he observes: "Perhaps the objection might be raised to my argument that the similarities of mythologies are not only due to borrowing, but also to the fact that, under similar conditions which prevail in a limited area, the human mind creates similar products. While there is a certain truth in this argument, so far as elementary forms of human thought are concerned, it seems quite incredible that the same complex theory should originate twice in a limited territory. The very complexity of the tales, and their gradual dwindling down, to which I have referred before, cannot possibly be explained by any other method than by dissemination."

Indianische Sagen von der Nord-Pacifischen Küste Amerikas. Sonder-Abdruck aus den Verhandlungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte. Berlin, 1895, VI, 363 S. 8vo.

This volume contains tales and legends from some twenty-five tribes and peoples of British Columbia and Alaska, together with a chapter on the "Development of the mythologies of the North Pacific coast." The German texts of the myths alone are given, but here and there explanatory notes are intercalated. The book contains a mass of material to be worked over by the psychologist and philosophic anthropologist. It is the only work of its kind on the mythology of the northwest coast.

Australian Rock-Pictures. R. H. MATTHEWS. Amer. Anthrop., Vol. VIII (1895), pp. 268-278.

Australian Ground and Tree Drawings. Ibid., Vol. IX (1896), pp. 33-49.

These two papers, together with other publications of the author in the Proceedings of the Royal Society of Victoria and the Royal Geographical Society of Australia, résumé all that is known concerning the subject of Australian aboriginal drawings, and the figures accompanying the text, with the careful descriptions, make these contributions valuable for comparison with the art of children, to which so much attention has of late been given. Of a certain group of cave-pictures the author says: "Interspersed among

the other figures, and, in some instances, partially covered by them, are seven human hands, done in white in the 'stencil method' of drawing. The only right hand among these is shown in the shut position, which is rather uncommon" (p. 271).

The Beginning of Agriculture. W. J. McGEE. Ibid., pp. 350-375.

Under the heads of regional characteristics, vegetable life, animal life, coöperative characteristics of life, human life, etc., Prof. McGee treats of that little known region in Arizona and Sonora (Mexico) called by the Spaniards "Papagueria," or country of the Papago Indians. It is a careful study of the influence of environment. The author's general conclusion is as follows: "It may appear paradoxical to affirm that it is in arid districts, where agriculture is most arduous, that agriculture began; yet the affirmation is not gainsaid by history, and is established beyond reasonable doubt by the evidence of the desert organisms and organizations. So, whatever its last estate, in its beginning, agriculture is the art of the desert."

Introduction of the Iron Age into America. O. T. MASON. Ibid., Vol. IX (1896), pp. 191-215.

Among the topics touched upon in this graphic sketch are: Absence of siderotechny from America, varieties of acculturation, intrusion of African culture, intrusion of Aryan culture, Eskimo and the Iron Age, the Iron Age and the Indians, the Russian Iron Age, the Iron Age on the Pacific coast, the Mediterranean Iron Age. The author's chief conclusions are: (1) Aboriginally there was neither smelting of iron nor working by means of it in America, —no iron products, no use of iron as a metal. (2) The Iron Age that modified America was the conservative folk-age, the Middle Age as distinguished from the Renaissance, which replaced the old in progressive Europe.

Mediæval "Glamour" and its Antidotes. DAVID MACRITCHIE. Amer. Antiq., Vol. XVIII (1896), pp. 87-95.

The conclusion of the author is that "*glamours*" are the mediæval equivalent of "mesmerism," and that this theory "places many of the folk-tale incidents in a new light."

Devil Worship as an Early and Natural Stage in the Evolution of Religion. DR. PAUL CARUS. Ibid., pp. 95-98.

The most interesting point in this essay is the interpretation of Leviticus xvi, where *Azazel* ("the strength of God"), translated "scape-goat" in the King James' Version of the Bible, is regarded as "a last remnant of a prior dualism" — Azazel, the strong god, has become a mere shadow of himself.

The Work of the Kunger-Bag. ALEX. W. BEALER. Ibid., pp. 99-106.

This is an interesting contribution to the literature of "conjuring" among the negroes of the south. The bag and its contents are fully described.

The Negro in the West Indies. F. L. HOFFMAN. Publ. Amer. Statist. Assoc. (Boston), Vol. IV (1895), pp. 181-200.

This study, well furnished with statistical tables, treats of population, elements of population, birth and death rates, conjugal condition, education. The following remark of the author is note-

worthy: "The statistics of conjugal condition, previously given in this paper, prove that the prevailing moral condition of the colored population of these islands is worse to-day than it could possibly have been in the past, and that, with the exception of the Bermudas, the tendency does not seem to be upward, but toward a still lower level of immorality and vice."

Left-Handedness in North American Aboriginal Art. D. G. BRINTON. Ibid., pp. 175-181.

This paper gives the results of the examination as to "plane of cleavage," asymmetry, etc., of several hundred flint blades in the museum of the University of Pennsylvania, taken from different parts of the United States. Dr. Brinton concludes: "The hand preferred was no doubt the right hand, but the notably large proportion of thirty-three per cent. for probably left-handed work indicates either that there were more left-handed persons, or, as I prefer to believe, that there were more who were ambidextrous. This may have been due to the fact that the methods of flint-chipping favored the use of both hands, but it is as likely that it indicates a general physiological tendency." From the observation and examination of drawings and picture-writing of the Indians, the author arrives also at the result that "the aboriginal race of North America was either left-handed or ambidextrous to a greater degree than the peoples of modern Europe." The real source of the preference for the right hand, which (though not to the same degree) has existed in the majority of mankind from earliest times, Dr. Brinton holds, lies in *the erect posture of the human species.*

Ueber die Vererbung erworbener Eigenschaften. G. RETZIUS. Biolog. Untersuch., Neue Folge, VII (1895), S. 61-71.

After brief discussion of previous literature on the subject, the author résumés the results of the investigations of Prof. Havelock Charles of the medical school in Lahore, India, on the "Influence of Function as Exemplified in the Morphology of the Lower Extremity of the Panjabi," a paper published in the *Journal of Anatomy and Physiology* for 1893, and another paper on "Morphological Peculiarities in the Panjabi and their Bearing on the Question of the Transmission of Acquired Characters," in the same periodical for 1894. Not only does Prof. Retzius see in these data evidence of the origin of variation through difference in body-position, customs and uses, but also of the possibility of the hereditary transmission of such peculiarities. The retroversion of the tibia is one of the most noticeable of these. According to Retzius this is also a *constant* characteristic of the Swedish fœtus; indeed, perhaps of the fœtus in general, and in it we have "*an original morphological character*," transmitted from grey antiquity by inheritance. But we must be careful not to mistake something else for an atavistic or hereditarily transmitted acquired characteristic. The ethnological side of the subject is still somewhat dark.

The Arrow. F. H. CUSHING. Amer. Anthrop., Vol. VIII (1895), pp. 307-349.

This is the first part of a most valuable and detailed study of the antiquity of the arrow, its influence, its relation to anthropology, the typical arrow, arrow-making, the origin of early art and of lance-form tools, the development of arrow-form missiles, the origin of the dart-flinger and the bow,—in brief, the complete history of the arrow as only an expert, like Mr. Cushing, could give it.

There is a good deal of truth in the author's remark that "as it was the chief reliance and resource of primitive man in the two main activities of his life—war and the chase,—it speedily became his first, and ever remained, by representation at least, his highest, instrumentality for divining the fate or fortune its use so often decided, and in this way came to affect, as no other single object of art ever did, the development and history of mankind in general the wide world over."

Korean Games, with Notes on the Corresponding Games of China and Japan. S. CULIN. Philadelphia, 1895, 177 pp. 4to.

This volume naturally belongs with Mr. Cushing's study of the arrow. Its chief original feature is a masterly attempt to trace back all games of divination to the arrow — cards, dice, chess, etc., all belong there. The special portion of the work is treated with remarkable skill, the introduction is scholarly and philosophical, and in every respect this volume is worthy of high rank. Korea is here made to serve the whole world. The volume is well provided with plates, figures, and index, well printed and well bound.

An Iroquois Condoling Council. A Study of Aboriginal American Society and Government. HALE. Trans. Roy. Soc. Can., Sec. Series, 1895-6, Vol. I, Sect. II, pp. 45-65.

In this paper Mr. Hale describes the most important and rarest of the public ceremonies and festivals of the Iroquois Indians of Canada, "the Condoling Council," at which he was present in July, 1883. The distinguished author does not hesitate to pay marked tribute to the intellectual and moral qualities of the Iroquois, "a people whose achievements, institutions and language show them to have been, in natural capacity and the higher elements of character, not inferior to any race of men of whom history preserves a record."

Durée de la Génération Humaine. Fécundité comparée de l'homme et de la femme suivant l'âge. M. V. TURQUAN. Revue Scientifique, 4e Série, Tome V (1896), pp. 8-17, 167-176.

This valuable demographic study is accompanied by numerous maps, tables and curves, with great detail of subdivision. The author's general conclusions are that at the age 15–19 years the fecundity of French women is hardly inferior to that of other Europeans, but beginning with the twentieth year the fecundity falls, and up to the thirty-fourth year is hardly two-thirds that of the Europeans, and after the thirty-fifth year one-half. In general, the natality in France is to the natality of other European countries as two is to three, but the mortality is nearly a third larger.

La Famille Annamite. PAUL D'ENJOY. Ibid., pp. 243-244.

In Annam "the ancestor represents divine right, and the family, like the state, is an absolute monarchy, whose privileges are based on birth."

Les Formes Primitives du Travail. G. FERRERO. Ibid., pp. 331-335.

The author is scarcely correct in asserting that "idleness and savagery are synonymous," and Robertson is not the best authority on the general characters of the American aborigines. Nevertheless the author's views are interesting and to some extent well supported. His chief points are: (1) The productive labor of civilized man is regular and methodic—savage *sport* is irregular

and intermittent; (2) in productive labor the excitation is voluntary, while in savage *sport* it is almost automatic; (3) in savage *sport* there is a voluptuous element which is lacking in productive labor, being replaced by an element of pain; (4) modern *sports*, in all their forms,—bicycling, horse-riding, Alpinism, etc., are identical with the first forms of savage activity.

La Sénsibilité de la Femme. M. OTTOLENGHI. Ibid., pp. 395-398.

This article résumés experiments on 400 men and 681 women. The author concludes that it is certain that women feel pain less acutely than men, and that suggestion and auto-suggestion (emotion, example, imitation) influence much the sensitiveness of women to pain. This less sensibility to pain he regards as a characteristic of inferiority.

La Notation des Couleurs au Japon. M. A. ARRIVET. Ibid., pp. 653-656.

This is a valuable study of Japanese color-names.

Racial Anatomical Peculiarities. D. K. SHUTE. Amer. Anthrop., Vol. IX (1896), pp. 123-132.

Dr. Shute concludes that "some of the anatomical peculiarities, which, taken together, stamp a race as high or low," are the following: "Cranial sutures that are simple in arrangement and unite early; a wide nasal aperture, with the nasal bones anchylosed; undue projection of the jaws and receding chin; well developed wisdom teeth appearing early and permanent; a humerus of undue length, and perforated; an elongated calcaneum; a small calf of the leg; a flattened tibia; a narrow pelvis, etc. These characters, the author thinks, are "simioid," and the races which possess them "in largest number and development" are "lowest in the scale." Dr. Frank Baker, in the discussion on Dr. Shute's paper, took occasion to call attention to the abuse of the term "atavism" by biologists and to the misunderstanding of what are called the racial peculiarities of the negro," and remarked that "there does not seem to be adequate ground for the conclusion that his racial peculiarities are remarkably simian;" also "after examination of many bodies of Africans found in the dissecting rooms, it seems evident that ape-like characters are no more common among them than among whites." Dr. Th. Gill thought that the key-words for the explanations of these peculiarities in great part were *use* and *disuse*.

The Purposes of Ethno-Botany. J. W. HARSHBERGER. Amer. Antiq., Vol. XVIII (1896), pp. 73-81.

This article is a plea for an ethno-botanical garden "to surround the museum building, to provide living plants for study in connection with the objects of vegetal origin displayed in the museum." The idea is to "arrange the plants with reference to the Indian tribes who cultivated them," and it is hoped that such a garden would soon "become a Mecca for those who desire to write upon our American plants and their uses among the aborigines."

A Contribution to Ethno-Botany. J. W. FEWKES. Amer. Anthrop., Vol. IX (1896), pp. 14-21.

This is a study of plants used for food and medicinal purposes by the Tusayan Indians, with etymological explanations of the names, where interpretation is possible. Of the *Mentzelia albicaulis*, it is interesting to learn that "its seeds are gathered by the girls in the afternoon, as it is asserted that the seeds will not fall until the sun has passed half way over the sky."

Beitrag zur Pflanzenkunde der Naturvölker America's. A. F. CHAMBERLAIN. Verh. d. Berl. Anthrop. Ges., 1895, pp. 551-556.

A study of plants used as food and medicine by the Kootenay Indians, with etymological interpretations where possible.

The Food of Certain American Indians and the Methods of Preparing it. L. CARR. Proc. Am. Antiq. Soc. (1894), Vol. X (Worcester, 1895), pp. 155-190.

A valuable contribution to the study of food among primitive peoples, a subject of increasing importance in ethnology.

The Whip-poor-will as Named in American Languages. A. S. GATSCHET. Amer. Antiq., Vol. XVIII (1896), pp. 39-42.

In this brief but valuable article Dr. Gatschet presents a rare onomatological study of interest to the students of the psychology of language, especially of onomatopœia. Names of the bird are given from Algonkian, Iroquoian, Maskoki, Yuchi, Natchez, Siouan, Sahaptian and Zuñi languages and dialects, and, whenever possible, etymologies are given. It is worth noting that among the Kayowé there is a children's name for the whip-poor-will, *pābī*= "younger brother."

The Mystery of the Name Pamunkey. W. W. TOOKER. Ibid., Vol. XVII (1895), pp. 289-293.

In this paper Mr. Tooker skillfully interprets for us the name *Pamunkey*, now designating a small tribe of Indians and a river of Virginia, but also in reality "a survival to our times of one of the reminders of an esoteric system which existed among the Powhatan tribes of Virginia at the commencement of the seventeenth century."

The Algonquian Appellatives of the Siouan Tribes of Virginia. W. W. TOOKER. Amer. Anthrop., Vol. VIII (1895), pp. 376-392.

Mr. Tooker treats with his accustomed *Sprachgefühl* and keen analysis the names which came to be given to the Siouan tribes of Virginia from the speech of another and distinct linguistic stock, with whom they came more or less into contact. Like others of Mr. Tooker's papers, this one also is a most welcome addition to the literature of the psychologyof primitive languages.

III. MISCELLANEOUS.

Das Wesen des Humors. Von DR. JOSEPH MÜLLER. München, 1896.

Humor, the most complicated form of æsthetical perception, is, according to Müller, still an unsolved problem. It is not strange, when one considers the quality of the theories hitherto propounded. One reads with weariness, not unmixed with pity, metaphysical and "idealistic" theories of humor in which the finite and the infinite, the ideal and the divine, the sensual and the non-temporal, etc., are held to be constituent elements of all humor. It is too Ptolemaic, too theocentric, too adulto- or anthropo-centric, if I may use such terms. An inductive study based on animal, children, youth, old age and the insane is needed and will doubtless soon appear.

Dr. Müller cites the various theories, all "made in Germany;" he has never heard of Herbert Spencer's view, and knows nothing of "barbarians" in general. Of the authors cited, Jean Paul makes humor to be the application of the finite to the infinite,

whereas its opposite, the sublime, is the application of the infinite to the finite. "Humor annihilates not the individual, but the finite through the contrast with the Idea." Vischer makes humor to be *Selbstverlachung*, and adopts Jean Paul's theory in general. "*Der Humor treibt immer Metaphysik.*" Ruge speaks of a "*Begnadigung der Welt durch Liebe*," and Lorms of a groundless optimism. Solger says that humor seeks in the most temporal and the most sensual the whole power and meaning of the divine, and Müller approves of the dictum. Lazarus speaks of the "*potenzirtes Nichtige*" in humor and makes it a conflict between the understanding and the feelings. Müller himself adds little or nothing to the better comprehension of the subject. ARTHUR ALLIN.

Notice sur le Laboratoire de Psychologie de l'Université de Genève. Par Prof. TH. FLOURNOY. Genève, Librairie Ch. Eggemann & Cie., 1896.

This pamphlet is an elaboration of the notice written for the *Histoire de l'Université de Genève*, published under the auspices of *Société Académique* and the University Senate in connection with the National Swiss Exposition in 1896. It contains a brief history of the psychological laboratory at Geneva since its inception in 1891, a statement of its present resources as to equipment, books, periodicals, etc., including a full list of apparatus, a list of the publications already issued by the laboratory, and an epilogue containing arguments in justification of founding a special chair of experimental psychology at Geneva and its future possibilities in coördination with the other sciences. The record of the Geneva Laboratory under Prof. Flournoy's charge has been most creditable.

THEODATE L. SMITH.

Observations sur Quelques Types de Réaction Simple. Par TH. FLOURNOY. Genève, Librairie Ch. Eggemann & Cie., 1896.

This contribution to the psychology of reaction time, a pamphlet of forty-two pages, is a report of studies made in the Geneva Laboratory during the years 1892-96. The author does not enter into the controversy between the adherents of Lange's theory and the Leipzig school, represented in this country by Profs. Baldwin and Titchener, but proposes to indicate the various individual types of reaction which have been brought out with more or less clearness by the reaction measurements in the Geneva Laboratory. In the course of four years Prof. Flournoy has accumulated some 25,000 reaction times, taken upon seventy students of both sexes, and ranging from 2,000 to not less than fifty for one individual. The d'Arsonval chronometer, for which a great advantage in saving of time is claimed, was used in preference to the Hipp chronoscope for the majority of these measurements. The principal aim of the research was to observe the *influence and direction of attention* upon the quickness of reaction times, and the time measurements were taken in the form of comparative series, where this factor alone is varied, all other circumstances remaining the same. Two successive groups of twelve reactions each, executed under the guidance of a certain mental orientation, *i. e.*, sensorial, visual or motor attention, adopted by the subject at the beginning of each series, were taken, the groups being alternated to eliminate the slight effect of fatigue. The two groups were separated by an interval of a few seconds in order to allow the readjustment of attention by the subject. Only simple reactions were used, no reactions with choice being included in the report. Apart from mixed cases, the author finds among his subjects four distinct types, which he clas-

sifies under the following heads: 1. Motor type, including the natural motor type and the artificial motor type, *le type moteur forcé*. 2. The central type. 3. The indifferent type. 4. The sensorial type, subdivided into visual-motor (*visuomoteur*) and kinæsthetic-motor (*kinésomoteur*).

The term central attention is adopted from Dr. Martius, who employed it in regard to complicated reactions to designate the case where the thought, instead of acting exclusively upon the idea of the sensorial signal or that of the responsive movements, concentrates itself chiefly upon the associative connection of the signal with the corresponding movement. The observations on which the author has based his classification consist of a series of individual studies, for which he states the quantitative results, attaching, however, even greater weight to the introspective reports of each subject, which form a marked feature of the work and include a minute and careful account of the bodily signs of the different kinds of attention and inner speech (*langage interieur*). This introspective study gives to the work a freshness and interest usually lacking in studies of reaction times.

THEODATE L. SMITH.

Kritische Psychiatrie. Von DR. MAX HERZ. Wien, 1895, pp. 124.

Dr. Herz gives us here some "Kantian studies in the disturbances and misuse of the pure speculative reason." He would make the doctrine of the pure reason useful for psychiatry. Since Kant, as Schopenhauer remarks, recognized the human mind as a machine, took it to pieces and showed, to speak popularly, how the wheels go round, there have been countless volumes written in the same spirit upon the same subject, but this "*ineinander greifendes Räderwerk*" has always been considered as working normally. Dr. Herz tries to show how the machine works *abnormally*, disease being, as Krafft-Ebing remarks, only function under abnormal conditions. Hence the name, the Critical Psychiatry. Accordingly Meynert is termed the Locke of psycho-pathology, because of his Kantian philosophical tendencies. The work deals largely with an exposition of the *Kritik d. r. Vernunft* and with the application of psychiatrical cases to fit and illustrate it. He treats of the disturbances of general logic, of the "*Erkenntnisvermögen*," of apperception, of concepts, and of the ideas (pathological cosmology and pathological theology).

The author shows much acuteness and learning, but, nevertheless, the work appears to bear no fruit. Psychology has grown since Kant died, and Dr. Herz's *psychology* is too full of Kant's *Erkenntnistheorie*, "faculties," separate mental water-tight compartments, "*ruhende Iches*" and other wreckage to make it an advance in present psychology or psychiatry.

ARTHUR ALLIN.

Die Philosophie des Selbstbewusstseins und der Glaube an Gott, Freiheit, Unsterblichkeit. Systematische Grundlegung der Religionsphilosophie. Von DR. GÜNTHER THIELE, Berlin, 1895, pp. 510.

This large volume on the philosophy of religion from a German professorial chair in Königsberg does not propose to treat religion from the standpoint of anthropology, psychology or the historical development of culture, but proposes to justify epistemologically and philosophically, the religious belief in God, freedom and immortality. The need of such is all the greater, since, according to the author, it has come to such a pass that the ordinary lay-

man rejects a theological proposition for no other reason than that it stands in the Bible or rests upon Bible authority. Hence this new attempt to justify the ways of God to men.

According to the author, the one great truth and highest concept in the philosophy of religion is personality. "Only man as person is free and responsible, only personal immortality has ethical worth, only a personal God offers full satisfaction to religious and moral needs. The real kernel of the concept of personality is self-consciousness. Hence the justification of the name of this philosophy of religion, the Philosophy of Self-consciousness." Knowledge, or *Wissen*, is used here in a narrower and in a wider sense. "In the narrower sense it denotes the quiet, certain possession of a truth; in the wider sense, that peculiar psychical light which not only in thought, but also in will and desire, sensation and feeling permeates with light more or less clearly our psychical life and specifically distinguishes it from mere dead being." This element of "psychical light" common to thought, will and feeling, thus makes possible "*die dem Seelenleben charakteristische Innerlichkeit, sein In-sich-, Bei-sich-, Für-sich-sein.*" Now the knowledge of knowledge *(Wissen des Wissens)* is easy after this, and one is not surprised to find Plotinus placed as acme of the ancients and cream of the Greek philosophy in this respect. The author, then, in this spirit, guides one through the Kantian categories and endeavors to show how Kant in his cosmological and other proofs gets hopelessly entangled and involved in self-contradictions. The *regressus in infinitum* of the causal chain of world actions ought not to impose on us; "we believe rather that we must set up a dam against it, and that dam is the concept of the unconditioned, the *causa sui*, the Absolute Substance." (The "must" is instructive.) The "soul-substance" of man is said to be supertemporal, simple, continuous, etc.; the ego is the identity of knowing and willing and substantial being. At the same time it said "Hume is right; through mere self-observation we find neither an *ego*, nor an *activity* of the ego, only a coming and going and association of presentations and at most of feeling and impulsive tendencies." How this is reconcilable with the author's Philosophy of *Self-consciousness* is difficult to understand. A German professor was once asked by a student to explain an obscure portion of his own book. The professor looked perplexed and replied, "There was a time when two persons understood this passage, *der liebe Gott* and myself; *jetzt weiss es nur der liebe Gott!*" In my opinion, we have here a similar case. The author then proceeds to make "*das Setzen, Hin-meinen des Ansichseins*" or self-consciousness a category, and with the aid of Kant, Fichte, Herbart and his own "psychical light" makes out his case more or less. "The supertemporal ego as spaceless-intensive can only stand to the brain in a spaceless-dynamic relation." The usual theological doctrines *re* freedom and immortality are developed in the latter part of the volume.

The good "professor of Königsberg" has, as in duty bound, written his book; whether it will appeal in any shape or form to the modern psychologist may be questioned. Here is what the professor says of reflex action: "The last ground or reason for the transformation of a sensory into a motor impulse is the circumstance that in the state of feeling following the sensory impulse there is already contained an acceptance or rejection of this condition, that is, an impulse (*Trieb*) which produces a motor process, a reaction of the soul upon the organism!"

ARTHUR ALLIN.

NOTES AND NEWS.

PROFESSOR DELBŒUF.

It is our painful duty to chronicle the loss to science and to this Journal of our distinguished colaborator, Professor J. Delbœuf, of the University of Liège, who died suddenly at Bonn on the fourteenth of August. A sketch of his psychological activities will follow in the next number.

THE MUNICH CONGRESS.

There can be no doubt that the Munich Congress, the third International Congress of Psychology, was, as from the outset it promised to be, more important than either of its predecessors. The attendance was not quite so representative in actual fact as might have been anticipated from the printed programme, — Wundt, James, Sully, Binet, Stanley Hall, Delbœuf and G. E. Müller were among the absentees; and the weather was as unfavorable as it well could have been. But a gathering of 450 psychologists could not but include a large number of famous names, and the generous hospitality extended to members of the Congress by city, university and state was not to be entirely balked by rain, however persistent.

The Congress sat from Tuesday, Aug. 4, to Friday, Aug. 7, inclusive. Proceedings may be said to have opened, however, on Monday evening, when an informal reception was held in the Café Luitpold. The two presidents, Professors Stumpf and Lipps, were present, and the reception afforded a pleasant opportunity to some 150 members for the renewal of old friendships and the making of new acquaintances.

The first regular session took place on Tuesday morning, in the great hall of the university. Professor Stumpf delivered the inaugural address, using the occasion to discuss, in a somewhat controversial tone, the respective merits of Interaction and Parallelism. His paper was followed by three brief addresses of welcome, given on behalf of the state by the minister of education, Herr Ritter von Landmann, — who hoped that the psychologists would not make things too easy for the criminal,—on behalf of the city by Herr Bürgermeister Brunner, and on behalf of the university by the rector magnificus, Professor von Baur, who in the course of his remarks paid a special compliment to American psychology. The morning closed with the reading of papers, *Sur la douleur*,

by Professor Richet, and *Die kriminelle Zurechnungsfähigkeit*, by Professor von Liszt.

In the afternoon the sectional sessions of the Congress began. It is impossible to give any adequate account of the sittings of all five sections on this and the following days. Many members failed to appear at their appointed time, so that the printed order of the addresses did not by any means correspond to the order of delivery, and it was out of the question to travel from section to section with the view of listening to the discussion of especially interesting topics in all departments. I shall be obliged to confine myself to notes of the proceedings of Section I (brain anatomy and physiology, physiology and psychology of the senses, psychophysics), and can do no more than mention the fact that much important work was accomplished in Section II on the psychology of the normal individual, in III on psychopathology and criminal psychology, in IV on the psychology of sleep, dreaming, hypnosis and allied phenomena, and in V on comparative and pedagogical psychology.

At the first session of Section I papers were read by Professor Exner on "Autokinetic Movements," by Professor Morselli on "The Vascular Reflexes of Simple Perceptions," by Professor Tokarsky on "The Minimal Duration of the Simple Reaction," by Professor Ebbinghaus on "The Method of Right and Wrong Cases," and by Professor Külpe on "The Intensifying Effects of Attention." The last gave rise to a vigorous discussion, in which Professors Ebbinghaus, Exner, Lipps and Münsterberg took part. The evening was devoted to a municipal reception in the old Rathhaus, at which Herr Bürgermeister Brunner again welcomed the guests, and Professors Richet, Sergi, Baldwin, Heymans, Sidgwick, Flournoy, Geijer, Tokarsky and Saliger returned thanks to the city of Munich in the name of their respective nations.

The second general session was opened on Wednesday morning by Professor Flechsig, who lectured on "The Association Centres of the Human Brain, with Anatomical Demonstrations." This was, without doubt, the most 'sensational' event of the Congress. The address was followed by a long and fruitful discussion between the lecturer and Professors Dechterew, Ebbinghaus, Forel, Lipps and Stumpf. The session ended with papers by Professor Sergi on "The Seat of the Emotions," and Professor Preyer on "Child Psychology."

At midday the Congress adjourned for Frühschoppen to the Spatenbrauerei, where, by the kindness of Herr Sedlmayr, all who desired were conducted over the brewery. It seems, as Herr Sedlmayr remarked, a far cry from psychology to beer; but Professor Ebbinghaus found a link in the notion of a 'Spatenpsychologie.' At any rate, the visit was most enjoyable.

The proceedings of Section I in the afternoon were opened by Professor Martius, who spoke of "The Influence of Light Intensity upon the Brightness of Color Sensation." Papers were also read by Professor Bezold on "A Continuous Tone Series for Testing Defects of Hearing, and its Significance for the Helmholtz Theory of Audition" (with demonstration), by Dr. Stern on "The Perception of Gradual Change," and by Dr. Aars on *Farbensynkrasie* (induction mixture and its relation to induction contrast). Dr. Stern's thesis was discussed by Professors Ebbinghaus, Exner, Külpe and Stratton; and all the other papers gave rise to brief discussions.

In the evening, a large majority of the members betook themselves to the little Residenz theatre, where a special performance of Don Juan was given, while a select few supped with the

prince regent at Nymphenburg. The garden party which was to have been held after the theatre at Dr. Hirth's residence, was rendered impossible by a steady downpour of rain.

On Thursday morning, Professor Sommer, at a brief general session, demonstrated his new graphic method of thought reading. The rest of the day was entirely devoted to sectional work. In Section I Dr. Wadsworth spoke of "Color Perception," with special reference to defective color vision; Professor Stratton described experiments on vision made without inversion of the retinal image; Dr. Wolff read a paper on "A Relation Between Irradiation and Simultaneous Contrast;" Dr. Kaes gave the results of an examination of the cortices of a two-years-old microcephalic girl and of a twenty-five-years-old macrocephalic female dwarf; Dr. Vram discussed "The Centrifugal Course of the Sensory Excitation produced by Visual Images," and Dr. Marbe stated his theory of intermittent visual stimulation. In the afternoon, Dr. Marbe demonstrated a series of photographic grays, and papers were read by Dr. von Schmidt on "The Definition and Seat of the Mind," by M. Courtier on "Capillary Circulation in its Relation to Psychological Phenomena," by Dr. Wreschner on "The Theory of the Time Error," by Dr. Hering on "The Integrity of Centripetal Nerves as a Condition of Voluntary Movement," and by Professor Wedensky on "The Study of Central Innervation." The addresses of Professor Stratton, Dr. Wreschner and Dr. Hering were followed by brief discussions. At the close of the session Dr. Stern demonstrated an apparatus for the production of continuous tonal change. It may be mentioned here that various firms, notably Herr Zimmermann of Leipsic, had sent pieces of apparatus to Munich for exhibition. They were laid out in one of the rooms of the physical laboratory, and were demonstrated at different times by Dr. Schumann. A demonstration of movements of the soft parts of the thorax by means of the Röntgen rays attracted considerable attention.—The English-speaking members of the Congress lunched together at the Café Luitpold. In the evening the formal Congress dinner was held at the same place.

At a meeting of the International Committee, held early on Friday morning, it was decided that the fourth Congress meet at Paris in 1900, with Professors Ribot and Richet as presidents, and M. Pierre Janet as secretary. On the same morning, at the last general session, lectures were delivered by Professor Brentano on "The Doctrine of Sensation," by Dr. Pierre Janet on "Somnambulistic Influence," by Professor Ebbinghaus on "A New Method for Testing the Mental Capacity of School Children," and by Professor Lipps on "The Concept of the Unconscious in Psychology." The third lecturer aroused special enthusiasm. At the conclusion of Professor Lipps' address, Professor Stumpf made a few remarks, retrospective and prospective,—and the Congress was at an end.

At lunch time there was a reunion of old Leipsic students in the Café Luitpold. The projected excursion to the Starnberger sea in the afternoon was replaced, in consequence of the weather, by an informal gathering in the great hall of the Kunstgewerbehaus.

It will be evident, from the above summary sketch, that the festal side of the Congress impressed the visitor as strongly, or nearly as strongly, as its scientific side. That the psychologists appreciated the efforts made for their entertainment no one could doubt who heard the speeches delivered on Tuesday and Thursday evenings. And it is, of course, almost a truism that the great benefit to be derived from any such convention lies rather in the results of personal intercourse than in those of attendance at a

series of lectures. We must wait to read the latter in the official *Bericht*,—which is promised for the end of November.

No account of the Congress should conclude without a word of cordial thanks to the general secretary, Dr. Frhr. von Schrenck-Notzing, upon whom all the labor of detailed arrangement devolved. M. Janet will find it a hard task to succeed so self-sacrificing and capable an organiser. E. B. T.

Books Received.

Adams. The Law of Civilization and Decay. An essay on history. The Macmillan Co., New York, 1896. Pp. 393. Price, $2.

Aubry. La Contagiôn du Meurtre. Étude d'anthropologie criminelle, 3d edition. Bibliothèque de philosophie contemporaine. Félix Alcan, Paris, 1896. Pp. 308. Price, 5 f.

Fouillée. Le Mouvement Positiviste et la Conception Sociologique du Monde. Bibliothèque de philosophie contemporaine. Félix Alcan, Paris, 1896. Pp. 379. Price, 7.50 f.

Gory. L'Immanence de la Raison dans la Connaissance Sensible. Bibliothèque de philosophie contemporaine. Félix Alcan, Paris, 1896. Pp. 346. Price, 5 f.

Haddon. Evolution in Art; as Illustrated by the Life-Histories of Designs. With 8 plates and 130 figures in the text. Pp. xviii-364. Price, $1.25. The Contemporary Science Series, imported by Charles Scribner's Sons, New York.

Kraepelin. Psychologische Studien, Erster Band, 2 u. 3 Heft. W. Engelmann, Leipzig, 1896. Price, 7 m.

Lombroso et Ferrero. La Femme Criminelle et la Prostituée. Traduction de l'Italien par Mme Louise Meille. Bibliothèque de philosophie contemporaine. Félix Alcan, Paris, 1896. Pp. 679. 13 plates. Price, 15 f.

Mach. Popular Scientific Lectures. The Religion of Science Library No. 21. The Open Court Publishing Co., Chicago, 1896. Pp. 313. Price, 35 cts.

Obersteiner. Bau der nervösen Centralorgane. F. Deuticke, Leipzig u. Wien, 1896. Pp. 572. Price, 14 m.

Ratzel. The History of Mankind. Translated from the second German edition by A. J. Butler, M. A., with an introduction by E. B. Tylor, D. C. L. Vol. I. The Macmillan Company, New York, 1896. Pp. xxiv-486. Price, $4.

Studies from the Yale Psychological Laboratory, Vol. III, 1895. New Haven, 1895. Pp. 110. Price, $1.00.

Swâmi Vivekânanda. Yoga Philosophy. Lectures delivered in New York, 1895-96, on Râja Yoga, or Conquering the Internal Nature. Also Patanjali's Yoga, with commentaries. Longmans, Green & Co., New York, 1896. Pp. 234.

Titchener. An Outline of Psychology. The Macmillan Company, New York, 1896. Pp. xiv-352. Price, $1.50.

THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

VOL. VIII. JANUARY, 1897. NO. 2.

A STUDY OF FEARS.

BY G. STANLEY HALL.

As psychological research has lately tended towards will and feeling, the limitations, of both the experimental and the introspective methods, have grown increasingly apparent, and in some directions are now exiguous and almost painful. We can neither excite the stronger emotions in the laboratory nor coolly study ourselves while they are on under natural conditions. Moreover, the many instinct-feelings come to but very partial and incomplete expression in any single individual. To bring them out clearly, averages, mosaics, composites from many lives may, I think, be used to show both the relative depth and the vastly wider ranges of psychic experience. Childhood, too, must be explored, because despite the higher reaches of the adult consciousness much is, and by the necessities of growth must be, forever lost to it. There is a standpoint from which the adult mind, like the adult body, is decadent. It was in view of this general situation that we have evoked the aid of the questionnaire method in this field, striven to give it both new applications and new developments and devised a scheme of treating data, all of which together are bearing important fruits, and can do some things impossible before. By these means, too, psychology is brought into closer contact with human life over more and larger areas, and also given practical bearings, and that in several fields, as well as enabled to exert corrective influences on certain tendencies now too manifest in psychology.

Hardest and all important is the choice of a topic. This

must often be so common and homely that the only wonder is no one had ever thought of it before as a theme for special research. It must be accessible to the psychological methods and have a certain ripeness and opportuneness. It must be specific, as opposed to the former blanket or omnibus syllabus. It must call for phenomena so marked that the non-expert parent or teacher can make reliable returns, as the untrained observers have long done to the official and voluminous questionnaires worked by four European anthropological societies, by students of meteorological phenomena, migratory instincts of birds, fishes, etc. Questions must suggest every main aspect, but no one answer rather than another, and must call for form enough so that the data can be fully treated statistically, yet must leave freedom enough to bring out details of all important cases which may be abridged and cited, as are clinical illustrations in medical literature, even if more briefly, because more numerous.

Such ideals are rarely if ever attained. The following report is well calculated, however, to show both the merits and defects of the method. It is based upon the returns to one of the thirty-two syllabi issued from Clark University up to September, 1896. Some preliminary tests had preceded, and in February, 1895, it was sent to 748 persons, about half of whom had heard of our series—of which this was No. IX—and had requested it:

1. Fears of celestial phenomena, as, *e. g.*, of winds, storms, thunder and lightning, heavenly bodies, meteors, sky falling, cloud, mist, fog and cloud-forms; end of the world and attendant phenomena; night and darkness, eclipse; moon breaking, that the sun may not rise; peculiar sky colors, northern lights, excessive heat and cold, loss of orientation, and points of compass.
2. Special inanimate objects, as fire and conflagration; water, drowning and washing or being washed; punishment and its instruments, and things and places associated with it; falling and of high places; uncanny places, as caves, ravines, gorges, forest gloom, high hills and solitude generally, and getting lost, or shut up; guns and weapons; points, sharp edges, very narrow or wide open spaces; dirt on garments or skin, and contact generally; vehicles and riding.
3. Living things, self-moving things generally; big eyes, mouth, teeth; dog, cat, snakes, pigs, rats and mice, spiders, bugs and beetles, toads, etc.; sight of blood, robbers and burglars, strangers, society and bashfulness; fear of being laughed at, talked of or being ridiculous; shyness of opposite sex; fear of fighting; cowardice, poltroonery, suspiciousness.
4. Disease, dying, death, loss of friends, position, fortune, beauty, or of health generally; heart disease, cancers, fits, consumption, starvation, fear of prevalent diseases, or of those read of.
5. Fears of the supernatural, *e. g.*, ghosts, spirits, witches, fairies, dragons or mythological monsters; dream fears, conscience fears, as of having committed unpardonable sins; punishments

specially incurred or sent from heaven, loss of soul and next world fears generally, fears of sin or impurity.

6. Describe any *sudden* experience you have felt or observed, and whether involving only distinct surprise or being intense enough to cause real shock, start or astonishment, with details of cause, effects and their permanence; terrors, without danger or cause other than an hereditary or a traumatic disposition to timidity.

7. In each case state order and age of fears, how long they lasted, how intense they were, what acts they prompted, and educational good or bad effects; was sleep affected? State specific symptoms, starting, paleness or sweat, urinations, rigidity, cramps, horripilations and "creepy crawling" feelings, nausea, weakness, fainting, flight, causes, treatment and cures.

This syllabus is drawn up by the undersigned, and is sent to *you* with the request that *you* will read it carefully item by item, and (1) jot down at once in the easiest form of notes whatever each paragraph or phrase recalls of your own childish fears; (2) that if you are a parent you will add to this any observations this paper may suggest or recall on your own children (it may aid you if you keep a "life book" or memoranda in any form about them); (3) that if you are a teacher, you will read this paper to your class, write it on the board, or give it to individual pupils (of upper grammar or high school grades) and ask them to write as an exercise in composition (setting apart an hour, or asking for out of school work) an account of their own early or present fears; (4) if you are a normal school principal or teacher of psychology, you may connect it with the class work in the study of feelings or emotions; (5) if you are a principal or superintendent, you can assign the work to some teacher or advanced pupil to collect the data. All returns may be anonymous if preferred, but age, sex and nationality must be stated in every case.

Returns may be sent direct to the undersigned or, if preferred, may be studied by you, and will make the best of material for a lesson in psychology, for a discussion in a meeting of teachers or mothers, or an address, or an article for the press. When you are entirely done with the material thus gathered and used, send it to the undersigned.

This syllabus was reprinted in several educational journals in this country and in England, and was also privately printed and multiplied by teachers and others. Returns which are the data of this paper were received as follows:

E. H. Russell, principal of the State Normal School, Worcester, Mass., sent 266 papers, each describing a single case of fear. These had been previously written, with no reference to any syllabus, but were the fear cases selected from nearly 40,000 returns made by his pupil teachers according to a method elsewhere described.[1] Their chief merit is conciseness, an attempt at photographic objectivity and absence of comment. Of these 134 were original observations, 88 reminiscence, 39 hearsay, and the rest from literature. They are well distributed between the ages 4 months and 12 years, and

[1] *Pedagogical Seminary*, Vol. II, p. 343.

the sexes reported on are nearly equal in number, except the reminiscences, which are mostly by females.

Miss Lillie A. Williams, head of psychology at the Trenton, N. J., Normal School, sent reports by 461 persons, of which 118 were original, 163 reminiscence, 75 hearsay. The reminiscences averaged six or seven pages of note paper each. The other 105 were compositions on their fears, past and present, by girls from 5 to 18. Miss Williams has developed the most effective of all methods for collecting valuable returns to questionnaires, which is described elsewhere.[2]

Principal H. S. Baker of St. Paul sent 552 papers, well distributed over all grades; those older writing their fears in the form of a composition after having the syllabus read and explained, and the younger children having their answers written by teachers.

Principal R. G. Huling of the English high school, Cambridge, Mass., explained and assigned this as a topic for one of his daily themes, and sent returns from 77 juniors, 6 intermediates, 55 undesignated, and from the main division of his school volunteers brought 18 returns and obtained 17 from children, making in all 173.

Miss Hughes, principal of the training school at Cambridge, England, sent 43 one hour compositions of unusual merit, by girls of from 17 to 22 years of age. Miss Harriman of Providence, R. I., sent 23 compositions very similar to the above. Miss Stickney of the Hughes high school, Cincinnati, O., sent 45 compositions on their fears by senior girls. Superintendent Pease of Northampton, Mass., sent 46 volunteer compositions by children of from 13 to 16. Mrs. J. M. Dewey of North Adams, Mass., 19 high school compositions; the Buffalo Seminary, 18 compositions by young women from 17 to 21; J. W. Dixon, 17 fear compositions by girls averaging 16; 38 were from friends and pupils of mine and others, some of whom have written with the greatest care and fullness.

Too late to be included in any of the tables, but utilized along with the above for illustration, and in discussing special fears are the following: 115 supplementary returns on special fears from Miss Williams; 27 volunteer compositions on their fears by seniors in Bowdoin College, sent by President Hyde; 44 well digested returns from children of 13 and 14, by Miss H. M. Bullis of Summit, N. J.; about 200 well classified returns sent anonymously, and other returns on specific points especially asked for, from various other sources.

[2]See her article, "How to Collect Data for Studies in Genetic Psychology," *Pedagogical Seminary*, Vol. III, p. 419.

The data used for the first tabulation, therefore, consists of the records of the chief fears of 1,701 people, mostly under 23 years of age, gathered in different places and by methods without great uniformity, and 386 supplementary reports and many returns or special points, all written on nearly 4,000 pages. Some merely list the objects they fear, and others give copious details of a single fear or even fright; some report half a dozen fears of their own and add others of their friends, sometimes omitting not only age, but sex. Thus the problem of statistics was rendered exceedingly difficult, and each table is based upon only those returns which yield its data, so that everything had to be gone over independently for each table. With the expert aid of Miss Watson, assisted by Miss Rawson and others, every individual was first represented in large tables by a line showing each of his or her fears, with age and sex, and with fullness of presentation marked on a scale of 10, with hieroglyphic signs for special features and a wide column for miscellanies. In these elaborate charts returns from each locality were kept by themselves, and running numbers referred to the original papers. It is upon these, too many and too voluminous to print, that the tables below are based. The 112 hearsay cases were discarded.

Next I read every paper with care myself, copying every salient or typical phrase and word, but dropping what was irrelevant, and condensing wherever possible. These cases were written as they came, and when all was done, scissored into several thousand slips, and with great labor brought into natural groups, and thus allowed to classify themselves. Each of these groups was later studied by itself, and, after each case had been brought next to that which it most resembled, all were pasted in due order. This process gave me several hundred closely written pages of topically arranged experiences, the reading of which, subject by subject, without a word of comment, the best members of my class have intimated was followed with the very greatest interest, and was a fresh breath from life full of stimulus and suggestion of new and larger fields for the psychology of the near future. As a pedagogic as well as a scientific method, subsequent experiences, too, are increasing my own sense of its exceptional worth. Like the above preliminary tables, this form of the material is too voluminous to present in full, but in all the descriptions of the special fears which follow, I have had them under my eye, so that although my pages are not disfigured with quotation marks, I have followed the very phrases of the returns as closely as possible, and it is only by exercising the greatest self-control that I refrain, despite limitations of

space, from doubling my pages with the records of cases of great interest.

The above 1,701 persons have described 6,456 fears, which are first very roughly grouped as follows, according to the objects feared:

TABLE I.

Celestial Phenomena.		Animals.	
Thunder and lightning,	603	Reptiles,	483
High wind,	143	Domestic animals,	268
Cyclones,	67	Wild animals,	206
Clouds and their forms,	44	Insects,	203
Meteors,	34	Rats and mice,	196
Northern lights,	25	Cats and dogs,	79
Comets,	18	Birds,	51
Fog,	16		1,486
Storms,	14		
Eclipses,	14	Fire,	365
Extreme hot weather,	10	Water,	205
Extreme cold weather,	8	Drowning,	57
	996		627
Darkness,	432		
Ghosts,	203	Strange persons,	436
Dream fears,	109	Robbers,	153
Solitude,	55		589
	799		
		Death,	299
		Disease,	241
			540

This accounts for 5,037 fears, leaving 1,419 directed to many scores of objects to be discussed later. It would appear that thunder storms are feared most, that reptiles follow, with strangers and darkness as close seconds, while fire, death, domestic animals, disease, wild animals, water, ghosts, insects, rats and mice, robbers, high winds, dream fears, cats and dogs, cyclones, solitude, drowning, birds, etc., represent decreasing degrees of fearfulness. When we specify reptiles, domestic animals, insects, birds, the kinds of disease, strangers, dream fears, and add the miscellaneous fears, we have in all 298 objects feared. This order, however, is not quite the same in different localities. In Cambridge, Mass., alone thunder and lightning does not lead, and self-consciousness, dreaded by 24 boys there, does not appear in either Trenton or St. Paul. In the latter place 67 fear cyclones and only 8 the end of the world, which has 62 victims in Trenton, where also 46 fear being buried alive.

The St. Paul returns, moreover, show an average of 4.86 fears for each person, those from Trenton 3.66, while the Cambridge, Mass., boys report 2.28 each. Whether this indicates more fears, more frankness, or, as I suspect, more importance attached to the work, and greater interest in it at St. Paul than at Cambridge, there is nothing to show. The St. Paul fears lead all others in intensity and objective realism; their quality is more primitive, and they have less variety. Here we have 7 out of the 9 children who declare that they "fear nothing," and 4 out of the 7 who "fear everything," and here only we meet with fears of train robbers, having to sleep on the porch, and starvation. Yet while one could not read the fears in any group of returns without inferring whether the children lived in the country or city, by the sea or in the hills, all the local coloring is, on the whole, surprisingly small.

Selecting next from our returns the 1,106 well described fears of 500 boys and the 1,765 fears of 500 girls on the 28 topics below, they were tabulated as follows to show the effect of sex:

TABLE II.

	F.	M.		F.	M.
Thunder and lightning,	230	155	Blood,	44	14
Persons,	190	129	Heights,	40	43
Reptiles,	180	123	Self-consciousness,	40	28
Darkness,	171	130	Noises,	36	10
Death,	102	74	Buried alive,	32	5
Domestic animals,	96	57	Imaginary things,	24	23
Rats and mice,	75	13	Drowning,	20	19
Insects,	74	52	Clouds,	15	4
Ghosts,	72	44	Solitude,	15	4
Wind,	61	35	Places,	14	2
End of world,	53	11	Meteors,	12	6
Water,	53	62	Shyness,	8	9
Robbers,	48	32	Fairies,	7	
Mechanism,	47	31	Ridicule,	6	1

Thus out of 500 girls 230 report fear of thunder and lightning, while the same number of boys report this fear but 155 times. In this, in fears of the end of the world, rats and mice, blood, and being buried alive, girls most lead boys, while boys excel girls only in fears of water, height and shyness. From the above it will appear that each of the boys has 2.21 fears, while each of the girls has 3.55 fears.

Again, out of all our returns, 516 boys with 1,521 fears and 671 girls with 3,101 fears were selected and grouped by age to show the relation of age to fears for both sexes as follows:

TABLE III.

AGE.	M.	AV.	F.	AV.
0— 4	36	1.76	74	4.89
4— 7	144	1.54	176	2.44
7—11	104	3.56	227	4.34
11—15	140	3.69	127	6.22
15—18	72	2.40	38	10.67
18—26	50	2.55	29	4.31
	524	(2.94) 2.58	671	(4.62) 5.46

Thus 36 boys below 4 years of age return 1.76 fears each, while 74 girls of the same age average 4.89 fears each, etc. All these boys record 2.94, and all these girls 4.62 fears each. The fears of the boys increase from 7 to 15, and then decline, while those of the girls increase more steadily from 4 to 18.

Taking the sexes together, the following classes of fears show decline with advancing maturity: meteors, clouds, blood, end of the world, being kidnapped, fairies, loss of orientation, shyness of strangers; while the following seem to increase: thunder and lightning, reptiles, robbers, self-consciousness, machinery. Increase during pubescent years, with subsequent decline, appears in wind, darkness, water, domestic animals, insects, ghosts, death and disease. With scores of other fears the numbers are too small even to give valuable suggestions. Important as is the influence of age, its determination has been baffling throughout; increased power as well as love of expression is a concomitant variation. While many special fears decline and others increase with age, many infantile fears remain through life, and scores of our reporters say there has been no change in their fears.

Passing now to our special groups, we begin with:

I.

FEAR OF HIGH PLACES AND FALLING: GRAVITY FEARS.

(All the cases in this and the following sections are selected from a large number.)

1. *F.*, 16.[1] Has no fear of falling from high places, but the impulse to throw herself down is so intense she must strain every muscle to get away, and must often call for immediate help; often there is a sense of smothering.

2. *F.*, 17. Describes the same impulse in order to see how it feels going down, and is exceedingly curious to know how it would feel to fall very far.

[1] *F.*, 16=Female sixteen years old. *M.*=Male.

3. *F.*, 12. Could only go up a high elevator by having a handkerchief tied over her eyes; when at the top she trembled and felt like leaping down till blindfolded again.

4. *F.*, 13. At the top of a high building was irresistibly impelled to squeeze between the bars of the railing to see if one could fall to the pavement; is sure she would have landed there if she had not been held, and describes it as an outside power forcing her against her will, as very terrible and conquering her control.

5. *M.*, 15. Could never climb the smallest tree; happening to glance over high banisters lately, he sprang back across the hall with a shiver lest by sudden impulse he should hurl himself down, and lie a mangled mass.

6. *F.* A young Scotch lady has such dread of falling that she can never go up or down stairs when it is dark, and never except very slowly; for the same reason she could never learn to skate, and often in slippery weather stands still and cannot take a step; she once tried rolling down hill with other girls, but trembled for an hour; can do nothing on gymnastic apparatus; is never giddy, and never had a bad fall.

7. *F.*, 17. On going down an elevator always feels that she is going straight to the bottomless pit spoken of in the Bible, and has nausea if she gazes down; wells have always had a great fascination for her; she never liked to stand and gaze down them, but had to.

8. *F.*, 37. Can never enter a store with a big sign over the door, lest it should fall on her; if it swings or creaks, it is all the worse; she is always fearing the stars will fall and crush the earth, or that meteors will drop on her.

9. *F.*, 10. Has for years had the greatest desire to look down a very deep well which the children thought bottomless, but has never yet dared.

10. *M.*, 11. When on a high place always wants to try to fly off.

11. *F.*, 23. Almost faints to see others on high places.

12. *F.* Can never cross a ravine or high bridge nor sleep in an upper story.

13. *M.* A professor of psychology, age 50, was fearless of high places through his youth, but soon after college saw a servant fall from his room four stories, helped bring him in, went for a doctor, but since cannot sleep in high rooms at a hotel; tried in vain to ascend Bunker Hill monument as a discipline, but found the tension too great when half way up; could only get over the suspension bridge at Niagara eighteen years later by walking in the middle and grasping a carriage; the fear is rather more that the whole structures may collapse, but partly that he will lose control.

14. F., 17. Cannot look straight up without dizziness and fear of falling and sometimes losing her footing.

15. *M.*, 17. Is almost as afraid to look up as down heights.

16. *M.*, 46. Can never sit under the chandeliers at a theatre, nor under the front of a gallery, for fear things will drop on him.

17. *F.*, 16. Has never been able to sail past the Palisades on the Hudson without fearing they would fall.

18. *F.* A lady's only memory of her grandfather was that he would lift and toss her high.

19. *F.*, 8. Was visiting a large farm, where she was very happy till she learned there was a well on it, when she ran in, wept and

prayed to go home; "she cried all night, and was always so about wells."

20. *M.*, 30. Can never sit in front row of the gallery at church.

21. *F.*, 28. Can only do so by clinging tight to the next person, "lest I should leap down on the congregation."

22. *F.* A mother says her eight children have always been intensely excited on being lifted towards the ceiling.

23. *F.*, 56. Went to the top of the Eiffel tower and enjoyed it greatly, but the memory of so doing has since come to fill her with nightly terrors.

24. *F.*, 24. Can never go up any open stairs or steps "without mortal trepidation lest some one should catch my feet."

25. *F.*, 27. Can never walk up steps or on iron flooring with openings as large as a pin lest she should fall through.

26. *F.*, 40. Is haunted with the fear of falling down stairs, and at night often sees herself a mass of broken bones at the foot.

27. *M.* An officer in a woman's college; has for many months suffered with great and sleepless anxiety lest the college girls should be hurt running down some steep bank.

28. *M.*, 3. Is horrified at riding down hill, shouts "drive slow!" clutches his mother's arm, gets nervous and trembles.

29. *F.*, 18. Can never look out of a window above the first floor without feeling she must jump to get the beautiful sensation of dropping through the air; she is not dizzy, but has a sinking feeling at the heart.

30. *F.*, 18. Has worried for years lest she or others might fall off the earth into space; this danger she deemed greatest at night, when all was upside down, but it was possible any time.

31. *M.*, 18. Otherwise normal, has never been able to ride in any kind of vehicle, neither cars, bicycles, boats nor carriages, and describes another boy of 15 with the same fear.

32. *F.*, 16. Loves driving, but has a horror of going up hill or down.

33. *F.*, 27. Can never ride in a carriage with comfort, for she always fears it will break and let her drop.

34. *F.*, 17. Can never drive over mountain roads that go near gorges or steep places. The last four cases each state that their fear has been caused by no accident.

35. *M.*, 16. The horror of hell is, you are always falling.

36. *M.*, 45. The chief fear is that he will leap out of the window in his sleep; he takes precautions every night, but never yet got up in his sleep.

37. *M.*, 21. In his early teens he dreamed so often of flying that he often woke feeling sure he had found out how; it became very pleasant.

38. *F.*, 9. Feared she should fall through cracks where puddles had dried.

39. *M.*, 31. Is sometimes impelled to sacrifice all when on a high place to get the exquisite pleasure of dropping, with a wild feeling he might be borne up a little, or strike a soft spot

40. *F.*, 6. Would not go to heaven, it was so high and she might fall.

41. *M.*, 67. Speculated much on the effects of "reversed gravity," which he thought probable sometime.

42. *F.*, 6. Used to have great fears of being carried as a baby;

was once startled at a high hill suddenly seen in riding, and could not bear to have a cloud get directly overhead.

Some come to rather like the sensation of hovering, as case 37, and perhaps 10 or for a time almost think they can fly from nightmare experiences. (See under dream cases 41 and 30.) For 2, 10 and 39 the sensation of dropping or sinking seems to have a charm so strong as to endanger control. For nearly all, these feelings are dreadful, and they may be caused by going up or down hill, 27, 28, 32; or stairs, 6, 26; or by the smallest openings 38, 25; may make every kind of riding a terror, 31; even to stand on ice is too suggestive, 6; galleries and second stories are avoided, 13, 12, 21, 20; wells and elevators are shunned, 7, 9, 19; to see others high, or to look down or even up, is painful, 11, 15, 14; and perhaps the dread of seeing things above, as 8, 17, 16, belongs here. Case 30 is one of many cases I have collected of "symptoms" of the thought of falling into space, or in even thinking of infinite time or space, which makes many dizzy and nauseated, (see later paper on sense of self, and what I have called *cosmic giddiness*, or cosmic agoraphobia).

These gravity fears are so common that it would probably be very easy to enlarge the above anthology of cases indefinitely, and every reader will readily add to it from his own or others' experience. Such fears, it is safe to assume, are very largely due to falls, etc. Despite the symptoms common to all fears, and even despite the absurd tendency to give Greek names to objects feared (which, as Arndt says, would give us such terms as klopsophobia=fear of thieves, triakaidekaphobia=fear of the number 13, and following which the 298 things feared in our returns might each have its name), without any suggestion of a new morbid entity, it would be convenient to have a term like barophobia for the gravity fears, and eluæsthesia for the group of falling sensations, and anakataesthesia for hovering, etc.

In actually dropping through space, the usual pressure of brain, heart, liver, kidneys and all other parts of the body upon those beneath is removed. The stomach with its contents is often the first to be affected, and nausea arises. Besides the tension caused by the tonus of the arterial and venous walls, the blood in the erect posture exerts the pressure of fluids in upright tubes. In falling this latter is removed, as in being lifted the conditions of pressure would be reversed. How this modifies sensation is unknown, but it is not impossible that the gravity movements of the fluids of the semi-circular canals represent a specialized function and organ once common to all vessels. Breuer[1] thinks he has proven

[1] Uber die Function der Otolithen Apparate von I Breuer. Pflüger's Archiv. Bd 48. P. 195.

that the gravity of the otolith plates in the ear pulls the cell hairs and excites thus in the centers the sense of the position of the head, and are organs of a specific feeling for vertical and progressive motion. These constitute the organ for a static sense, giving impressions of translation, as the ampullæ do of rotation, in the three planes of space. It is even suggested that out of the function of sensing disturbances in the surrounding medium that endanger gravity the perception of sound waves has been developed as a secondary function. Again heart action and circulation are modified in falling, and so is respiration. As lungs have taken the place of swim-bladders, the unique respiratory action of hovering as in nightmares, with all the anakatæsthesic phenomena, and perhaps the eluæsthesic sensations of a falling which are quite distinct from the former, although not without common elements, suggest the possibility that here traces of function may have survived structure. Inhalation is harder, and in dropping great distances the residual breath is sucked from the lungs. The removal of the pressure always felt on the soles of the feet, podex, or other sustaining surface, and the approximation to a prenatal state of fluid pressure on all sides, visual, auditory, perhaps now muscular coördination,—all this brings conditions throughout every part of the body which are unique in a high degree.

Our animal ancestors were not birds, and we cannot inherit sensations of flying, but they floated and swam far longer than they have had legs, had a radically different mode of breathing, and why may there not be vestigial traces of this in the soul, as there are of gill slits under the skin of our necks; and why may not the former come to as great prominence in exceptional states and persons as the latter do in some monstrous human births? To deny it is to make the soul more limited in its backward range than is the body. For one I am too idealistic and cannot think so meanly of the soul as to do this. Although it cannot be demonstrated like rudimentary organs, I feel strongly that we have before us here some of the oldest elements of psychic life, some faint reminiscent atavistic echo from the primeval sea, not as primitive as the strange geotropism of plants, but antedating perhaps limbs, and possibly even visual factors of space perception, and which could it be dissected and explored far enough might lead us, in connection with II and III seq., near the psychoplasm of the spatial quale itself. Indeed I may be teratological, but to me sensations of hovering, gliding by a rather inner impulse and not by limbs, falling and rising have been from boyhood very real both sleeping and waking, and I may add with as-

sured soundness of heart, lungs and stomach, although if caused by disease it would not hurt the argument.

Again, man's erect position is exceptional and lately acquired. The exhilaration of a child at its first step is due to a real feat of balancing. The vigorous soon love to play with these sensations in tossing, baby jumpers, coasting, swinging, the motions of vessels at sea, mountain climbing, ballooning, tight rope, bridge jumping, and now flying. Lotze ascribes the æsthetic pleasure of stilts, high heels, tall hats, etc., to the exquisite exhilaration of slightly raising the centre of gravity. The monkey-like propensity of children at a certain age to climb everything, everywhere, which needs special investigation, is another illustration, and so in a different way is the rhetorical device of a German professor who had three steps, on one or more of which he could rise to express to himself and enforce to his hearers the relative emphasis or loftiness of his utterance. The words buoyancy, exaltation, and conversely heaviness and depression, are suggestive. Unusual vigor of muscles gives a sensation of lightness, amounting sometimes almost to a belief in levitation, or in the reality of the state of rapt ecstasy, or in the glories of a physical ascension. On the other hand, cases like two I know, of persons with exceptional fragility of bones, which were at any time liable to spontaneous fracture, and who therefore had just fears of standing that would otherwise seem morbid; or hypochrondriacs, like Tolstoi's case of the man who thought he was glass, slipped one day, despite all his preposterous precautions, said smash and died; or cases of inverted gravity, like No. 41, or a paranoiac who, when about to hurl a visitor from the roof to show God's sustaining power, desisted at the suggestion that this power would be still better shown if both should go down and jump up;—all show not primitive, but perversely developed forms of the baræsthesic sense.

These latter and most of our fear cases may be considered as instances of arrest, some at the stage before erect position was acquired (6, and perhaps 25, 26, 27 and 28, and many fears of falling over if near steep places), and others as due to an awakening of the normal impulse of the young of the human species to get up, not only to the full length of the body, but beyond. At any rate, where in the soul might we expect to come upon traces of far past conditions if not in such massive impacted sensations as these? Must we not assume function to be as old and as diversified as organs? Even its morphogenic value may be far beyond the wildest dream of Lamark if we accept such speculations as those of Cope or even of Roux. As Quincke and Bütschli and others

find, the earliest protoplasmic structure is governed by the physical laws of surface tension, and currents that control oil emulsions, and which are still seen to be active in blood corpuscles and fixed in the cell structure of tissues like the liver, etc., so we must assume the earlier life of the soul to be formed on the basis of such fundamental relation with physical nature.[1]

II.

Fear of Losing Orientation.

1. *F.*, 7 to 10. Often woke up in terror and cried loudly because she could not think where she was, even whether in bed or not.

2. *F.*, 19. Sweats, feels faint and nauseated if she cannot instantly locate every door and window on waking nights.

3. *F.*, 20. Is speechless and motionless with dread if she wakes up crossways or diagonally in bed, often thinking she has been carried elsewhere.

4. *F.*, 19. Used often as a child to wake up on the floor, and had to creep around to find the bed and everything else; was sick, dizzy and frightened, and thought she could never be right again.

5. *F.*, 17. Often wakes with a sensation of being in the wrong bed, with windows misplaced, or being surrounded by thick walls, with a peculiar feeling of suffocation.

6. *F.*, 18. Can never have furniture moved in her bedroom, because the feeling of being turned round gives her a terrible panic.

7. *F.*, 21. Never has suffered from any other fear so great as that of getting lost or turned around in bed; in every strange place this fear keeps her awake; she has always been haunted with fear that she should lose her way from school and go off in the wrong direction, although the ground was very familiar; the fear of getting the wrong class room always haunts her; she can never enter the smallest forest, and can never turn a corner or curve without fearing it is wrong and painfully fixing the angles in her mind.

8. *M.*, 12. Suffers from the constant fear of losing the points of compass in city or country.

9. *F.*, 20. Awakes in anguish till she knows which way is north, and the sense of lost direction may come suddenly and stunningly upon her anywhere.

10. *F.* An English woman is haunted by the thought of losing the points of compass in some wood; it is accompanied by a sickening sensation, and sometimes by the fear of dying alone of starvation.

11. *M.*, 7. Clings desperately to his mother when turning any angle, shopping, or elsewhere.

12. *F.*, 35. In a sea voyage suffers from an elaborate fear that the ship will lose her chart or compass.

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[1] See especially O. Bütschli, "Untersuchungen über Mikroscopische Schäume und das Protoplasma." Leipsic, 1892, p. 139 *et seq.* Verworn, "*Allgemeine Physiologie.*" Jena, 1895, *Passim*, and especially on Barotropism, p. 428 *et seq.* Dantec, "La vie." Paris, 1896, p. 34-50. Wm. Roux, "*Ges. Abhandlungen.*" Leipsic, 1895. Cope, "Primary Factors in Original Evolution." Chicago, 1896, ch. X.

13. At 10 *F.*, 17, "began to realize eternity and think on the end of time, space and the world;" this brought a feeling of weakness and palpitation; "made her serious and thoughtful," and she developed a ritual of Bible verses and hymns for such occasion.

14. *F.*, 25. Has "always had a horror of the vastness of eternity; the most creepy feelings came over me at the thought; these things haunted me till twenty, when a reaction came, and I thought I believed in annihilation and loved the idea of being universally diffused."

15. *F.*, 21. Never could go off with her mates because of the incessant fear lest they should hide from her; to be lost for an instant brought the most sickening feeling.

16. *M.*, 42. A college teacher, ambidextrous, has always had difficulty in telling right from left; at corners must often pause and think, is always getting turned around, and sometimes grows nervous about it.

17. *M.*, 27. Studied a year in Berlin, but was never happy there because east would seem west and the sun went the wrong way.

18. *M.*, 72. A very intelligent farmer, has never been but twenty-two miles from his home, because he dislikes strange places and people, and might get lost.

19. Till *F.* was 3 she saw very little of outdoors, and then it oppressed her; to attend to distant things seemed painful, and she would never go twenty feet from the door.

20. *M.*, 3. Had all one summer an uncontrollable passion for running away; his proclivity was to get away at any time, anywhere.

21. *M.*, 38. Must have a map of every town or city he is in or carry one in his head, or else he gets confused.

22. *F.*, 18. Could never go the shortest distance across lots, no matter how plainly she can see across, without getting confused and turned round.

Some or all of the first six cases above may have struggled out of a dream of a very different environment, with strange and possibly alarming features. Children's dreams of place are very vivid and melt like dissolving views into the waking sense of the real environment. "Where am I?" is often the first problem of their morning consciousness, and there are often as strange oscillations and mosaics of the two states, as in hypnagogic phenomena. Everything in the room is a lighthouse or buoy to aid them into safe harbor from the far dream voyages, and so cannot be moved without confusion. Some writers attach the greatest importance to spontaneous and especially to complete waking. Dread of getting lost is common, 15, 18, 19, and may be hypertrophied, and the attractions of "sweet home" may be even too strong. Children differ immensely in the quickness and certainty of learning the environment, and probably even more in the vigor and courage to explore it. Cases like 8 and 19, and perhaps 9, 10 and 15, almost suggest atavistic relapse toward the early forms of sessile life, or attachment to parental

bodies, and remind us how slow and late in the animal series well developed locomotor organs came. On the other hand the propensity of children to run away is very common, but although shown here only in 20 suggests the migratory instincts of birds, fishes, animals, nomadic races, the spring fever so common among northern races after their long winter mentioned by Holmgren, *scholares vagantes*, tramps, explorers, globe trotters, etc. The primitive eye, ear and nose are organs of orientation to direct movement. The motor powers which selection develops are intense and sustained before they become manifold. The sensations of active and especially of passive motion are so exquisite, the experiences of travel so absorbing, and the new modes of transportation have so increased man's range and changed his habits, that although observation shows that the natural configurations of rolling ground and salient landmarks are among the earliest and most persistent of all the forms of memory, to part with them forever now rarely causes the phenomena of homesickness. On sea, desert and prairie, the "loved spots which our infancy knew" lack characteristics, and hence have little anchoring power. Cases 13 and 14, are vastations of this fear of getting lost to cosmic dimensions. Even to know in what direction the solar system is moving may mitigate cosmic dizziness as a map steadies 21, or knowing the points of compass, 8, 9 and 10. Hard as it is for children to tell p from q, few confuse p and b, so people may find it hard to tell right from left, walk in a circle, etc., and because there is no magnetic sense for north, the mortal dangers of getting lost in a primitive, gregarious life must have been vivid and prompted to a careful study of all landmarks, and, especially on plains, of the heavens. That some of the common phenomena of orientation among children have philogenetic elements, due to such ancestral experiences, I think probable. Animal life must act, but to do so it must distinguish front and back, the directions toward and from which action tends, must have more and more fixed localization to act from and on, must push out, away, and on, but later wants anchorage, and so acquires a persistent thought of return. This kind of orientation must also be a very primitive factor in the development of space feelings.

III.

Fear of Closeness.

1. *M.*, 14. I have always had the horrors if a blanket got over my head, or I was shut in a dark closet.

2. *F.*, 19. The least sense of confinement is stifling.

3. *M.*, 28. Cannot endure a closed carriage; it is not the riding, but the being shut up.

4. *M.*, 18. Has such horror of being smothered that if, in a boyish scuffle, his head gets in chancery, or he gets sat upon, he has a panic and yells murder.

5. *F.*, 18. Often dreams of being shut up, makes a great struggle, but can never throw off the impression until she sees a bright light.

6. *F.*, 36. Hates all small rooms; must have windows if not doors open; can never enter a room if the key is on the outside; if she does so must make great effort to breathe.

7. *F.*, 18. Hates caves, ravines, gorges and all narrow places, and is oppressed in every forest so that she cannot draw a long breath.

8. *F.*, 20. Has these symptoms if she sits near a corner, of which she has a great horror.

9. *F.*, 43. Sometimes when shut in a room I suddenly feel the door is locked; I feel my breath leaving me; it is the same feeling I once had when suffering with sore eyes; I would sometimes awake and find them stuck together, and I would leap up in a great panic.

10. *M.*, 16, colored. Most of all fears to be shut in; if a door must be locked he must be the one to lock it; "I still feel the same sensations about everything that limits my freedom, and want to shout, like Patrick Henry, 'Give me liberty or give me death.'"

11. *F.*, 20. Can never close a strange door behind her, but will stand and hold or prop it open on some pretext; ascribed to being shut in a barn, aged 11.

12. *M.* A boy was shut in a trunk in play, and when his mates refused to let him out lost his head with panic, grew desperate, screamed, "I shall die," and ever since dreads all narrow places, lest they should crush him, and is haunted by the fear of being buried alive.

13. *F.*, 26. Every heavy fog oppresses; she fears it will settle closer and nearer and choke her, but if in the house does not have this fear.

14. *M.*, 16. Expects to die by being choked with gas, and goes all around every night to see if it is off.

15. *F.*, 15. When three, first noticed mist, and was terrified, thinking it a veil God had spread on the earth that would never lift.

16. *F.*, 18. Thinks the sky falling when there is a mist; cannot breathe, and has nausea.

17. *F.*, 17. When awakened before daylight feared the sun would not rise, and prayed and cried she must have light.

18. *F.*, 20. Cannot see anything snake-like without the thought of slimy coils about her neck, squirming and choking.

19. *F.*, 11. Gypsies are worst, for they put plasters on your mouth so you cannot holler or breathe.

20. *F.*, 17. Has long dreaded warm weather, for fear of suffocation, and every thought of death suggests strangulation.

21. *M.*, 16. Suffers intensely from the fear of being buried alive, and writes accounts he has collected of the horrid distortions of bodies later dug up that came to life.

22. *F.*, 20. Very often dreams of being shut in a coffin and breaks out in a cold sweat.

23. *F.*, 21. Once had a trance in measles, heard all that was said, but could not move; was for years haunted with the fear of being buried alive, but cured it by the thought that God who cured that spell would not let her die in another.

24. *F.*, 18. Although in good health wrote out directions that her body should not be cremated, but that a bell should be fastened to her hand.

25. *M.*, 18. Wanted a tube so that he could speak and breathe.

26. *M.*, 16. Wanted his coffin padded on the bottom, with plenty of room, and holes for air.

27. *M.* Another wanted his tools buried with him to get out with; another food and drink.

28. *M.*, 42. Has always had such dread of smothering that he cannot sleep in the coldest weather without windows wide open.

29. *F.*, 27. Cannot hear or even read such words as suffocation, strangling, hanging, etc., without nervous symptoms, and sometimes has them at such words as oppression, confinement, tyranny, constraint, and occasionally is overcome by them when night is settling down.

30. *F.*, 18. A bad or even any very strong odor makes her feel close, smothery and hot.

31. *F.*, 12. Hardly likes to wear a ring, and will not unless it is very loose; if it sticks the least bit in getting it off she is in a panic; she cannot have a medal hung around her neck.

Hunger for breath, which starts with the first filling of the lungs after birth, demands room for air, and restriction causes incipient asphyxia. Slight dyspnœa predisposes to claustraphobiac states of consciousness, although any association of apnœa and its attendant oversaturation of the blood by oxygen with agoraphobiac symptoms by no means follows. In all these deep lying analogies of sensation, which seem better illustrated in sleep than in waking, although with laws common to both, the state of blood, lungs or heart seems to suggest the concept more often in dreams, and the converse to be more characteristic of waking. Breathing is a specialized form of skin respiration, and it takes longer to strangle young than adult animals, as is probably also the case with man. Some children habitually sleep in closed rooms, with the head under heavy clothing from darkness fears, to the detriment of health, while the fears of this section may have an opposite effect, 1, 28. Actual experiences bring out this acute panic in all its terrible intensity, 4, 10, 11. Sthenic smother effects and even globus may be caused by closed carriages, small rooms, or even shut or fastened doors, 3, 6, 9, 11. A valley, 7; corner, 8; fog, 13; mist, 15; warm weather, 20, may arouse it, and so may dreams, 5, 22; darkness, 17, 29; a snake, 18; gypsies, 19; an odor, 30;

imagined burial, 24, 25, 26, 27,[1] and even words suggesting restraint, 29. That a boy's struggle to get his head out of chancery should make liberty more real, 10, or that the thought of tyranny may cause stifling, 29, shows the immense range and power of symbolism and how our highest ethical aspirations are those that strike their roots deepest down to sensations perhaps more primitive and basal than anything else modern psychology studies. The impulse of prisoners long confined to "break out" and smash things or their own heads and fists, the vagaries of some ventilation cranks the psychic tortures of being compelled to sit long, love of tents instead of walls, mountain fever and its inspiration, and some of the associations of altitude with vast psychic range in I, also belong here. If we could stand a man safely based on a high pillar and gradually shut up his horizon around him like a closing umbrella till he was in a pit, and measure at what point claustraphobiac symptoms were felt, and then reversing the movement let his horizon sink until he was left on a pinnacle, noting the agoraphobiac symptoms passing to fear of heights, we could measure interesting and doubtless new psychological relations. Sully Prudhomme wished the world was not round, but stretched out infinitely and continuously with sky and stars; its limitations he found oppressive.

In the three groups above I, II and III, we may have important factors of space perception. The sensation of falling and gravity fears hardly suggests primitive aquatic life as hovering and floating, always associated with modifications of respiration, may do. We have no desire to speculate concerning the relative age of these two groups of sensations. Horizontal length and breadth orientation may begin with the distinctions between head and tail directions as cephalization and forward motion increased, and then between front and back after the erect position had been assumed. After this latter change, it became almost as much easier to get turned around as it did to fall, so that horizontal orientation was far harder. We require many times the cubic contents of the body in air for respiration hourly, and this, like each of the above elements, may have been a factor in the very early development of the spatial quale. That they are demonstrably *a priori* to the space of sight, or even touch, is not claimed. Class II may have been coeval with active motor feelings, but the Silurian fucoids do not more completely defy analysis or definition. Touch, motor sensa-

[1] See cases and remarks on this fear in Colin Scott's "Children's Ideas of Death," AM. JOUR. PSYCHOL., Vol. VII, No. 1, p. 67 *et seq.*

tions[1], semi-circular canals have specialized these functions; sight and the increasing predominance of eye-mindedness has re-edited them with vastly larger interpretations, but the ultimate root, the quale, the *ding an sich* of space perception, if we can ever decompose it into ulterior elements, may be found to include these factors, contributed in the earlier days of animal life by those stern but venerable pedagogues, who still teach man his surest and most abiding knowledge—fear and pain. If so, then Berkeley, Kant and modern epistemology must make room for genetic factors of space perception not hitherto considered, which open up the problem to larger and less formal treatment.

IV.

Fear of Water.

This fear in some unreasonable form is almost universal at some stage of childhood, when it is almost sure to be found if questioned for. It has many forms.

1. *F.*, 19. "To be washed always made me stiffen out, my eyes bulge, and I was almost convulsed with fear."

2. *F.*, 17. Had intense fear of water till eleven; when bathed would scream with fear, and was almost convulsed.

3. *F.* A girl had horror of being washed almost from birth till three or four; the sight of warm bath water made her kick and scream as if in agony; at one time it was thought to be hatefulness; she began to enjoy dabbling and was not afraid of a pond near by.

4. One mother found it best to cover the water in a blanket and upon it lower the child gently, to avoid this terror.

5. Another gradually broke it by playing peek-a-boo with two boys with a wet towel, occasionally touching them more and more, diverting with stories, etc., till the fear was gradually overcome.

6. *F.*, 16. Says, "How I dreaded water; I would dip the tips of my fingers, touch each cheek, and then considered my morning ablution done; it was partly dread of cold, but partly of wet."

7. *F.*, 28. Had for years a sense of great relief when a bath was over, fearing God might somehow strike her dead in it, like a case she had heard of.

8. *M.*, 7. Could never be induced to paddle on the beach or even in a small brook, but said his feet were tender, when the real reason was clearly fear.

9. *F.*, 17. Till nine could never pass a stream of water ever so small even in the cars without closing her eyes and turning her head.

10. *M.* A boy of two would always cry and scream whenever he heard water poured in a dish or the noise of a stream.

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[1] See "The Muscular Perception of Space" in my Aspects of German culture, from p. 225 on.

11. *F.* For years a girl of six had such horror of water that she had to cross all streams in the middle of the bridge lest something should come out of the water and drag her into it, and at fourteen had something of the same fear.

12. *F.*, 20. Had an overpowering and sudden fear with a sense of choking on first attempting to go into salt water.

13. *F.*, 19. Had a horror of touching water till once forcibly plunged in, when it began to develop a great charm for her.

14. *M.* A boy never dreaded it till a man took him in bathing, aged five; since then it has a nervous terror for him.

15. *M.*, 16. Was ducked all over under when eight; has never dared to go in swimming since, and hates the sight of water.

16. *M.* Four boys describe long horror of putting face or head under the water; two are good swimmers, but never ducked the head.

17. *M.*, 11. "If it rains when I am in a boat, I have the horrors."

18. *F.*, 17. Although much in a boat is always haunted by the fear that the bottom will fall out, but can give no cause.

19. *F.*, 16. Daily crosses the ferry, but can never keep her eyes off the life-preservers, and is always planning what to do if the boat sinks.

20. *M.* A young Englishman, if boating near a large vessel at anchor, or a quay in deep, glassy water, feels an irresistible drawing force, or falls under the spell of being pushed to the bottom.

21. *F.*, 18. On small bodies of still, dark fresh water has a strange sensation of depth and lack of her own buoyancy.

22. *F.* An English woman enjoys bathing while the sun shines, but if a cloud darkens the sky and water, is seized with a panic; she used to scream, but now if alone cannot stand by a still lake or river or the sea in a dead calm without feeling that she must do one of two things, throw herself in or hasten away; sometimes she loses the power to move; water in motion causes no fear.

23. *F.*, 15. If goes near falls or a rapid stream, she feels a compulsion to go along with the water.

24. *F.*, 26. When it rained hard and streams were high, feared one after another of her friends would be drowned.

25. *F.* A lady teacher dreads all bridges, especially if she can see the water; sometimes she is powerless to go forward or back.

26. *F.*, 24. "My brother is a sailor, and I cannot bear to see or think of a rough sea."

27. *F.* Five girls report horror of hard rain, lest there come a general flood.

28. *F.*, 18. Was in bathing and suddenly exhorted her companions to walk into the water and end it, "so we won't know any more."

29. *F.*, 18. Cannot look down upon water without an imperative impulse to plunge in, although she cannot swim.

30. *F.*, 15. Does not trust herself to gaze into deep water, because it seems so cool and quiet down there it draws me.

31. Several describe the charm of slowly sinking, floating or lying in the bottom of ponds or seas.

32. The noise of the wind suggests to many the sea, sometimes sea-sickness, sometimes visual images, or some mood of the sea corresponding to or changing with the wind.

33. *F.*, 14. Was for days and nights haunted with the sight of an aquarium, which gave her nightmares and sensations of drowning.

34. *F.*, 7. So feared the ocean after her first sight of it that she must always be assured that her bath was not sea water.

35. *M.*, 32. "My boy of six in bathing fell in eighteen inches of water; instead of making the least effort to get up he lay there helplessly rolling, and was nearly drowned before I could get to him; he seemed to have easily and at once resigned himself, and showed no fear even afterwards."

36. Some children take pleasure in imagining themselves drowning; some of them dream it out; in both cases there may be sensations of choking.

37. Others picture the sea as full of beautiful and precious things or beings which they long to see, such as corals, jeweled caves, nymphs, while to others there are unreasonable fears of all conceivable monsters.

38. *M.*, 16. Could never put his head under at the seashore without a horrible feeling that he was bidding farewell to land and entering a new element that was "just the same all round the world and held all kinds of things."

39. *M.*, 28. A well experienced swimmer could never go under an instant without a sudden and absurd fear that sharks or other monsters were on the point of seizing him.

40. *M.*, 22. Never swims beyond his depth lest he should be drawn under, or have a sudden impulse to go down forever.

41. *F.*, 43. Fancies she has sensations of drowning in a very hard rain, and sometimes in a thick fog.

42. *F.*, 21. Thinks drowning by far the best way to die, and sometimes is so enamored with the thought of quietly sinking into unknown depths and leaving care and pain that she almost resolves to try it.

43. *F.* For an English lady drowning always had a poetic charm; she often pictured herself a corpse floating easily about or drifting upon the shore in artistic places and attitudes, yet always had a horror of bathing except in the tub.

44. *F.*, 20. Always felt she was destined to die by drowning; shunned every possibility of this end and imagined its symptoms.

45. *M.* Two boys could not skate where water was known to be deep, no matter how many others were there; indeed the more, the greater the danger of a general break-in.

46. *F.* A lady writes that her boy of 16, otherwise normal, has micturition, which is associated with such fear that he dreads to urinate, and even to drink water.

47. *F.*, 32. Felt the sea to be a cold, cruel and almost omnipotent but malignant giant.

In many cases of young children's dread of water, it is simply because it is cold. This was perhaps the case with 1, 2 and 6 and others. To this their skin is exceedingly sensitive, and lack of temperature adjustment either way may easily cause not only discomfort, but pain, and so fear. This, however, can scarcely account for 3, 4, 5, and most of the other cases must have other elements. Association with accidents

or with creatures supposed to live in water appears in 7, 11, 14, 15, 26, 32, 33, perhaps 45, and very likely others where the record does not show it. Eliminating, however, all that can be due to these two causes, cases like 8, 9, 12, 13, as they stand, are less clear, and those like 16, 17, 18, 19, suggest other elements, while the "drawing" factor in 20, 21, 22, 23, 29, 30, 31, 40, suggests the doctrine of imperative ideas, which here, however, as so often, needs more explanation than it gives. Still other elements appear in 28, 35, 42, 43. The smother factor, one of the deepest roots of horror, here, too, is often a form of physiological resonance which rain, clouds, or even fog may evoke, or indeed dampness in the air. The specific gravity of water takes the jerkiness out of the movements and tends to slow down or rest all but passive motions, and in states of heat and fatigue its coolness and softness have great charm. Drowning has always been a favorite form of suicide, especially for women. Prose and poetry have described both these fascinations, and peopled sea and stream with mythic creatures, both captivating and terrifying.

Deducting all fairly due to individual experience, is there in these phobophillic feelings toward water any hereditary, race remnant? This question is both as inevitable and as unanswerable here as is the problem of innateness versus empiricism in other fields. The data are certainly unsatisfactory, although full of suggestiveness. For one I incline to the view that it would be well for psychologists to postulate purely instinctive vestiges, which originated somewhere since the time when our remote ancestors left the sea, ceased to be amphibious and made the land their home. Do we not dishonor the soul by thinking it less complex or less freighted with mementoes of its earlier stages of development than the body which, in the amniotic fluid medium, unfolds its earlier prenatal stages like a fish, and carries traces of the primitive gill-slits through adult life? As these latter traces are sometimes hypertrophied in teratological forms, so the old charm and the old fear of water may come to the very foreground of consciousness in exceptional cases. It is at any rate conceivable that the influence of the predominant proportion of time and of volume of life that has been lived aquatically since its dawn should still make itself felt in the soul, and should find expression especially in poetry, both more emotional and more archaic than prose, in the faint traces of struggle between fear and love occasionally seen here. Sometime, perhaps in the Permian age of the great amphibia, or at any rate between Devonian and carboniferous age of fishes and the gigantic reptiles of the triassic and jura, and thus at

any rate very long after the chief features of the vertebrate type were established, the modes of movement, breathing, feeding and the senses of equilibrium, orientation, the action of all the special senses, etc., were more or less radically changed. But why should the older and deeper types of psychic activity be assumed to have had a reconstruction any more obliterative of the past than the body?

The simplest of all hypotheses, and therefore the view that may fairly claim that the burden of proof should rest with any other less ultimate one, seems to me something as follows: Deepest of all the feelings for water is the old love, traces of which still survive and crop out in some features of its charm and drawing power, when it seems so cool, soft, restful, buoyant, embracing and transparent. Returns to another syllabus will show what an unaccountable passion it is for children to see, feel, paddle in, play with or sail on water. The force and depth of this passion, after eliminating all influences in this direction due to the experience of the individual child, and others of recent philogenic origin, strongly suggest the earlier and far longer life in the sea. Later, after land developed to continental dimensions, and amphibian habits gave way to conditions that established life permanently on land, the higher animals swam less and less, and at length water became dangerous in proportion to this loss of power. Those best adapted to land were at greatest disadvantage in water, and thus a fear of it became chronic and very strong because it must control the old love. Those that feared water most had an advantage in survival at a certain stage over those less timid. How severe this discipline of weaning from the old home of all life, some childish fears like these above still show. The thought of return to the old element is sometimes suddenly reinforced to the intensity of an imperative and uncontrollable impulse by the recrudescence of the archaic element, like an eruption forcing through in dyke or fissure where the superposed strata are thin or not conformable. Female suicides prefer drowning as a mode of death more often than men, because the female organization is more conservative of archaic influences than the male; the old love is stronger relatively to the old fear in them. But thirdly, in all normal souls the two are adjusted harmoniously, so that all the pleasure of the one and all the safety of the other are combined—the fear and danger now adding a new charm.

It should perhaps be added here that hydrophobia seems likely to be dropped from modern medical literature as the designation of a central feature of a symptom group. Real fear of water as such, as distinct from fear of other bright things or more solid ingesta, probably does not exist except

in hysterical and pseudo-cases. Rabies, with dryness and constriction of the throat and difficulty of deglutition, whether an imaginary or infectious disease, has perhaps no connection with this theme.

V.

Fears of Wind.

1. *M.*, 1 year, 8 months. Every time the wind whistled or made any kind of noise would run to his mother's lap.

2. *F.*, 2. Is always strangely excited when the wind blows; wants to cuddle away and be quiet somewhere.

3. *M.*, 16. During all my childhood nothing frightened me like wind; to subdue me they only needed to say the word.

4. *F.*, 18. When the wind moaned I always said to myself it is like a mother weeping for her dead baby.

5. *F.*, 19. Has always been distressed and depressed by every sound of wind or rustling of leaves.

6. *F.*, 40. The wind at night always seemed like dogs growling, and she would lie awake fancying them outside.

7. *F.*, 22. "To be out in a violent wind only makes me cross and very irritable, but its howling, especially at night, has always been extremely depressing; I have no definite fear, but it brings to mind many possible and impossible disasters, and makes me sad and blue."

8. *F.*, 28. Is nervous and restless whenever she hears the wind in the trees; "it requires all my will power to make myself sit still and continue my work instead of roaming around the house like a restless spirit; any kind of storms without wind do not trouble me."

9. *F.*, 17. Always dreaded wind, but trembles less than formerly. "Never fail to awake at night if it increases; I cannot lie still; wring my hands; run to another room and pace the floor until the wind has ceased."

10. *F.* A high wind makes a refined lady feel herself at sea; makes her feel the rocking motion of the waves and causes nausea.

11. *F.*, 17. "The least wind terrifies me lest trees or limbs should fall, if I am out I keep the exact middle of the road, or, if possible, with blue sky above me."

12. *F.*, 19. Heard her mother say as a shower was coming up, "We shall have a gust of wind;" she had never heard the word gust before, and it long filled her with terror, and was associated with wind.

13. *F.*, 43. "As a girl I was always unhappy in exact proportion to the strength of the wind, and used to watch the movements of the boughs of the trees to estimate its intensity; a sudden or even gradual crescendo in the noise of the leaves still starts up my heart; I feared every light breeze would increase into a gale; every morning on waking my first thought is of the wind, and I often compare its intensity hour by hour; I have never experienced any really dangerous wind."

14. *F.*, 24. Has great horror of wind, and studies the clouds incessantly to infer their direction and intensity.

15. *F.*, 4. Fears the wind will blow her or her friends away.

16. *M.*, 46. Distant machinery, cars, thunder, surf or deep organ notes sometimes suddenly suggest wind of awful power that could sweep sea, land, and earth itself away; some of the "elemental motives" in Wagner's Trilogy are intolerably tragic.

17. *F.*, 20. It is the piping and whistling of the wind that give her the fidgets, and sometimes she fancies it is a monster breathing.

18. *F.*, 17. Used to think armies were fighting when there was a gale.

19. *M.*, 28. Sometimes fears the earth may be swept clean, and even that the ultimate forces of nature may break out and everything be reduced to chaos.

20. *M.*, 9 Wind was God's wrath; the harder it blew the more angry He was.

21. *F.*, 18. Used to feel there were wild men in the wind screaming to each other, or a lot of elves frollicking or playing hide-and-seek.

22. *F.*, 18. Used often to fancy she heard the wind say such words as: I am coming; I will push you over, etc.

Often, as in other of our returns not included above, this fear is directly caused by experiencing, seeing or reading of the havoc of high winds, gales at sea, etc., and much is due to the close association with storm and thunder. Noise has wonderful power over the emotions of childhood, especially during all the plastic inceptive stages of language, and creates all kinds of scenes and imagery on the principle illustrated in descriptive programme music. The wind starts up, rattling, roaring, sighing, all kinds of sounds suggesting animals, 6; monsters, 17; enginery, 16; battles, 18; the sea in all its moods, 10; pathetic scenes, 4; universal dissolution, 19. It is the bandmaster of the many membered orchestra of nature's music, and can play upon almost the whole gamut of our emotional life. The pan pipe of its Æolian whistling needed only to be fretted with scale and tonality to create music, the power to compose and appreciate which it had done so much to make. Yet with all its power it is invisible. More perhaps than any or all things else, it created in primitive consciousness the unseen spiritual world. Where things transcendent would have been but for the wind, the etymology of words like spirit, soul, thought, mind, etc., in many languages savage and civilized suggests. It is the child's first and chief teacher in that school where all the causes that are real enough to bring heat, cold, sunshine, cloud, rain, destruction, change of mood, as if by a new indwelling personality, and which no eye yet ever saw, are learned. Its changes are incessant in intensity and direction, follow no known law, yet are as close to us as our own pulses, and as in nervous

states we listen intent on its "what next," our very breath is bated as if even its coming and going was in the power of this mysterious agent. Living at the bottom of a great sea of air, the changing pressure of which affected their blood and muscle tension, and even knee-jerk, it is no wonder that primitive men did not know there was such a thing as air itself when still, although personifying wind in many forms. We may fancy, if we like, that on some such theory as, *e. g.*, Mach's of hereditary, or a form of memory by direct continuity of molecular vibration in cells or their elements (Weissmann's biophors, Wisner's plasomes, de Vries' pangens, Nägeli's micellæ, etc.), or in any other less material way the present reactions of childish and adolescent souls, or of specially sensitized geniuses, or neurotics, still bear some trace or scar of the more dreadful storms of the long age of diluvial man or even of the older sea, which still make our souls better resonators to bring out some of the wind effects in the above cases, provided we never for a moment forget that seven logical proofs are made of radically different stuff. All that anyone can claim is that we have here new points of view, with an interest and suggestiveness all their own, the stimulus of which, whatever it is, we ought to utilize to the utmost in studying these groups of ancient, all-conditioning, but in adult life mostly effaced and heretofore strangely neglected experiences. Anemophobiac souls are Æolus caves, from which imaginary winds that threaten to sweep away earth, sea and heavens may still be loosed.

VI.

Fears of Celestial Objects.

In this section I have selected only a very few typical fear cases from over a thousand returns illustrating the feelings of children toward sky, cloud, heavenly bodies, weather, etc., as follows:

1. *F.*, 17. When 12 saw a picture of a fierce clown between the clouds; often imagined she saw him afterwards in the sky, and could even trace his outlines in the stars, was greatly terrified, but never told.

2. *F.*, 16. Always shudders when looking at clouds; she used to trace outlines of terrible monsters, has still the same feeling even when looking at pictures of clouds; another used often to run in from play in terror from cloud-shapes; she would watch their changing forms with breathless fear.

3. *F.*, 19. Used to trace each of the following animals in cloud-forms, cows, dogs, horses, reindeers, cats, rats, pigs, goats, lions, camels, etc., when she was 9; she fancied great animals were somehow up there, and often had shudders of fear; this interest made the scientific study of cloud forms a fascination later.

4. *F.*, 16. Has not yet got over strong fear that heavy, low hanging clouds will fall; she used to think some of them beasts of prey and mythological monsters.

5. *F.*, 18. Had a horror of clouds that were stacked or piled, one above another; if they were black she feared they would burst and spread destruction; she could never endure clouds directly overhead.

6. *F.*, 27. If clouds were low felt smothery.

7. *F.*, 19. Long thought clouds took the form of coming events, one, *e. g.*, looked like a volcano, and for days she expected one would burst forth from a certain hill near by.

8. *M.*, 5. Is frightened at every little cloud; he always watches the sky, and if he sees one coming over runs in.

9. *F.*, 22. I dreaded sharply formed clouds, for I supposed if they burst it would rain fire.

10. *F.*, 17. Was for some years always on the lookout for funny shaped little clouds; any jag downward she thought a cyclone.

11. *F.*, 5. For months had a horror of clouds, and was haunted with the fear of rain drops; when they fell she was always gloomy and in terror.

12. *F.*, 7. Had heard of the flood, and if it rained hard on the second day would cry and fear the world would be drowned.

13. *F.*, 18. Once saw the crucifixion scene in the clouds.

14. *F.*, 21. Used to see angels and chariots, groups of heavenly beings.

15. *F.*, 23. Used to see the face of her dead mother shaped in a cloud.

16. *F.*, 26. Used to see the scenes of nearly all the stories she read pictured in the clouds, especially if they were terrible.

17. *F.*, 17. Used to be greatly elated by bright cloud colors, and filled with awe if they were gloomy or sad colored.

18. *F.*, 8. Used to see all the Bible pictures in the clouds, and thought the pretty ones God's clothes.

19. *F.*, 19. Clouds always suggested the next world, she thought them very near it.

20. *F.*, 22. Used to think the motion of the trees made the wind, and the wind herded the clouds like a shepherd.

21. *M.*, 11. Anything unusual in the clouds made him fear the end of the world; it was a Bible "sign."

22. *F.* A lady recalls a cloud she thought a mythological monster, and another she thought the head of satan, and has had several other experiences with individual clouds which she will never forget.

23. *F.*, 18. Often used to see mountains, sea and landscapes in the clouds, but they seemed uncanny, and the scenes of dire events.

24. *F.*, 16. Used to get dizzy and nauseated watching the moon running under the clouds.

25. *F.*, 21. Long had great fear of heavenly bodies, yet was fascinated by them; would gaze long at the stars, "I would overwhelmingly realize my own insignificance and the power of God; I would want to pray to be better, but felt myself of too little consequence to be noticed; star gazing has improved my behavior."

26. *M.*, 23. "Had mental terror of a yellow sky, clouds or light; red in the heavens suggests blood and something terrible to come; a college professor, as a child, had horror of red sunsets, "the sun seemed coming down to the earth to set it on fire."

27. *F.*, 21. On hearing of the planets and their paths, developed a chronic panic that they might get off their tracks and hit each other, especially that the earth would run into the sun; "it made me a better girl."

28. *F.* A high school teacher never feared celestial phenomena except northern lights, these still give her an indefinable feeling of horror, and she never sees them without shivering and shaking.

29. *F.*, 9. Once ran away and was taken home at night by one who showed her shooting stars; she thought they jumped from their places because she had been bad, thought if she did not behave stars would fall, felt very guilty, and when she saw a star fall wondered whether she had been bad, or who.

30. *F.*, 17. Says both she and her friends dreaded meteors, fearing one might fall on the house, a comet was worse yet; it always seemed to be making straight for the earth to brush us all off with its tail.

31. Till 6 *F.* connected meteors and eclipses with fireworks and both with the end of the world.

32. *M.*, 4. Watched an eclipse, and as the moon grew dark cried with terror and could not look again.

33. *F.*, 7. Cried with alarm thinking some one had blown out the sun.

34. *F.*, 18. Hearing much of an eclipse feared the sun and moon would hit each other, be knocked out of socket and so destroy the world; all the while she expected to see a big ball of fire fall, and was studying where to get so it would not fall on her.

35. *M.*, 18. At 3 had great terror of the full moon, and would always run and yell to get away from it.

36. *F.*, 4. Fears the moon and always thinks it is after her.

37. *F.*, 16. Loved to watch the moon, but could never do so alone, fearing the real man there might come down and carry her off; she still has this fear.

38. *F.*, 30. While hearing stories on the verandah one night as a girl, saw the moon break out and suddenly tint everything with silver; this, she thought, is the end of the world, even yet she cannot see the moon break through a rift in the clouds without some fear.

39. *F.*, 20. From about 7 to 9 feared the moon would fall and kill everybody; watched it nightly to see if it looked bigger or nearer, would not sleep on her back lest it would fall on her face and crush her; prayed to be at home if the end of all things came, and hoped that when people should cry to the rocks and hills to fall on them she might be lucky enough to find a crevice so they would not crush her.

40. *M.* A young man had great fear as a child that Orion, the crab, and other monsters among the constellations would descend to earth.

41. *F.*, 10. Was looking at the moon and thought it smiled at her, and ran in terrified.

42. *F.*, 8. Thought the moon sometimes looked pale and sank into the sky, and might go out.

43. *F.*, 22. Used to be terrified and sometimes angry because the moon always followed and spied on her.

44. *M.*, 18. Used to when small have panics at his own shadow, tried to run away from it, stamp on it, and thought it might be his soul.

45. Two children thought rain was the tears of celestial beings because they were bad and feared punishment.

46. *F.*, 19. When small had horror of red sunsets, which she thought would set the world on fire, and feared to go on the hills lest she should fall off the earth.

47. *F.*, 26. Once had great terror of ice, frost, and especially snow, thinking the earth would be buried and everybody frozen.

48. *F.*, 16. Used to have a great horror of twilight, which was the time she thought when ghosts and witches came forth and spells were wrought.

49. *M.*, 12. Had persistent fear of meteors, of falling stars, which he connected with the end of the world.

50. *F.*, 17. The most "shuddery" thing in all the world is the northern lights, they seem to go through her so.

51. *F.*, 13. Dreaded, awful messengers from heaven or distant planets.

52. Very warm weather suggests to F. 19 that the elements may melt with fervent heat.

Here again we find many falling fears. Sky, clouds, sun, moon, rainbow, meteors, comets, balls of fire, the man in the moon, the monsters of the constellations may drop on us, knock things off the earth or crush it, 4, 5, 29, 30, 34, 37, 39, 40, 41, 49; there may be collisions, 27, 34; or explosions, 5, 9; heavenly visitors, guests from other planets, 51; cloud monsters or demons, 1, 2, 22, 40; or beasts of prey may arrive. The future is revealed, 7, 26; the terrors of the judgment or the next world are foreshown, 19, 21, 31, 49; cyclones are imagined, 10; the northern lights strike terror, 28, 50; cold weather or snow suggest the freezing up or snowing under of all things, 47;[1] heat, that all things will dry up or melt, 52; rain, that floods impend, 12, or yet more superstitious terrors, 11, 45; Bible scenes are reproduced in the clouds, 13, 14, 18, 22; the sun, 33, 34, 27, 26, 25; the moon, 32, 34, 35, 36, 37, 38, 39, 41, 42, 43; shadows, 44; bright colors, 17, 26, 46; twilight, 48; to-day nothing of wind and thunder treated elsewhere, become objects of special fear.

We know too little of the effects of weather upon psychic states.[2] Each season predisposes to certain diseases, and even to its own immoralities, and has a strong effect on recurrent and circular forms of mental alieniation. Bad

[1] See "Zan Zoo," *Harper's Mag.*, Aug., 1891, Vol. 83, pp. 345-355.

[2] Cf. J. S. Lemon, "Psychic Effects of the Weather," Am. Jour. of Psychol., Vol. VI, p. 277, *et seq.*

weather increases suicides and accidents and lessens factory productivity sometimes as much as ten per cent. Good weather increases muscular and arterial tonicity and facilitates digestion. Hot and cold, wet and dry, dark and light, and perhaps electrical tension play upon moods, affect studies and discipline in school, trade and business enterprise, control agriculture and many industries, modify the conduct of animals till its variations are utilized as weather signs, is the first topic of conversation among all races, and so great is human interest in it that a body of weather lore has been developed the comparison of which with modern meteorology affords one of the most instructive of all the many parallels between folk-lore and science. Many hymns, from the *Dies Iræ* down show how commonly divine wrath, and even the terrors of the judgment are conceived and described as simply awful weather. The last revision of the Episcopal prayer book contains weather prayers. Children's souls still show abundant traces of the original psychoplasm out of which primitive man created the many fairy or demonial beings seen in cloud, fog and all the phenomena of day and night. Earth is fixed and solid, but the heavens are a theatre of incessant changes, controlled by no known law, and which seem the direct expressions of the feelings of personal beings toward man. Just as in antiquity and down to Columbus it was a very common view, that by persistent sailing or traveling men could reach the sky and heavenly bodies which were connected with the earth, as then known, by direct physical continuity, so to many a child not only is this true, but hell is hot weather intensified to a fiery stage, and heaven is people unusually fine and events unusually magnificent, set in sunset hues and skyey brightness increased, and all reached by climbing sacred mountains, real or imaginary. Now, no state even remotely like this, has prevailed since the nebulous age, when the whole solar system was simply cosmic weather. But extremes from the laval heat to the cold of the glacial period, the storms and floods of cataclysmal force that have prevailed since the Silurian age, when life became well established here, and especially those convulsions which broke the continuity of the successive geologic periods, lethal elements that have entered so densely into the composition of the atmosphere, floods of subsidence and emergence, thunder, wind and storms of inconceivable violence,— all these toned down to a mildness that makes present conditions of life possible, fixed in bounds by fate constitute what we now call weather.

Hence from the standpoint of the new conceptions of soul that now seem imminent it appears to me not surpris-

ing, but rather in accord with hypotheses, we must assume, formulate and test that in this class of childish fears we still have echoes of the grander and more awful phenomena of primæval weather, when even clouds were denser, and which perhaps first suggested such old traditions as the firmament of Genesis, the upper earth of Plato and Dante and many others reminiscent of a time when all present changes had a far wider range. If we knew the whole history of weather it might appear that some children and adults who suffer from these fears, illustrate stages of arrest in the development of inhibitory powers which reveal psycho-neural elements older and less controlled within bounds than our present meteorological variations. To such individuals no bows of promise give surcease of dread "Elemental" music like some of Wagner's, seems to work by waking and stirring these old echoes, which motives like *e. g.*, the pastoral symphony allay.

Far above the realm of flux in our atmosphere is the heaven of blue sky, of fixed eternal stars, and of the pilgrim sun and moon in the divinity of which Socrates in the Apology intimates that all wise men must believe, and to which, as a later paper will show so many Christian children still pray. Here for unknown generations men have read their fate as astrologists still do. Assuming that every plant had its planet and each planet its plant, the doctrine of signatures at the hands of Cardanus and the herbalists still controls, or at least modifies the therapeutic ideas of the vast majority of mankind. The more we know of children's drawings[1] and conceptions of form the more inevitable we see for childish savage man was the development of constellations out of star-points, which like cloud forms have done so much to lay deep the conviction of a vast superstitious realm above, rank with life. The Müller-Cox idea of primitive Aryan man shut up in valleys by mountains he rarely crossed, with no political, industrial or other occupation for his thoughts, inevitably turning the freshest and most vigorous of minds to the celestial vault as the only field of change and interest with an eagerness and zest we cannot conceive, and evolving the roots of the myths of all Aryan races in the personification of dawn, storms, sunset, and describing in long epics, the prototypes of classic theology, the battle of day and night, the Hercules labors of the sun, his fight with cloud monsters, and the romances of the gentle moon, etc., finds some slight confirmation in the filmy *Anlage* shown in the above

[1] See "A Study of Children's Drawings in the Early Years," Herman T. Lukens, Ph. D., *Pedagogical Seminary*, Vol. IV, p. 79, *et seq.*

scattered illustrations of the fears and fancies of the children of to-day. Just as glacial action after making the landscapes and soils of the later quaternary age and leaving its mementoes in vast bowlders and moraines has shrunk to the present polar ice-cap or retreated to high mountains where all its continent-shaping phenomena can still be observed on a small scale, so this, like other great primal psychisms, after shaping and basing man's deepest and all conditioning instincts, has slowly retreated toward ineffective infancy, where in rudimentary and transient forms we may still study these "vague snatches of Uranian antiphone."

The heavens are also the chief and best *tabula rasa* for the projection of all the entoptic phenomena of the primitive men once so vivid, that like those of the modern savage, they may be mistaken for objects of sense and the visions of ecstatics, the strongest of which do not need darkness. By far the most of the old deities and demons are powers of the air or sky where Jove ruled. Besides "above" is so vast and so open on all sides that, although the dangers are small from any one point or source, the possible ones from all are so many and the superstitions that literally stand over us have such advantage of position as well as locomotion, that all in all it is no wonder that astral fears seem hardly less deep seated than the foundations of the religious nature, are so easily aroused even to intensity, and are so manifold.

VII.

Fear of Fire: Pyrophobia.

1. *F.*, 16. I used to regard fire as a sort of demon, the flames being his tongues, which licked up everything within reach, and he seemed always trying to get more in his grasp.

2. *M.*, 18. One of the grandest sights is a big fire; there is an awful feeling in seeing its power; I do not know whether I love or fear great conflagrations most.

3. *M.*, 21. Is always awakened by fire bells, and can never sleep until the return is rung; all through his boyhood he was nervous, excited, and could not sit still at school if he could not run to every fire; "a fire is such a magnificent sight; I always secretly sympathized with the fire rather than with the firemen, and wanted it to blaze higher and spread; had it been my father's house I should have had an undertone of the same feeling, though I should, no doubt, have fought it with all my might; all this while I have grown almost morbidly cautious about sparks and matches."

4. *F.*, 41. "I dread so many coming ills that I often used to ask myself, 'What is the good of living with such dreadful things liable to happen at any moment?' My chief dread is fire, due largely to experience; I so dread it that I cannot bear the thought of being cremated, although I know that is the best way, because I know my body would feel the fire though insensible to everything else;

when I read of people badly burned I imagine the pain and wonder how they can bear it."

5. *F.*, 18. With no fire experiences, for years had spells of lying awake and dreading it; her pet terror, which often got into her dreams, was being obliged to jump and feeling the awful sensation of falling.

6. *F.*, 18. Must always make a tour of the house to see if there is fire if she awakes at night.

7. *F.*, 17. The worst fear is that she will get her hair on fire; she cannot bear to see much less use a match, but can handle a lighted lamp.

8. *F.*, 15. Still takes her dolls to bed every night so as to rescue them if there should be a fire.

9. *F.*, 19. Could for years sleep little on windy nights for fear of fire, and often goes over the house, yet has always been strangely fascinated by fire, always watched it by the hour, feeding it as a child with many forbidden things.

10. *F.*, 18. Was always trying to regulate the drafts to fit the wind.

11. *F.*, 19. "The fear of fire preys upon my mind waking and in dreams; I always imagine I smell it, and am always expecting to see flames when I explore the house; black smoke from any chimney or any crackling sound makes me tremble."

12. *F.*, 17. "Just to hear the word fire sends chills all over her, her heart seems suddenly to stop."

13. *F.*, 16. "Near our house is a pile of combustibles that would make a bonfire such as would delight the wildest imagination; my impulse to touch it off is getting almost beyond control, yet I know our house would go too."

14. *F.*, 17. Feels lonesome and must be with somebody long after having heard of or seen a fire.

15. *F.*, 16. Long connected fire bells with the end of the world, which was to begin in a city fire.

16. *F.*, 17. Used to fear in hot days that the world would suddenly burn up; she was nervous to learn that the centre of the earth was on fire, and thought the sun would draw it out.

17. *F.*, 19. Used to fear a rain of fire whenever the sky grew red; so intense was this that the fear of thunder showers was overcome because she felt that the rain of water would cool off the earth and postpone the rain of fire.

18. *F.*, 14. Never sees the fire burn bright without dreading the chimney, and then the house will catch fire.

19. *F.*, 3. Is always terrified at the noise of lighting a match.

20. *F.*, 3. Often has convulsions when the kettle steams, fearing explosion.

21. *F.*, 5. Has a horror of flat irons, even when cold, although never burned.

22. *M.*, 16. "The terror of my boyhood was fire alarms; I often felt the wall to see if it was hot."

23. *F.*, 18. Used to have terrible dreams, and day fears when alone, of the terrible face, and especially the flaming sword of an angel pictured in the Bible as guarding Eden.

24. *M.*, 14. Feared to get overheated after reading of "spontaneous combustion."

25. *M.*, 45. When 13 was haunted for weeks by the line of a well known hymn, "and when a raging fever burns," etc., and felt many symptoms, and thought how dreadful hell fire must feel.

Only five of our cases report any actual experiences with conflagrations, being burned or knowing others to have been.

Mild pyro-phobia appears in the caution of 3 about sparks and matches, in tours of the house, 6, 9, 11; dread of every bright fire, 18; of the noise of lighting a match, 19, or the sight of it, 7; of the word fire, 12; the sound of crackling or the sight of smoke from a chimney is feared, and may even arouse the sense of smell, 11. This dread of loss by fire is offset by or struggles with the slight pyro-mania of 3, 13, and perhaps 2 and 9. Other fears may start by suggestion from the physical sensations of heat, 24, 25, 16, or imaginary burns, 4, 7, 21. It may be associated with wind, 9, 10; with dread of jumping and falling, 3; with hell and judgment, 23, 25; hot weather, 16; fire bells may announce the final conflagration of all things, 15; fire may rain from above, 17; or come up out of the fiery centre of the earth, 16; or even break forth from our own bodies, 24.

Unlike many land animals and amphibia man neither hibernates nor æstivates, and unlike so-called cold-blooded fishes, whose body temperature ranges through nearly as many degrees as separate the summer from the winter temperatue of water, even the surface of man's body follows but very slightly the thermal changes of the atmosphere. Slight as are the normal changes of the temperature of human bodies, life in colder latitudes, clothing, indoor life and artificial heat have made it very sensitive independently of the hot and cold spots. But, as even these latter suggest, man's psychic states are profoundly modified by temperature. All human affection and ideals languish and almost die at 90° F., and as if thermal effects resisted by the body vented themselves upon the soul, not only love and temper, but will, fancy, morality and all the racial differences that separate arctic from equatorial man, so superficial in the *soma*, so deep in the psyche, can be in part measured by the annual average readings of the thermometer.

Since the culture heroes taught man the control of fire, cooking has not only established the hearth as the centre of domesticity, but enlarged man's dietary and economized digestive energy for other uses, and made metals plastic for the arts. Traces of the charm of these old associations are abundant in child-life, as other returns show. Just to idly gaze at fire now starts dreamy reveries, veined through which are traces of very primeval yet earnest thinking. It stimulates memory and story. The very play of form and

color half hypnotizes and autonomizes the mind,and as we see solid matter volatilize to smoke there seems some mysterious power within and behind it all. This the Parsees worshipped, and thus from ancient altars offerings went up to the gods. In children too, as still other returns show, all this and more is still seen only fuller and richer than history preserves it.

Early man often conceived himself as between volcanic fires below and sun, stars, lightning and burning empyrean above, and Heraclitus, working up many ancient and scattered philosophemes, taught all things to be fire in various stages of extinction, here burning hot, then smouldering, and the world alternating between the reduction of all things to pure fire and its almost utter extinction in cosmic death. The three stages of ice, water and steam were for him, no doubt, as formative a concept as we have lately been told it was for Hegel's idea of quality sublating itself into quantity. For him soul was life or animal heat, a fiery particle diffused through and warming the body just as the sun was nightly absorbed in the earth, making its substance not only a little warmer, but lighter by night. This general view (which, with Schuster and Teichmüller regards Heraclitus as editor of the most magnificent of all the philosophic traditions of antiquity, and based most immediately on sense) has been yet far more grandly re-installed and developed by modern science in the doctrine of the gradual diffusion of thermal energy. Between —461° F., at which all gases if they continued their ratio of contraction to cooling and did not fluidize would vanish—that strange zero of the universe where even chemical action is dead—and some unknown degree of heat where the most obstinate substances would become gas or nebulae, just at that point most favorable for the most sensitive and rapid metabolism of carbon compounds man's body, and especially brain are poised, polarized somehow to possibilities each way, but held steady by fears, many directly due to burns, chills, and personal losses by fire and cold, but some incalculably older, preserved as it were in the fossil forms of neural tweaks, inherited terror, thrills and shudders, which we may regard as survivals from a stage of psychic life so low and so far transcended that the adult consciousness, while it may repress, cannot uproot them. The elements of the great Heracleitic philosopheme must have been developed in the souls of men by natural phenomena, but they were latent, scattered, and ineffective till this great master brought them out and together in a system which, from its very debris some are now coming to regard as the greatest of all the indiginous philosophic systems of Greece, and beyond all ques-

tion the one most filled with anticipations of the modern kinetic sciences.

VIII.

Fear of Darkness.

This extremely complex group of fears may be sampled as follows:

1. *M.*, 16. Always dreaded shadows, and feared to go up stairs or on the street where they were.

2. *M.*, 15. When younger used to fall into panic at shadows, and would run out of breath to get away from it.

3. *M.*, 6. Was found transfixed with fear at his shadow on the window, thinking it an Indian outside.

4. *F.*, 44. Used to play all day in an attic, but as daylight faded the shadows seemed horrible forms, about which she developed fear images that made the room intolerable later.

5. *M.*, 22. Is, and always has been gloomy, depressed and timid in a forest, his thoughts dwell on every gloomy possibility; the company, even of a dog, dispels it all.

6. *M.*, 14. Always thinks something moves in the twilight; whether within doors or without he often detects motion.

7. *F.*, from 10 to 14. Used to dread a certain window in her house, which she never could pass after sunset without feeling that a hand was reaching in to grab her, or that she saw a face peering in.

8 *F.*, 9. Can never sit on her piazza at night without hugging up to and holding some one from fear.

9. *F.*, 27. Never goes through any darkish place without looking behind, and often thinks she sees shadowy, flitting forms.

10. *F.*, 22. The cedar trees near by looked like men and were always fancied to be such; she can never go into a dark room without feeling chills and quivers, and then flushing.

11. *F.*, 18. At the age of 8 often had to pass a row of trees after dark; as she approached each tree she saw in it a man's hat, arm or leg, and hurried past, only to repeat this at every tree.

12. *F.*, 19. Used to pass papa's corn field after dark where were two scarecrows, made of coats on sticks; she saw them put up, and passed them daily without fear, but at night could never avoid a panic, and always ran past them.

13. *F.*, 19. Always pretended to be fearless of the dark, and would often go up stairs without a light, but if she touched a buffalo robe always had to scream with fear till some one came to her relief.

14. *F.*, 17. Can enter a dark place with composure, but the moment she turns her back to come out she has the horrors, must generally run, and sometimes scream.

15. *F.*, 17. Can never trust herself to look behind in the dark, and must always be the first to enter the house.

16. *M.*, 16. Used to be a coward in the dark, but was cured by being often frightened.

17. *M.*, 19. Ascribes his cure to never being frightened and never forcing himself to go where he was afraid to go.

18. *F.*, 30. When 13 was frightened by her cousin, who jumped out at her in a sheet, she fell down stairs into convulsions, and ever since has horrors of everything white in dark places.

19. *F.* A young English woman never feared actual ghosts, but has dread of nameless, shapeless somethings in all woods, dark corners, under beds, especially behind her in narrow places, when coming down stairs, etc.; on fetching things from a dark room she comes down the first flight slowly with every muscle tense, dashes down the second, bangs and must often lock the door behind her.

20. *F.*, 17. Used to sit by the window nights and wonder how it was in the woods out opposite, her mind would imagine all sorts of horrors there till she was all goose flesh.

21. *F.*, 27. Can go into a dark room if she tiptoes so as not to hear her own footsteps, and if the floor does not creak, but always shudders from fear of something near and about to touch her.

22. *F.*, 17. In a dark room feels some one looking at her from the corners and pursuing from just behind.

23. *F.*, 19. Always strains her eyes to see things, often fancies she does, then stands perfectly still and gets hot and prickly.

24. *F.* An English woman has the idea of a long hand stretched out to seize her, often imagines herself actually touched, pictures "indescribable evil personages" each side of a long, dark stair case, and her joy at seeing light again is very vivid.

25. *F.*, 34. Must always sleep with a light in her room, or else sees terrible faces.

26. *F.*, 57. Can never enter her bed room without being assured that the gas burned brightly there all the evening.

27. *F.*, 19. Pictures horrid forms if there is the least noise at night, and her face is beaded with perspiration.

28. *F.*, 18. The great shadow over all her early life was the dread of the moment her mother should kiss her good night and leave her alone in the dark; she lay tense and rigid, held her breath to listen with open mouth, smothered herself under the clothes, with which her head must always be covered, fancied forms bending over her, often awoke with her heart pounding and a sense of dropping through the air, flying or falling backward, feeling quivery for hours; she now vows "I will always put my whole foot on the stairs."

29. *F.*, 20. Always looked in every crevice of her room before going to bed, but one night, five years ago, found a broom her brothers had dressed and placed behind the door, the shock robbed her of all control, and for months she would laugh and cry without occasion, and has not yet got over it.

30. *M.*, 16. Used to kneel by the bed and say the Lord's prayer, but gradually grew so afraid that something under the bed would grab him by the legs that he gave up praying.

31. *F.*, 21. Had the habit of holding her breath and breathing as little as possible in bed, because she read of a man who saved his life by doing this when a lion was smelling of him and thought that by thus feigning death she might escape any monsters in the room.

32. *F.*, 18. Used to eye the foot board, expecting every instant to see hand, claw or other awful shape, reach over it and grasp her foot.

33. *F.* An English lady can never bear the "big dark," and is sometimes frightened almost into fits by hypnogogic terrors; she lies perfectly still with her back to the wall or protected side, her hands under the clothes lest a spider should bite them, her feet drawn up so nothing can grab them, and often momentarily expecting a dagger to come up through the mattress from some one beneath.

34. *F.*, 14. Imagines dreadful men standing in the doorway and coming nearer till "she cannot stand it, but must break out with something."

35. *M.*, 14. "Most every night when I get most asleep I think I see something dark looking at me; sometimes I cover my head and seem to say, you can't get me now old fellow; often mother calls out and thinks I am fighting by the way I punch the wall and holler like some one was choking me."

36. *M.*, 16. Had for years a dread of waking up at midnight when dreadful things happened; one whole year he expected to see a black coach, with black headless horses, a headless coachman dressed in black, and a black lady who, when they drove up to the gate would get out, walk up to the front door, knock, return to her carriage and drive off.

37. *F.* An English lady teacher writes, as a child "I had a strange idea of safety when I was alone in the dark; I always imagined that at each corner of my bed there was a lion, who was always on the alert to fight with the ceaseless number of tigers and snakes which I fancied were prowling up stairs all night; so long as the lions were there I felt safe, but if I thought one disappeared I would lie awake in dreadful fear that the others would not be enough to struggle with the tigers.

38. *M.*, 16. From about 8 to 10 "had a foolish idea that bears inhabited the dark room of our house at night; no one could argue me out of it.

39. *M.*, 14. At 8 or 9 I was afraid of the dark and of imaginary beings which I called Bos and Boos;" now I have not the slightest fear of either, I can go to bed without a light; I conquered these fears by putting my trust in Divine Providence.

40. *F.*, 35. If she must go out after dark had to cling to the door latch until she had formally committed herself to God.

41. *F.*, 19. When a child on going to bed would gaze at the dark ceiling until suddenly little black figures appeared jumping about between it and the bed; at first they were watched with pleasure, but as they increased to thousands she would grow frightened, hold her breath, scream and rush out.

42. *F.* One woman writes that all her manifold spiritual fears sprang from one absorbing terror—dark; now she fears, she knows not what; as a child she feared a mysterious, invisible, but very real spirit she and her sister had manufactured in the nursery, and called the horrid man; he and his awful threats became so terrible that they were forbidden to ever mention his name, so he was called H. M.; when alone near dark the three children would sit *dos-a-dos* in the middle of the nursery, that one might watch the door, one the chimney, and one the window, lest H. M. should appear; "I never liked to kneel to say my prayers, lest some invisible hand under the bed should cut my legs off, nor to have the blinds up at night lest a strange face should appear at the window and I should see its lips moving to pronounce my name.

43. *M.*, 19. Has no definite fears, but whenever it gets dark has short and oppressed breathing.

44. *F.*, 23. Till 8 never went down cellar even by day; till 12 never dared to go to the barn after dark; till 15 could never go to bed in the dark; till 17 never could step over to the next neighbor's, to do each of these for the first time was an epoch.

45. Thirty-four mothers in Miss Marsh's club, Detroit, discussed this topic; most agreed that up to eight or nine, boys feared the dark more than girls, that parents were often to blame, but that it was unwise to try to break up this fear by forced methods.

In some of the strangest of these cases 27, 32, 34, 36, 35, 38, and even 41, it is possible that dreams have helped to give form or intensity. Often the dreaded object is definite and recurrent, as in these same cases and 37; often it may be one of several, and is ill defined, 9, 19, 26, 31, 32. Something is almost seen, 23, 27; or it has faded a little, but the fear of a fear, 42, 5, 8, 10; so that one dare not look behind, 14, 15; fright cures one of timidity, 16, but makes others worse, 17, 18; touch is fancied, 21, 23; especially in the form of being grabbed, 7, 28, 31, 32; animals, 13, 36, 37, 38; eyes, 22, or faces, 7, 24, are feared. Fright stops the breath, 27, 30; makes one run, 2; paralyzes another, 3; may restrict many normal activities of life, 43, leave a permanent scar, 18, 27, 28, 41; be overcome by the thought of God. Even forest gloom or shadows suffice to excite them. The cases above give but a faint idea of the intense and manifold fears of every kind of monster, accident, dreadful men, or worse ghosts that prey upon childhood in the dark. Only two cases in all our returns report complete exemption from this fear. Often in the best born and most carefully shielded and healthy children, they break out suddenly on the slightest suggestion or none at all, and overwhelm all control, predispose to or actually cause deep-seated nervous disorders.

Of the natural history of sleep we know very little. Hodge and Aikins[1] found amœbæ as active by night as by day, but Loeb, Graber and Vierworn found very low forms of life stimulated not only by light and heat, but often by color. Through most realms of life the withdrawal of the sun's influence tends to repose and sleep. Twilight subdues activity, suggests home and friends, and often thoughts of death. Darkness checks motion because most volitional acts need light, and are controlled by the eye. Blind children on coming to asylums often have very low muscular development because they have followed the inclination of all with grave eye defects to move about but little, till the motor elements

[1] "The Daily Life of a Protozoan." AM. JOUR. OF PSYCH., VI, p. 524.

are sometimes hopelessly atrophied. In closing the eye gate, too, darkness shuts off the main current of stimuli to psychic activity. This has a profound influence on arterial and muscular tension, and upon the time and vividness of psychic processes, as experiments show. This is far more the case with children, because their psychic activities are more closely bound up with sense properties than are those of adults. Darkness removes the stimulus to hold the eyelids open, and also suggests closing them, and this suggests sleep, which state the eye is the first of the senses to enter.

Exceptions to this general rule, that darkness tends to sleep, are many, but nocturnal habits in animals must be and often can be explained as must the development of the "evening habit" among men. First, the eye itself often resists the abeyance of its function which darkness urges. Children strain the eyes to see in twilight, and even inky blackness, till perhaps darkness is reified as if it could be felt or cut, or the "big dark, out of doors" seems as if it would swallow them like a monster, and the little dark within becomes close and smothery. Entoptic objects and processes are projected, and like all faint outlines or points may be grouped into all kinds of things, especially if the sensation of stillness, often no less irksome and active, is ever so little broken. In the excitement of children at early lamplighting, the just begun rest of the visual area is suddenly broken, resistance to it succeeds; and in the habitual eye rubbing of "light hunger," so common among the blind, the nearest stimuli are applied, but in vain.

Shut off from light and resisting sleep, visual images may come out all the clearer as we close the eyes to think hard. At first in the young these are not far from after-images. It is in darkness without sleep that the imagination slowly learns to take its first steps alone, and develops its first pictures in visual terms upon the canvas of darkness. From many points of view, æsthetic, moral, hygienic, we can hardly overestimate the evolutionary and pedagogic value of the early stages of acquaintance with darkness. I suspect that the age when this fear is greatest will be found to be about the same as the interesting nascent period of eye-mindedness; (five to seven, after which age children becoming blind always continue to think in visual terms, but cease to do so if made blind before[1]). Whether faint images seem stronger because not contrasted with present sight, or energy, because shut off from optical processes, becomes

[1] J. Jastrow, *New Princeton Review*, Jan., 1888. Also, Heermann's classic treatise.

greater elsewhere by the law of kinetic equivalents, or both, is unknown. Normal vision, too, dominates attention and tyrranizes over retina and percipient activities. We have to see what is before us, whether it pains or fatigues us, or not. But in the dark fancy images are spontaneous and *freisteigende*. The professional oriental story teller is dull and inept like an owl in sunlight by day, and despite his will can unfold the charm of his art only when night has fallen. We know not what the imagination would be but for darkness, its great school, or if the eye, like the ear, could not close; or if eye pictures, like noises, had no night.

This brings us to our problem, viz., why childish fancy dwells on awful things in the dark, when children so strongly prefer pleasant to painful objects, and when night is the most protected and safest time. One reason very plain from our returns is found in the common phenomena of starting. On falling asleep the brain remits its repressive action upon lower centres and existing stimuli, and the tension of basal and spinal cells is relieved by a more or less general convulsion. From its analogy to the struggles of beheaded animals, this phenomenon is called psychic decapitation, and is so analogous to the start caused by the shock of sudden fear as to suggest danger. Sometimes we have the fear psychosis with no object of fear, or else some dim hypnogogic scene or object that may be present is intensified, or else a fit and adequate one is instantly suggested from the symptoms. Nightmare, and even most dreams (see IX below), and other causes that wake us, are painful, and so feared. Thus when the momentum of sleep is well on, most of our wakings, if premature, have been painful so that darkness has here another association favoring fear.

Again at night, and still more in sleep, we know we are helpless. We could neither fly nor fight. We are also more alone, and solitude favors timidity, and helplessness not only suggests, but seems to invite danger, which the sensitized ear and brain so easily invent. Again, when the constraint of sense is off and images struggle to reach and survive in the focus of attention, those that are stronger and more rousing have an advantage. Thus the nascent imagination takes its first lesson in the school of fear as both anticipatory and reminiscent pain, just because the latter is a stronger stimulus than pleasure, and outclasses it in this struggle. Children who gloat over horrors may be instinctively applying strong stimuli to develop the rude, early stages of imagination, as we pinch ourselves to keep awake.

We must go back of this to explain fully both the fear diathesis and some special fears. It is just in these drifting

automatic states so favored by darkness, and sometimes even by fatigue, when the imagination is laying the basis of mind and first divorcing thought from sense that the soul feels the pain of its old scars received in the long struggle by which intelligence unfolded out of instinct and instinct out of reflexes. In the past the pain field has been incalculably larger than the pleasure field, and so potent is this past that its influence dominates the most guarded child, in whom otherwise the pleasure field should be relatively the largest anywhere to be found. Now, darkness and the unknown alike have few terrors ; once they had little else. The old night of ignorance, mother of fears, still rules our nerves and pulses in the dark despite our better knowledge. Lacking this latter, children fall still more abjectly under her spell. Hence it is that animals found only in distant lands or long extinct, robbers, impossible monsters, ghosts, etc., rarely present, and never feared in waking consciousness, bear witness again to the remoteness of the past to which some of the roots of this class of fears penetrate.

IX.

Dream Fears.

1. *M.*, 12. Had a bad nightmare, and for months his fear of its recurrence was such that he would deny himself any food and refrain from anything any one told him would cause it; several children have persistently tried to keep awake to avoid bad dreams.

2. *M.*, 19. Has always been a victim of horrid dreams of things taking on the attributes of persons, and doing weird and uncanny things; these acts he long felt even in waking were possible.

3. *F.*, 16. Has had dreams that have left impressions on her brain that she thinks will last her lifetime.

4. *F.*, 14. Late reading of novels gives me a bad dream; I always fear I shall dream it again and that it will come true.

5. *M.*, 24. Has the most vivid dream fears; he has been eaten by animals, burned alive, his bones broken by falls, mangled by lightning, etc.

6. *F.*, 9. Cannot go home from school alone after she has had one of her bad dreams.

7. *F.*, 18. When she has a cold her tonsils enlarge, and she dreams of all kinds of enormous and horrible things touching her.

8. *F.*, 19. Had a standing horror of walking in her sleep, which she never did, leaping out of windows, etc.; she feared to see the door locked nights, lest she should remember where the key was and could unlock it in her sleep.

9. *M.*, 34. When about 8 dreamed three times that his brother was drowned from his own carelessness, and felt these prophecies; he was beside a silent river, heard his gurgling sound in sinking, put out his hands to feel for him below; the thought of these dreams haunted him for years, although he shivered and prayed to forget them.

10. *F.*, 16. Had a dream that will always be more vivid than any reality; she was alone with her mother on a wide plain; all was dark, but less so in some places than in others; from a cave on the left people were coming, weeping and wringing their hands; the stars came out, and then suddenly all was dark again; again they came and darted across the heavens with comets and meteors; a flash then lighted the east and shook the earth; "I hugged and kissed mother, but her lips were dry and clung to mine; my arms gradually fell away and I sank dead."

11. *F.*, 12. A colored girl was a great sleep-walker; once when thus walking on the porch she was grasped, pushed over, but held; this wakened her, gave her a dread of high places and cured her of sleep-walking.

12. *M.*, 5. Is sickly, and his greatest trial is in an oft-repeated dream of a big red cow with big green eyes; his mother writes, so great is his fear that I believe if he should meet a cow at present he would die.

13. *F.*, 19. Has since 8 a persistently recurring but vague dream. "Some kind of a wild thing comes up in front; I suspect it is a little hideous, old woman, but what I see is a pair of arms and hands waving, stretching and twisted in and out of shape; it gives me the horrors, and I have bad feelings long after."

14. *F.* An English lady teacher has been from 2 to 3 years of age subject to six or seven distinct forms of nightmare, each recurring every three or four months in never deviating order at intervals of about three weeks, so she could always predict the next one; they were perfectly clear and never changed, and each had just so much horror; in sleep she could predict their course, and she would awake with joy that it was over; although they ceased at about 12, she still remembers all so vividly that she can almost hear the mocking laughter prominent in one of them, and can still feel the sensation of flying in another.

15. *F.*, 40. When 19 once dreamed of going back of the barn, digging a grave, making a coffin, getting in, dying, being buried and coming to life in the grave; this gave her a permanent horror of being buried alive.

16. *F.*, 30. Remembers a dream of something coming at her, a peculiar rushing whirl, a roaring in the ears, cold perspiration, a shrinking on losing consciousness, which was caused by the absence and cured by the presence of a light in the room.

17. *F.*, 19. Had an oft-repeated nightmare of being pursued and slowly overtaken, which she thinks has left a permanent mark in her nerves.

18. *F.*, 18. The worst dream fear was of some one breaking into the house; it ended in a scream.

19. *M.*, 16. An oft-repeated dream was of seeing himself standing at a gate trying to pick up a stick that he could not quite reach; his arm would stretch out long and grow rigid, and the terror of it still remains.

20. *F.*, 30. Often has a waking sense that some object in the room is getting bigger and coming nearer; this has grown very terrible, and she ascribes it to a dream.

21. *F.*, 17. Is often made sick by recurrent dreams of being bound, not being able to hurry, walking on a board over chasms and falling.

22. *M.*, 35. At the age of about 11 often dreamed of being in a

large sphere from which he could not get out; he would often know that his mother was holding his hand, but the sense of being shut in the awful thing would persist a long time in the waking state.

23. *F.*, 17. Feels that her brain has been permanently scarred by dreams of Indians.

24. *F.*, 16. Often is where snakes are so thick she cannot walk without stepping on them, of coming to chasms that widen as she would cross, that the earth cracks open as she walks, etc.

25. *F.*, 19. The favorite dream terror was of being in an open field with no bounds; she would start from a big tree and run on and on, seemingly all night; it would never end, and she would stop in misery and awake tired out and in a cold sweat; she never feared open spaces when awake.

26. *F.*, 18. Dreamed of a big dog which she could only escape by rolling down stairs, through the yard, up the streets; this caused dread of dogs.

27. *F.*, 19. Often dreams of swinging a great distance in the air, and feels the cold swish of it on the cheeks; all is spooky, and she is breathless and paralyzed; her other dream is of being in a vast clear space, with nothing anywhere but just blinding whiteness; suddenly all changes and she is looking at a narrow place, which is the deepest black imaginable.

28. *F.*, 21. Often dreamed of walking off the wharf; she did not sink into the deep below, but would wade on sometimes as if on a springy board; the horror was to start.

29. *F.*, 20. Often has a feeling of floating and twisting in the air with no support, and got so she could not sleep without clasping her sister's hand; in waking this all comes to mind when going down an elevator.

30. *M.*, 19. Dreamed so much of flying that he told stories of his aerial soarings and that he almost came to believe that by filling his lungs, stretching his arms and running he can leave the ground; he still wakes sometimes sure that he has discovered how to fly.

31. *F.*, 44. Dreamed so often of falling down stairs that she came to dread stone stairs, new steps, etc.

32. *F.*, 18. At the age of 12 would dream of her father throwing her into the water, feel herself falling after waking, and almost began to suspect he would do it.

33. *M.*, 16. The dream terrors are of climbing things and having them topple ever.

34. *F.*, 16. Enlarges on the delight of awaking from her dream to find after all she is not riding along tied in a gypsy wagon.

35. *F.*, 15. Long had a sense that she had just awoke from a dream, when she tried to look back on her infancy she felt that she had come to life that day; this worried her and made her feel that she was very old.

36. *F.*, 18. When 10 saw a Bible picture of a woman falling on spears held by soldiers, which long haunted her dreams.

37. *M.*, 16. Had horrid dreams of the devil and of a big something coming toward him and getting larger, till his head would whirl round.

38. *F.*, 25. Often dreams of the walls of a room slowly coming together to crush her, and of a cruel face growing bigger.

39. *F.*, 17. Has recurrent dreams of driving and dropping the reins; sometimes the horse runs and sometimes not.

40. *M.*, 14. Has dreamed so often of being chased up to the door-step which he could not climb that now he can think during the dream that it is only a dream, and that when he starts to fall he will soon awake; this has now robbed these dreams of terror.

41. *F.*, 19. Often used to remember while dreaming of flying that she had dreamed it before, but late years believes she is really flying.

42. *F.*, 18. Shuddered at intervals for weeks at a tall and awful man in the pulpit.

43. *M.*, 15. Persistently dreams of conflicts with animals.

In some of the above cases symptoms of fear are strong, but the images are not clear, 13, 16, 17; in others favorite terrors recur in different combinations, 17, 20, 37; in some optical symptoms, 10, 27, or tactile experiences, 7, are prominent. Some are cause or effect of intense strain or effort, 19, 25, 26, 24, or may leave great exhaustion. Falling and floating, 27, 28, 29, 30, 36, 41, are common; claustrophobia, 22, 38, less so. The form of dream terrors is often recurrent or even known at the time to have been previously experienced, 9, 12, 13, 14, 17, 21, 24, 25, 29, 31, 39, 41, or are expected to come true because repeated, 4, 9. Fear of bad dreams may cause dread of sleep, 1, 8, and waking may be a welcome escape, 14, 34. Not only are awful experiences or flitting fancies repeated and magnified, but dreams may leave long and perhaps permanent traumata in the waking state. Sudden dread of dogs, 26; of cows, 12; of going out alone, 6; falling on stairs, 31; Indians, 33, and even of a parent, 32, may thus be suddenly injected into the waking consciousness. Flying, 30, and otherwise strange things, 2, seem possible; fatigue rising almost to paralysis may remain, 25; and education in sleep is possible, 11. The cases selected above show but faintly the volume or manifold form of this group of very common fears. See, too, under VIII, cases 27, 32, 35, 36, 38.

Any class or form of fear may arise in dreams: falling, orientation, animals, thunder, water, fire, etc. Thus to explain these would be to explain all fears. There are frequent tendencies both to specialize and repeat. Any impression grows to illusion easier than in darkness, because the repressive influence, not only of sight, but of other senses and centres, is removed. Hence evils only feared in waking become real in sleep, and we actually fight, fall, are chased, seized, choked, run till we drop, fly, sob, love, and die. We shall make here but one suggestion. Sleep is a process of repose for run-down cells, a state of great metabolic activity on the plane of what we may call the higher digestion, and nor-

mal, spontaneous waking of any organ or centre that sleeps, should be satiety, overflow and perhaps euphoria. To secure such sleep and waking is one of the best ends and tests of all that can be called hygiene and regimen, whether of body or soul. Circulation and digestion should be at their best, and in sleep we may be especially sensitized to any disturbance here. Vast as is the majority of all painful dreams due to this easily avoidable cause of so much of the fear diathesis, these are all due to interferences with normal sleep. This latter would not exclude dreams, because waking is gradual and, as as it were, in spots, nor would it exclude dreams of fear and pain, if these had specific centres and functions whose normal action caused them. That there are such foci of pain no less deep seated and with quite as strong a tendency to act as in the case of pleasurable sex dreams, seems to me probable from our full dream record. Some of the inherited and repeated cases, as well as those that fall under other sections, suggest an organism hereditarily handicapped with old insane tendencies, but functioning normally in dreams, rather than they do overfeeding, etc., which, however, like any other present condition, may be an occasional cause even of this class. Nowhere is there greater need of further and more special study than of such dream motives as flying, getting bigger, being held, lost, etc.

X.

Shock.

1. *M.*, 18. Once saw a sheep run over, and heard its death cry of agony; for weeks he would go through it all nights, and has never got over it, although now to see animals suffer causes more anger than fear.

2. *F.*, 17. Never feared robbery and murder till old enough to read newspapers, and never feared diseases till after learning their horrors in quack advertisements; now both haunt her.

3. *M.*, 37. Never takes up his morning paper without palpitation and nausea, fearing the gruesome things he is sure to see and must read.

4. *M.*, 16. Saw a case of sunstroke, and for years after dreaded the sun, and kept in shady places when possible.

5. *M.*, 6. Was once in a cyclone, when his mother gathered her children and said they would all die together; was frightened into St. Vitus' dance and made weak-minded.

6. *F.*, 17. Was once run away with; ever since in any crowd or excitement, horror makes her beside herself.

7. *F.*, 9. A girl tore her nail in a door and fainted; her older brother saw it, fell in a faint and injured his shoulder; another brother found them, and all three were found lying together in a faint, and were nervous for weeks.

8. *F.*, 27. Starts at every little thing twenty times a day; her heart leaps to her throat.

9. *M.*, 12. Started with fright for months every time a new clock struck.

10. *F.*, 2. Her horror is a jack-in-the-box; it has made her nervous and jumpy.

11. *F.*, 7. The agony at hearing a drum was "too intense to describe."

12. *M.*, 5. When he was playing his grandmother gave one of those sneezes that "made the very crockery rattle in the pantry;" he was shocked into unconsciousness, and lay fainting for a long time.

13. *F.*, 13. The greatest shocks for her is to be intent on something, and looking up suddenly to find people near.

14. *F.*, 7. The worst punishment was to have a teaspoonful of water thrown in her face; this was stopped because of its effect on her health.

15. *F.*, 18. Ever since she heard the word electricity, it has been the source of great terror; in the physics class she can never touch the brass knobs; she tried it once, but worlds would not tempt her to do it again, no matter how light the shock; "they say batteries strengthen people, but I would die first."

16. *F.*, 12. Her mamma once touched her hand in the dark; she jumped, fell down stairs and had "my worst attack of hysteria."

17. *F.*, 13. Once in church there was what seemed a loud knocking at the door; they went out, but found nothing, although it was repeated; she thought nothing of it until later she heard some thought it a heavenly summons; for years after that a sudden knock aroused great fear.

18. *M.* A man dying of typhoid fever was moved from a burning house in the country to another house, which also soon caught fire, when he was taken to the road, where he was burned by a hot shingle on his forehead; his wife too died some weeks later from the oft-rehearsed horror of it all.

19. *F.*, 18. Heard of the sudden death of a friend she had chatted with that morning; "the awful shock nearly killed me, and changed me in a moment from a careless girl into a woman."

20. *F.*, 13. Never was afraid except when burglars entered her house last summer.

21. *F.*, 12. Never feared until they were shipwrecked, coming from Europe last fall.

22. *F.*, 18. When burglars were found in the house, "my teeth chattered, I twitched all over and could not say a word."

23. *M.*, 13. Saw "a fellow's leg mashed two years ago," and soon after "saw a fellow killed when jumping from a train; ever since he has had a horror of the cars, though he must ride on them every day to school.

24. *M.*, 13. Saw the "Span of Life" at the theatre, and was long haunted, especially nights, by the villain's laugh.

25. *F.*, 15. Says "a tragedy at the theatre sets me nearly crazy with nervousness."

26. *F.*, 18. The Chamber of Horrors at museum almost gives her nightmare by night, yet it has a great charm for her.

27. *F.*, 12. Visited the prison, and while seeing the men work felt someone take her arm; she shuddered and almost sank with fear, and although it was only another girl did not soon get over it.

28. *F.*, 17. Ever since her brother jumped out at her in the dark, she fears darkness and sudden meetings.

29. *F.*, 18. When a small child the cook once jumped out of a dark corner to frighten her; she can never since pass that corner in the dark.

30. *F.*, 16. At the age of 10 her brother jumped at her, and the fright caused stuttering which lasted for years, but was slowly overcome.

31. *F.*, 15. "When jumped out at one night, stood panting and silent for some time; was nervous all the evening and night; next day had nausea and fainted, and may never quite get over it.

32. *F.*, 19. Loves the stage, but must know if a pistol goes off in the play, and if so will not go.

33. *F.*, 17. Guns are the torment of her life; her brother was fond of shooting, but she would run, hide, shut her eyes, stop her ears, and often scream.

34. *F.*, 18. From a child feared being shot, having a presentiment that she was to die that way; when 12 dreamed she was sentenced to be shot, and although she felt the bullet strike it did not hurt her; this cured her fear.

35. *M.*, 19. Was about 8 when he first learned that a gun would shoot where it was aimed; by seeing a man do the same he lost his fear.

36. *F.*, 18. Was in a hammock, toward which a dog rushed after a cat; when he was near he gave one bark, and she saw the open mouth which she thought was meant for her; "it was over in a flash, but I could not move; was given a horror of dogs, and had complete exhaustion for weeks."

37. *F.*, 34. When 9 and was playing on the track suddenly saw a train rushing toward her; the next she knew she came to, beyond a fence, over which she had unconsciously climbed; ever since she cannot look at an approaching train without fancying it a horrible, living monster.

38. A young man and wife once crept under a freight train which blocked their way home, when the cars engineward began to move; the sight and sound of freight trains for years afterwards filled her with horror.

39. *F.*, 21. Snatched her baby sister as she was about to fall down cellar; the fright caused a sudden throb in her head, and she passed into one of her worst nervous headaches.

40. *M.*, 10. Entered a dark kitchen to drink, when the cistern burst and the water wet his legs; he ran back, locked and held the door, beside himself with fright.

41. *F.*, 44. The least shock causes nausea, sleeplessness and excessive urination to her, but a pleasing surprise, like the unexpected arrival of friends, robs her of appetite and sleep.

42. *F.*, 30. Upon sudden news of a friend's death had hemorrhage of the womb, from which she died in a few days.

43. *F.*, 6. On hearing sudden news of the death of a friend shouted to the messenger, "It is a lie, go right away," and *F.*, 22, struck him in the breast, lost consciousness, and for years after could not hear of like accidents without fainting and acute pains in the back; a spot on the door remains somehow indelibly associated with the scene for twenty years.

44. *F.*, 42. All firearms are dreadful, and a gun is feared "without locks, stock or barrel."

45. *M.*, 14. Says "all guns kick and may burst, are dangerous at both ends and all the way between."

46. *F.*, 8. Always runs past the armory on her way to school, and *F.*, 19, always runs up and down the stairs under which in a closet is a gun.

47. *F.*, 1. Suddenly noticed with a start of alarm the picture of a big dog the nurse had pinned up the day before.

48. *F.*, 43. Sat long on the beach a rod from a strange child at play; after a long time the latter looked up and screamed with fright.

The shock may be caused by slight but unexpected touch, 27, 16, 15, 14; by sudden bad news, 19, 42, 43; by great danger, 5, 21, 22; by noise, 9, 11, 12, 17, 32, 33, 34, 35; by every slightest thing, 8, or by thinking over things not feared at the time, 17, 26, 28; while being jumped out at, 28, 29, 30, 31, is almost a class by itself. Fear fetichism is suggested in 15, 18, 24. In sudden frights some are motionless, or faint, 7, 27, 31; others make a wild rush, 37, 40, or fight, 43, or develop slow, grave symptoms, 5, 16, 30, 39, 42, 43. Fright may cause painful associations, 3, 23, 29, and be cured in curious ways, 34, 35. For two children and many women the Fourth of July is dreaded on account of explosions. Four cases of shock or prostration are due to explosions at the theatre. Three were made ill by blasting. Besides our 603 fears of thunder and lightning, there were nine well developed fears of earthquakes, 14 scares at locomotive bells and whistles, 12 haunting fears of paralysis, 4 of epilepsy, 12 of apoplexy, 26 shocks at the onset of street bands, fire and church bells, and 9 of sneezes, or stories with "boo" in them.

The effects of sudden shock are of two chief kinds. The first is a muscular start. This may be almost entirely incoördinated, a "mass of clotted motion," or more organized movements of defense, flight, etc. It may be of all degrees of violence, from the slight start, so common in impressionable people, to cramp or reflex epilepsy, with resulting lameness. The other group of effects is predominantly psychic. There is intense *commotio cerebri*, with its present distress and perhaps sequent obliteration of memory and motor images, paræsthesia, hypalgia, etc. In the voluminous shock literature so suggestive for psychology, there is a marked recent tendency to turn from the earlier theories of specifically spinal to general localization, from *vaso-motor* paralysis, blood, cell, and other attempts at physical explanation to the admission of psychic causes.[1] Cases like 5,

[1] Openheim, "*Die Traumatische Neurosen*," Berlin, 1892, p. 178 *et seq.* And also Groeningen, "*Uber den Schock*," Wiesbaden, 1885, p. 134 *et seq.*

6, 9 and others suggest a psychic factor, acting analogously to an epileptogenic zone or to some scars. Over-attention, sudden exhaustion, reflex inhibition, or emotional strain, to which neuropathic people are so predisposed, or perhaps hypnotic suggestion, may cause pain, changed sensations, and psychic alterations so deep as to affect the entire mental and moral life, and all may be of ideogenic origin.

Whatever theory of shock we adopt, however, we may, I think, conceive the hodograph of attention, with all its sequence of topics, intensities, tones, etc., as always moving between the extremes of complete interruption and extreme continuity. If the latter is perfect, there is unconsciousness, illustrated by the frog boiled to death without moving if the heat is applied gradually enough. Rupture of continuity is shock. The minimal changes perceived, and especially the maximal of sudden change that can be reacted to without error or waste of energy, differ widely with age, vigor, health and moods, and probably have anthropometric value not yet recognized. Variations from excessive vulnerability to shock to obtuseness, from one person's horror of it to another's passion for it, may have the highest pedagogic as well as diagnostic value.

Now dread of shock and surprise, which, if extreme, we may call hormephobia, appears to be a very fundamental instinct of physical and especially of psychic preservation. It prompts birds and animals to post sentinels, build shelters, etc., and profoundly modifies their habits. Spencer's theory of the evolution of the eye as anticipatory touch in order to avoid sudden contact, the definition of science as prevision, the struggle to get science logically organized and thinkable, evolution, the elimination of miracles, are all in order to protect from and save the waste of shock by enabling man to anticipate change from afar, and do his thinking and feeling with the shock elements reduced to the point of greatest possible economy, yet not so faintly agglutinated as to be obscure. Even attention is an organ of anticipation, and increasing knowledge makes its hodograph approximate an ever steadier causal alignment. As man reduces and organizes the shocks with which his psychic life began to terms of greatest legibility with given time and energy, the subtlety required to deal with these reducta as well as impressionability to the vastly wider ranges they open, increases, and intelligent adults grow less familiar with the ruder forms of shock and less tolerant of them. Children, however, are more exposed. Their world still has wide realms of chance, where the most unexpected things may happen any moment. In many cases of development arrested in juvenile stages, we still

get glimpses not only of what the ancient chaos of ignorance really meant and of the awful struggle and loss by which it has been overcome, but also of the sanifying culture power of what are now the common-places of science. Just in proportion to the lability or convulsability of the psychic elements is the dread of anything sudden that may cause fulminating discharge, so that no class of fears needs to be more carefully respected, or is harder to treat, while no class of fear studies opens a more promising field for scientific research than this.

With this class of fears, more perhaps than with any other, we now have within reach the possibility of a direct reference to the underlying mode of brain action, which may be roughly set forth as follows:

Amœboid motions, which represent the beginnings of most of the basal physiological functions and which are of such increasing charm and suggestiveness, have two chief phases, one of expansion and one of contraction. In the former living substance stretches out pseudopodia in any direction, flows or pulls itself along, takes food, etc., and in the latter state, which is assumed in response to touch, jar or shock, as well as to strong thermal, chemical or electric stimuli, it balls itself to present the least possible surface, and always dies contracted. Whether vital phenomena represent a new solution of a complex problem in molecular mechanics or a new vital principle, we, of course, do not know. They are, however, limited and partly controlled from without by the laws of surface tensions, and one problem is to find the causes of its diminution which lets out the movements and its increase which favors the spherical form,[1] affinity of the protoplasm for oxygen lessening the tension and possibly rapid metabolism increasing it.

Duval[2] suggested that the free nerve endings of Cajal, which the latter found often in contact with both the protoplasmic processes of nerve cells and with the body of cells in the brain, might be conceived to retract by amœboid motion, and that this breaking of contact might be the cause of sleep and narcotization. In the waking state he conceived this conductivity as restored by spontaneous re-contact, although movement was sought for in vain by Kölliker in the ends of both the motor and sensory fibers in living larvæ, where they would be most expected. The view of Duval has been modified and extended by Rabl-Rückhard, while Lenhossek[3] thinks such a view does not impair the functional value of brain

[1] Verworn, "*Allgemeine Physiologie.*" Jena, 1895, pp. 544 *et seq.*

[2] *Comptes Rendus à la Société de Biologie*, Feb., 1895.

[3] "*Der Feinere Bau des Nervensystems im Lichte der Neuesten Forschungen.*" Berlin, 1895. See p. 75, 143, etc.

architecture, but is an addition well befitting the complexity of nerve function. Moreover dendrites may be tuned to act upon certain contacts and not to others, growth may make new contacts possible, etc. Lateral fibrils he thinks receptive both of food and of stimulus. If Cajal's free ends are to be assumed so often where Golgi found network, and if they act without contact, Lenhossek can readily adjust himself to a new principle of action at a distance in place of the idea of direct nervous continuity, for a connection that is functional only is less materialistic.

Cajal[1] says the neuroglia cells of the gray substance show all stages of retraction and relaxation. In the former the protoplasm of the cell body increases, the processes grow short and thick and the secondary processes vanish. In this contractile function he compares them to the pigment cells in the skin of color-changing animals. Contractile brain cells he finds most abundant in the molecular layer where fibrillar contacts are thickest. In their relaxed state the neuroglia processes pass between the nerve tips and the cells and isolate them, while when contracted they absorb the protoplasm of the secondary processes and thus cause contact. According to Duval, contractions accompanied psychic rest and relaxation meant activity. For Cajal, the reverse is true, and these cells become by their movement, which may be automatic or not, shunting and isolating agents. As the energetic contraction of these cells makes connections here or breaks them there, there occur in the mind associations, imperative rapidity of words or thought, or stagnation and forgetfulness, monoideistic concentration of attention, vehement action, etc. In attention the hundreds of pseudopodia inserted into each brain capillary contract, and thus cause hyperæmia, or congestion of the perivascular space. Thus the physical basis of all psychic acts and states whatever, morbid as well as normal, sleep, fatigue, attention, confusion, etc., are all created by the contraction and relaxation of cell branches in the brain. Demoor[2], leaning on Nissl's dendritic granulation theory, thinks any prolongation may be and those caused by morphine, alcohol and chloroform are always moniliform. Without going quite so far as Klemm, who says[3] "reticulary, fibrillary, alveolary, are only states of one and the same plasma, transient or lasting during life, or perhaps first assumed in the

[1] "*Einige Hypothesen über den Anatomischen Mechanismus der Ideenbildung der Association und der Aufmerksamkeit.*" *Archiv f. Anat.*, 1895, p. 367.

[2] "*La Plasticité Morphologique des Neurones Cérébraux.*" *Archiv. de Biol.*, XIV, 1896.

[3] *Jahrb. f. Wiss. Biol.*, 1895, Heft 4.

act of death," Demoor thinks that much histologic detail does not give us a fixed aspect of the neurons, is not their real morphology, but only their reactionary state, and shows us chiefly the enormous plasticity of their sensory protoplasm. Cells, he thinks, associate their functions by establishing more or less contacts between their prolongations, and so add and coördinate their otherwise monadic work by their own energy of biotonic movement. Retzius[1] takes a more conservative view, conceding longitudinal transformation to glia cells, at least during fœtal stages, and holding that if tangential contact of processes occurs then, they rigidify later; while Kaes[2] thinks his measurements may show that the caliber and volume of fibers increase by use, and that the extremes of acute delirium and stupidity may show a difference of size, and Golgi[3] thinks motion undemonstrated. While this motion is as yet unproven, these hypotheses of motion have created intense interest and given great stimulus.

The dead brain that histology has chiefly studied heretofore, affords us little idea of the complex activities that take place in the living one. The classic work of Hodge has shown to the eye the metabolic cell changes attending normal nerve action. Now, if movements like those above or any others do attend normal psychic activity, I think we are surely justified in inferring that strong shock, which is perhaps the most drastic of all experiences, must greatly increase it and cause transformation, obliterating or intensifying some associations and opening up new ones, giving to attention new labilities, modifying our automatism, laying the basis of paræthesias, loss of words, imperative ideas, impulsive acts, innervating the wrong or antagonistic muscles, flushing the vaso-motor or splanchnic nerves, causing stuttering, sudden rigidity, exhaustion, paresis, and all the other shock effects possible to the point of the dual personality phenomena. Strong and sudden experiences of fear may have shaped the brain and modified its minute structure in the past to an extent hitherto unsuspected, laying even in its now fixed architecture, to say nothing of its motor habits or the diatheses of its neurons, a physical basis not only for easy fear-convulsability generally, but especially sensitizing it for particular forms of shock. Brains of greater plasticity or less established coherence of parts or elements would thus most dread and be most damaged by shocks of eruptive violence.

In attempting to explain "why we are distracted," G.

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[1] *Biologische Untersuchungen. Neue Folge*, Bd. VI, 1896, pp. 28 and 36.
[2] *Wien. Med. W. Schrift*, 1895, Nos. 41 and 42.
[3] *Untersuchungen*, etc. Jena, 1894, p. 270.

Hirth[1] conceives the ego as a synthesis, mosaiced together of many elements, the parts of which are not all functionally connected in any act or at any given time. I find hardly a feature in those primitive symptoms of certain forms of mental alienation which Meynert called amentia, Koraskoff conceived as polyneuritic psychoses, Kräpelin describes as delirium of collapse, Ziehen as dissociative paranoia, Chaslin as simple mental confusion, etc., that is not present, at least momentarily, in extreme sudden fright. Very closely connected with these fears are those of the following section, which still further illustrate this group:

XI.

THUNDER.

1. *F.*, 18. Summer in the country would be paradise but for thunder, which spoils it all.

2. *M.*, 17. Thought it impious to look at the heavens when a thunder storm was approaching; it was also impossible.

3. *M.*, 4. Was always angry and thought God was shooting all the time on purpose to scare him.

4. From 3 to 5, *F.*, would kneel by her mother's lap in agony and cry, and wish she were dead.

5. *F.*, 18. Always wants to lie on a sofa with her face buried in a particular way, but her fear is not for herself, but the buildings.

6. In a school room one day every clap of thunder caused many pupils to break out with fresh cries, but as it grew bright and the shower passed, the bolder laughed and gibed at the cries of the others to rouse their spirits.

7. *M.*, 12. Wants everybody to make all the noise he can in a shower.

8. A lady I know, of about 35, has been bedridden for eight years with a rare form of nervous prostration. She mends steadily during cold weather, but sinks away during the season of thunder showers just in proportion as these are severe. Every peal makes her rigid and crampy like a frog with strychnine. Every fall her state measures the total amount of thunder during the season.

9. *M.*, 6. Deaf and dumb, has great horror of thunder and lightning.

10. A girl of 8, in whom this fear was strong, often imagined the house struck, the family lying dead on the floor, in bed, in the barn, etc., striped red, white and blue with lightning; she never spoke of this, now aged 17; always thinks vividly of it in showers.

11. *M.*, 18. Saw a tree slivered when 9, and now every loud clap of thunder brings this image vividly up.

12. *F.*, 18. Always says automatically to herself: "In some such storm as this the earth will be shivered; will it be now?"

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[1] *Localisation-Psychologie*, 1895, p. 67 *et seq.*

13. *F.*, 11. Almost has fits in showers, but says that when it stops and the sun comes out, and there is a rainbow, and the air is fresh and cool, it is the prettiest thing in the world, and she is as happy as she was terrified.

14. *M.*, 16. Has great terror, but when showers are over wishes they had been heavier, as they have great fascination, specially for memory.

15. *F.*, 17. Sweats and cannot move.

16. *F.*, 24. Feels with every flash, although with eyes closed, as if she had been pounded on the head.

17. One young woman always fears thunder will crush the house down flat.

18. Another, 18, fears the sky will burst.

19. *F.*, 14. That a rude wagoner above will fall through.

20. *F.*, 20. That something awful is booming down from the sky toward her.

21. *F.*, 19. Her chief fear is that the flash may destroy her sight.

22. *F.*, 18. Fears a big ball of fire may get into the house and explode, so that everything must be shut up.

23. *F.*, 16. Says to herself after each peal: "I am not dead yet; it is nice to know that thunder comes after the lightning, although this is cold comfort, because the next clap is just as dreadful."

24. *F.*, 19. Got her fear of thunder from a cannon on the 4th of July.

25. *M.*, 14. Was cured of this fear by being shown the beauty of the lightning at the window by his father.

26. A teacher cured her long fear by having to encourage timid pupils.

27. *F.*, 17. Cured herself by realizing that God sent showers to make things grow.

28. *M.*, 14. Reading about electricity cured him.

29. *F.*, 28. Can never remember having a fear of anything living or dead; this she ascribes to perfect health, and to the fact that she was never left with servants. Her parents made thunder showers an object lesson to teach electricity and æsthetics, so that she longed for them, and was surprised that others dreaded them.

30. *M.*, 7. Goes off and prays God not to let it strike him.

31. *F.*, 3. Becomes frantic with terror whenever, after experiencing a heavy shower, she heard the word rain.

32. *F.*, 19. Her conscience talks loudest and her wish to be good is strongest when a shower is coming, especially if the sky is coppery.

33. To *M.*, 14, thunder means war and brings up its images.

34. *F.*, 28. Has always had the greatest love of watching the lightning; the louder it thunders the more she is exhilarated.

35. *F.*, 34. Weeps several handkerchiefs wet in a thunder shower.

36. A well-known professor as a boy always watched clouds and studied winds, squinted across trees to judge how thunder-heads were moving; the first solemn roll was often mistaken for other noises; he would not work to save hay, because he had heard that sweat drew lightning. Every fork full of hay pitched on the load would attract lightning to the steel tines; he skulked near trees that they might draw it, yet not too near, for fear of falling limbs;

would never set foot on a rock, which was dangerous; kept glass under the bed posts; sat on stairways or rolled in a hot feather bed; made prayerful compacts with God. When the thunder began to abate he felt a sense of triumph more than gratitude and wanted to jeer the clouds and dare them to hit him.

37. *F.*, 26. Always knows by her nervous tension long beforehand if a shower is coming; is in a state of abject terror during it, cannot keep still, collects and hides all knives and steel things, loses power of speech and motion if there is a loud clap, thinks of her sins, always has a headache afterward, and wishes there was no summer so there would be no thunder.

Of all our cases, but two, 29 and 34, had not feared thunder. This fear is often cured, 25, 26, 27, 28, and resistance to it appears in 3, 7, 23. It may be specialized, as in 10; develop specific imagery, as in 10, 17, 18, 19, 21, or almost ritualized acts, 5, 36, or automatic psychoses, 12, or convulsions or paralysis, 15; strong emotional expressions, 4, 6, 15, 35, 37, or fear fetichism, 31, or moral and religious associations, 3, 30, 32, 36, may appear. It may gravely affect health and the course of life, 1, 8, 36, 37, and the reaction afterward may be joyous, 13, 14. On the approach of a thunder shower, some shut all the windows, blinds, curtains, and perhaps light the gas, go down cellar, into a dark closet, cover up the head in bed, sit on pillows in the middle of the floor, creep between feather beds on steads with legs insulated by bits of glass, etc. Some children develop elaborate protection in their fancy, as being in a globe of solid steel, a house of rubber or glass, a cellar cave, or having a fantastic system of lightning rods, some of which are amusing. It is pathetic to read of some family groups where the children have inherited this fear from the parents sitting in silent dread, praying or singing hymns, thinking, repeating or reading aloud some of the Biblical descriptions of Sinaitic thunder, or making puny spectral resolves for radical self-reconstruction, which fade in clear sky like ghost fears at dawn. The inefficacy of these terrors in carrying out good resolves, or even in preparations for the next storm, so often planned, is amazing. But it is too much to say, as one does, that those who suffer most from this fear never have lightning rods. Till about eleven, the average child in our reports fears thunder more than lightning, and often enjoys the latter while dreading the former. Some describe with satisfaction and detail the *Aufklärung* of learning that it was the flash and not the noise that was to be feared. A few jump and start with, as they think, no stimulus at all, but from sheer tension.

The fact that this fear leads all the others, and as that yet so small a fraction of one per cent. of deaths are by lightning,

shows that as yet our correspondents have not adjusted their scale of fear to that of danger. Perhaps nowhere is the power of noise to control feeling and also to excite imagery so well seen. This latter differs greatly in intensity and still more in form. In a thunder shower some children persistently think of a battle, bombs bursting, etc., some of the moon or sky cracking. Some conceive the approach of a storm as from above downward toward the earth. Often the imagery involves a firmament, as an arch of sheet iron, boiler metal, zinc, tin, etc., resonant like a sounding-board, over which barrels, balls, wheels, etc., are rolled. Sometimes clouds burst or bunt into each other, or into hills or houses. Loud thunder is described as bearing or pressing down heavily in a mechanical sense. Again it is God, Santa Claus, devils or angels groaning or shouting in an angry voice. All kinds of noisy events and occupations—ice sliding off houses, coal being run in, big mills, machinery, locomotives, etc.,—are fancied, all according to familiar laws of apperception.[1] Vivid lightning in the dark makes an even sharper contrast to the eye than that between thunder and stillness to the ear, but the former can be closed, the latter not. Not only is noise itself more massive and overwhelming, but the imagery of lightning—many matches struck, gas turned on, clouds splitting, big eyes winking, etc.,—is fainter and less varied.

The main point, however, is that thunder gives a profound sense of reality above. For primitive consciousness, belief in and reverence of powers above are never so fervid as in a thunder storm. How such phenomena at Sinai almost created both the religious and political consciousness of the plain dwelling Hebrews, making God more actual, powerful, dreadful, near, etc., Renan has shown at length,[2] while Kühn's great work[3] shows how many beings, motives and story books of the mythology and folk-lore of all the Aryan races are cast in the mould of this imagery. It is perhaps too much to say that we now as little realize the moral, æsthetic and religious capital to be developed at a certain age out of children's feeling for this group of natural phenomena when their psychology shall be adequately known, as Franklin foresaw our age of electricity. But it is certainly superficial to ascribe all these effects to jar and noise, and to note reflex effects while ignoring the larger and deeper phylogenetic factors.

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[1] See my "Contents of Children's Minds," *Pedagogical Seminary*, Vol. I, p. 161 *et seq.*

[2] "History of the People of Israel," Vol. I, p. 157 *et seq.*

[3] *Herabkunft des Feuers.*

XII.

Fear of Animals.

Our returns include every familiar domestic animal, 44 intense fears of wild animals never seen, fears of 12 purely imaginary animals and most of the common small animals, bugs, insects, worms, etc.

1. *F.*, 6. Frightened at a tame bear; did a series of absurd automatic acts, and till 21 imagined bears in every dark, lonely place.

2. *F.*, 19. Read of a panther shot on a forked branch; instantly imagined it a forked branch on the way to school, and could not pass it without great effort.

3. *M.*, 4. For months had bears on the brain, fancying them in the next room.

4. *F.*, 9. Was long haunted by a purely imaginary lion.

5. *F.*, 18. Denies knowing any fear save that of cows.

6. *F.*, 26. Can never walk in any fields for fear of cows or bulls, and used to dream of supernatural ones.

7. *F.*, 5. Feared to drink milk after seeing it drawn from a cow.

8. *F.*, 18. Dreads everything cow-colored in the fields, and if cows are seen in the distance climbs on the wall and prays, but has never been pursued or noticed.

9. *M.*, 11. Had for years fear of being carried off by an eagle.

10. *M.*, 7. Had for a period of months tigers on the brain.

11. *M.*, 4, and *M.*, 7. Long thought, talked, dreamed of lions, which they imagined everywhere, and had monstrous ideas.

12. *F.* Two girls, four and five, were terrified at a man named Wolf, and fancied all his features wolfish.

13. *M.*, 12. After reading of wolves in Russia, he could not enter a dark room.

14. *F.*, 22. Imagines wolves' eyes in all dark corners.

15. *M.*, 5. Long believed a big wolf lived under his bed.

16. *M.*, 6. Thought bears dwelt in a dark corner of his room; "they would come to my crib and tell me to stop breathing for a short time, which I did, for though I liked them I was afraid to disobey."

17. *F.*, 17. Has always had, with no ascertainable cause, such fear of horses that she cannot go near them or ride; her thoughts and dreams dwell on runaways, being run over, kicks, bites, etc.

18. *M.*, 7. Has a monstrous idea of sheep, and especially bucks, and dreads them accordingly, thinking they could butt down a stone wall.

19. M., 8. Both admires, fears and fancies amazing stories of a big black woodchuck that has singular fascination for him.

20. *M.*, 6. Has a greatly exaggerated idea of the tusks, power, etc., of wild boars, and cannot hear enough about them.

21. *M.* Elephants are now the fad of my boy, 6, and have been all this year. "I do not know whether he loves or fears them most, but am sure he thinks them higher than man."

22. *M.*, 7. Dreads centaurs, and especially horses that breathe fire, which seem pretty real.

23. *F.*, 17. All nightmares are dog-dreams, as are all her fears by day.

24. *F.*, 22. Says every dog thrills her with a feeling like that Faust felt for the growing dog behind the stove.

25. *F.*, 19. Never hears a dog bark without a shudder of fear, even if away off.

26. *F.*, 16. Does not know whether she has more horror of their uncanny eyes or their dreadful lolling mouths.

27. *F.*, 18. Loves dogs if their backs are towards her, and can stroke them, but from her childhood, if they face her, must fly.

28. *F.*, 8. Calls all dogs to her by pet names, but if they approach her runs.

29. *M.*, 34. Still remembers his childish horror of dogs, because if mad they made men whom they bit creep, bark, bite, and then become dogs.

30. *F.*, 19. Has a phobia for cats because they walk so softly, can jump so far.

31. *F.*, 39. Has always had an almost morbid antipathy for cats; cannot explain it, but fears nothing so much; "they are also disgusting and loathsome."

32. *F.*, 27. Always knows if a cat is in the room, though she does not see it; her terror is beyond control and brings nausea.

33. *F.* From 8 to 12 a lady imagined that if she swallowed a cat's hair a cat would grow inside her, and therefore feared them intensely.

34. *M.*, 25. When four thought he had once been a cat, would turn into one again, drink as they did, etc.

35. *M.*, 19. The horror of cats is that they are sly, noiseless, witch-like, shiny-eyed, and you never know what they will do next.

36. *F.*, 6. One evening fell asleep twice in her chair, and both times as she woke saw the cat just waking and yawning in another chair, and was horrified, thinking the cat had got her breath.

37. *F.* When 3 or 4 a woman feared nothing so much as the end of a cat's tail, which writhed when the cat slept, and she thought would bite.

38. *F.*, 21. The sight of a mouse always gives her hysteria, sometimes for hours, and was the cause of her worst illness; even a toy or candy mouse terrifies.

39. *F.*, 19. And so does their squeak, which often makes her shriek; every one knows it is her weak point.

40. *F.* A live mouse makes a cook weak and sick for the day, and a dead one "queers" her badly.

41. *F.*, 18. When four was given a toy rat; had never seen one before, but screamed, and has never overcome the fear.

42. *F.* Sometimes a sudden fear seizes an English teacher, when walking nights, that there might be a mouse just where she was going to put her foot; she used to pause with foot in air, but now sings to scare it.

43. *M.*, 54. A strong man fears a cat or a mouse worse than death, and will walk far out of his course to avoid a rat; his father was the same, and his brother.

44. *M.* A powerful butcher, if he cuts himself the least bit, faints dead away at the sight of blood.

45. *F.* A college girl has never been able even to think of hideous long-tailed rats without creepy feelings and moving restlessly about, but never had experiences with them.

46. *F.*, 15. Snakes have a wicked look, as if they would enjoy doing evil; they fill her with dread even when dead and pickled in museum cans.

47. *F.*, 16. Searches every article of furniture for snakes in her room every night; she keeps a long stick to feel for them between bed-clothes before getting in; must have the window closed in the second story lest they should creep in, but never had any special fright.

48. *M.*, 16. Feels in his bed nightly for snakes, imagines them winding over chairs, tables, etc.

49. *F.*, 23. Dreads to walk off a path in grass for fear of snakes; she peers around, walks very slowly, scanning each spot, and often jumping at a crooked stick or brown grass.

50. *F.*, 19. In childhood she and her sister had such terror of snakes they could not touch a book that had pictures of them in it.

51. *F.*, 15. Shudders at every rustling sound in the woods made by the wind in trees, thinking it a rattlesnake.

52. *M.*, 15. Has often declined an invitation to drink, and signed the pledge because of his great horror of snakes.

53. *F.*, 18. Locates her horror of snakes in their eyes, not in their motion or poison.

54. Children often think snakes can stand erect, roll like a hoop, breathe fire, sting with the tail, run up the body, crush, jump, etc.

55. *M.* "My boy's first experience with a snake, age 4, was having a small one coil about his foot; he was not hurt, but screamed with horror, and could never for a year after be left alone."

56. *F.*, 9. Has tried in vain for months to get used to a toy snake.

57. *F.*, 12. Often dreamed of snakes, and then would lie outside her bed, no matter how cold it was.

58. *F.* Adult, has horrid symptoms at everything that creeps or crawls, no matter how small.

59. *F.*, 20. Could never in any way get a caterpillar off her dress; she knows they are harmless, but she is petrified.

60. *F.*, 24. Has cold shudders at everything in the shape of a worm or grub, and almost faints to see people touch earth worms, caterpillars, etc.

61. *F.*, 18. Has always suffered the greatest horror lest worms should touch her.

62. *F.*, 17. Is dizzy, cramped and nauseated at green worms.

63. *F.* A college professor of botany cannot overcome her horror of worms; when botanizing, even a small one makes her grow rigid and scream.

64. *F.*, 19. As a girl she had peculiar horror of earth worms; would run till she dropped if anyone tried to put one on her, screamed and thought she would die if they touched her; now this has faded into a peculiar dislike.

65. *F.*, 27. Fears nothing so much as earth worms; it is in-

stinctive and she knows no cause; it often crops up at night, when she must press the clothes up around her neck lest they get down her back.

66. *M.*, 15. Dreads spiders most; feels creepy to touch their webs; fears they may drop on him at night, etc.

67. *F.*, 19. The greatest childish fear was that, like Miss Muffet, a spider, the image of which was dreadful, should sit by her.

68. *F.*, 20. Could never sweep down cobwebs for fear.

69. *F.*, 17. When she found they had stopped the blood-flow from her cut finger with a cobweb, her terror was extreme; she daily expected death.

70. *M.*, 3. Was stung by a bee, and for a month after would not eat cake with raisins, watermelons, etc.

71. *F.* A young college woman pretends to like to handle worms, bugs, etc., but no one can know how she loathes them all, and always shall.

72. *M.*, 14. Imagined rose bugs crawling on him, and repeatedly stripped and found none.

73. Scores of girls and women, and not a few boys, describe special and greatly exaggerated horrors of bugs, mosquitoes, bees, wasps, ants, vermin, roaches, and many other things that crawl or buzz.

74. *F.* One girl cannot control her nerves if flies often light on her, and devises elaborate means of keeping them off.

75. Two that chronically imagine them where they are not.

76. One is nervous at everything that hums and buzzes.

77. Often very superior intelligence is assigned to animals; they hear our language and have one of their own, hence the fear.

78. Two fears specialize on moths, one on blood-suckers, two on newts; one could not bear to see fish.

79. *M.*, 6. Refused water for two weeks because he had heard of animalculæ.

80. Many fear fur rugs, robes, garments, etc.

81. Nearly all children pass through a period of fear of dogs.

82. Four children have special fears of small birds, while crow, hawk, hen, goose, turkey, and especially owl, are often dreaded.

83. *M.*, 6. Two boys often got on their knees and growled like lions, to each other's great terror.

84. Often it is a peculiar look in the face of the cow, sheep, horse, dog, etc., that excites the fear.

85. The terror of very young children at the first sight of even small animals is often intense; in three cases this occurred with toads; in two with very young chickens; in one with a caged mouse; one with a goat; one with a turtle.

86. *F.*, 19. Feared animal pictures so that it destroyed her interest in geography.

87. *F.*, 19. The most terrible fear was that a sparrow might light near her.

88. *F.*, 17. Never can look on the parts of animals in the physiology class, and the thought of killing even a fly makes her shudder.

89. *F.*, 13. Cloud animals are the worst.

90. *F.*, 7. The greatest fear is for the noise of a whip-poor-will.

These samples from the 1,486 fears of animals in Table I, which altogether make our largest group, illustrate some of its chief features. Totemistic tendencies appear in 3, 11, 19, 20, etc.; fetichism in 25, 83, 86, 88; various superstitions in 22, 24, 29, 33, 36, 67, 81; remote associations in 7, 8, 12, 41, 46, 50, 51, 69, 70, 71, 79, 84; specialized fears in 3, 10, 21, 25, 62, 64, 65, 66, 67, 73, 78, 81, 85, 88; exaggeration of animals' size and power in 6, 9, 11, 18, 20, 54, 77. Certain animals may be fancied as very near and only half feared, 3, 15, 16; and about as real as some of the darkness cases, VIII, 31, 37, 38. The onset of the fear may be sudden and spontaneous, 41, 64, and may involve imaginary touch, 72, 75.

Fears of reptiles lead all others, and snakes, which have played such a part in early religions[1], and of which all known species of ape have such deadly fear, are first of all. Fear of mice, worms and insects is so strong, compared with fear of great and dangerous animals, as to suggest that, just as slight but certain penalties are better deterrents of crime than uncertain great ones, so our nerves have been more affected by common stings and bites of vermin and things that crawl and hum than by possible death from beasts of prey. The great sensory disturbance of minimal of tickle-touches is probably also a factor. The animal world is so much larger and more diverse than the human in features, forms and acts, while animal traits and expressions are so easily detected in men, and *vice versa*, that the child comes into a far larger world in knowing animals. Æsthetic, moral and physical qualities are isolated, magnified and better understood. Sympathies are enlarged, a background and a key are given to a knowledge of some of the basal traits of human nature. Yet frequent as are the shyings and novelties, and inveterate as are some of these old and rapidly decadent fears, the love and interest of all normal children in animals are far greater, and the pedagogic value of wide acquaintance with many forms of animal life, low and high, is invaluable. The vast diversity of the world of instinct, with its marvelous plasticity with which it fits and fills every possibility of life, by such a vast variety of habits, is more akin to childhood than to adults, and is one of the best possible schools for sympathy, and not a few of the more innate powers of the soul. Much that makes the latter good or great rests on and finds its explanation in animal instincts. The more I study the feeling of children for animals, the less I can agree with Sully, Compayrè and others

[1]See Fergusson, "Tree and Serpent Worship."

that the hypothesis of ancestral transmission is not needed here. More than many others, these fears seem like lapsed reflexes, fragments and relics of psychic states and acts which are now rarely seen in all their former vigor, and which neither the individual life of the child nor even present conditions can wholly explain. Very far from asserting that any of the fears of the cat, dog and cow class can be proven to be older than domestication, or that even the smallest root of the snake fears runs back to the tertiary age of reptiles, etc., it still seems wise to keep this larger solution, to which Darwin was so strongly attached, open, and to push on further and more detailed studies of this greatest but, perhaps, most rapidly vanishing of all our fear groups.

Meanwhile our data permit us to look a little more closely at a few of the many points suggested here in the following:

XIII.

Fear of Eyes.

Forty-seven cases, suggesting the term ommaphobia as convenient.

1. Nine girls fear big eyes.

2. *F.*, 6. Was long terrified at a silver pepper-pot in the shape of an owl, with its fiery-red eyes fixed on vacancy.

3. *F.*, 9. Feared the bureau where an uncle kept his glass eye.

4. *F.*, 8. Loves to frighten herself when alone before a mirror, with wide eyes fixed on those of her own image, till the cold shivers run up and down her back, and she has to hide her head to blot out her wild terror.

5. *F.*, 6. Could not hear or play "Red Riding Hood" unless they would promise that the wolf should not make big eyes.

6. *F.*, 17. Once at table glanced at a window, and thought she saw a Turk with very large eyes gazing steadily at her; was nearly convulsed, and has never got over it.

7. *F.*, 5. Saw some eyes in the garden that shone and seemed fiery, and up to 16 the words "shiny eyes" would quell her and make her shake.

8. *F.*, 21. Has for years been greatly troubled by the fear of seeing eyes looking in at windows, but can assign no cause.

9. *F.*, 19. As a child used to see big eyes and sometimes hideous faces staring at her just as she was going to sleep; the more she covered her head and tried not to see, the more dreadfully they peered at her; she can still have no one make big eyes at her.

10. Four dolls with lost or disfigured eyes became objects of fright.

11. *F.*, 17. Has from childhood the fear that any ill-looking old woman may look her in the eyes and bewitch her.

12. *F.*, 17. While hearing a ghost story, saw her father in the next room making big eyes at her through the glass door; she

turned white, became motionless, and long after was nervous and jerky at every little noise.

13. *F.*, 17. Knows a person whose eyes always give her a very creepy feeling, and whom she especially dreaded to meet after dark.

14. *F.*, 10. Has an almost uncontrollable fear of a colored woman who rolls her chalky eyes.

15. *F.*, 7. Suffered by spells day and night for fear of the eyes of a Bible picture of a bad angel.

16. *F.*, 10. Was long frightened at the eyes of a picture hung on the wall, which followed her to every corner till fright yielded to anger.

17. *F.*, 14. Is always a little afraid of people with prominent eyes.

18. Most children cannot bear to be watched, looked at or stared at.

19. An infant had long played with a dog, till one day he gazed into its eye and caught a panic, which made him shun it for weeks.

20. *M.*, 6. Saw the eyes of his cat shine in the cellar, and showed great fear.

21. The words, "big eyes," were for years, 4 to 7, sufficient to make an otherwise brave boy run to his mother, or scream in the dark.

22. One teacher thinks the eye the chief agent in school discipline.

23. One or more children each dread eyes that are unusually mobile, or that look at them very askance, or show much white.

24. More specify horror at rolled-up or corpse-like eyes.

25. Small eyes frighten some.

26. *F.*, 29. Is especially frightened by some people because she thinks a second face is looking through the eyes of a first person; at night she sometimes sees imaginary faces in the dark gazing at her with strangely-knowing eyes, and is "occasionally startled by a peculiar look in the eyes of a person I am addressing, as if there was another soul behind who knew me."

The eye, which is the most mobile of our features, can open and shut, is incessantly changing the aperture of its pupil, so that this is almost as sensitive a register of psychic change as the knee-jerk, bulges forward and sinks back with changing attention, corneal tension, so that it grows bright and dull, and with its color contrasts, etc., is naturally the first object of visual interest to the child. Froebel signalizes the infant's first gaze into its mother's eyes as an important stage of psychic growth. The eye is the first feature to appear in children's drawings.[1] Young children look the speaker in the eye and rarely in the mouth. Unlike other senses the eye's first interest is in another eye, and Dr. Drew[2] found in 356 students' love poems the charm of eyes was mentioned

[1] See Dr. Lukens, *Ped. Sem.*, IV, p. 79 *et seq.*
[2] *Ped Sem.*, Vol. II, p. 504.

ninety-one times, leading by far all other features. Eyes hypnotize; a staring test is really a battle of two wills, and in older children to gaze too steadfastly marks insensitiveness. So identical is commonly the focus of vision with that of attention that to be looked at makes children conscious and constrained, and they very early learn to know when they are looked at, often dread even God as a spy. The gaze anticipates action, and is seen, *e. g.*, in stalking. For every animal that is attacked or preyed upon, the critical moments of its life, and those that summon its greatest energy, are those between being seen by its enemy and the seizing, fight or flight that follow. Instinct first looks to the eye for signs of evil or good intent, and the latter have to be slowly learned, for the slightest novelty here was often the most pressing of danger signals. The big eyes that subdue naughty children, illustrate tales of big animals, goblins or witches, etc., must owe some of their terrors to ancestral reverberations from the long ages during which man struggled for existence with animals with big or strange eyes and teeth, and from the long war of all against all within his own species. Savages depict their deities with awful eyes, and the collections of their totem-posts, masks and rude drawings show that, perhaps, next to teeth, eyes have most power to conjure fear. I once made notes, many years ago, on a case of a young woman in the Baltimore City Hospital for the Insane, who suffered for months from the fixed delusion of a monster with dreadful green eyes in a glass sphere, and of another man with imperfect sight, who thought the sun a malignant cyclopean eye of a deity about to eat his human children as a punishment for their sins.

XIV.

Fear of Teeth: Odontophobia.

1. Four children cry with fear if they see false teeth move.
2. Seven showed signs of fear when they first saw people laugh.
3. Two would not go near a relative who had lost one or more teeth.
4. Others fear people who show teeth unusually broad, long, sharp or serrated.
5. Big, prominent or irregular teeth sometimes cause adults to be feared.
6. It would seem from several cases that the grin tends first to be feared, and that only later does pleasure come to be associated with it.
7. *F.*, 15. Always hated people whose eye teeth looked different from the others.
8. *F.*, 14. Could not bring herself to touch another's teeth.

9. *F.* Three girls under 4 would not kiss people because of peculiar teeth.

10. *F.*, 19. Is always a little anxious lest a friend should smile and spoil everything.

11. *F.*, 18. Cannot like those who show the back teeth when they smile.

12. To show and gnash or grind the teeth terrifies three small children.

13. *F.*, 3. Cannot learn biting games where hard teeth touch soft flesh; the rare pleasure often shown in such plays is sometimes not far from fear, and like so many other things owes its chief charm to the courage that reduces fear to a plaything.

14. *F.*, 17. Is still nervous to hear teeth grind or clash together.

15. *F.*, 19. Thinks people should be taught to smile agreeably and show their teeth rightly.

16. *F.*, 4. Is afraid to go near a drawer in which her mother's false teeth are kept.

17. *F.*, 5. Fears to enter a room where stands a small idol with horrid fangs.

18. *M.* A dying man in his delirium expressed terror of a half shut melodeon, calling the keys teeth; his daughter, who was present, reports a long uncanny feeling, not only for that melodeon, but all keyed instruments.

The entrance to the alimentary canal must have been the object of supreme fear wherever the law eat or be eaten has reigned. One primal element in the charm of the kiss may have been the mutual pledge and faith that in the place of supreme fear love reigns. The repellant element may originally have been stronger than the attraction. The charm of mouth as well as teeth, now so great for amorists, must have been secondary, and interest in all their movements, positions and shapes may have arisen out of the slow conquering of this archaic dread.

XV.

Fear of Fur: Doraphobia.

Of this I have 111 well developed cases, 11 of which are one year old or under, 15 of which are between one and two, 19 between two and three, 7 between three and four, 10 between four and five, 7 between five and six, and the rest later or with age not given. The following abridged cases illustrate these returns:

1. *M.*, 6 mos. First touched a fur muff, screamed and cried so hard we almost feared he could not get his breath; his fear was overcome by patience when he was 3.

2. *M.*, 7 mos. Threw up his arms and screamed loudly with fright when his sister playfully shook a muff at him; months later he was induced to touch it, but this revived his old fear.

3. *F.*, 8 mos. Seeing a boa, put up her hands and cried; it looked a little like a gray cat she feared.

4. *M.*, 8 mos. Had what seemed to be an instinctive fear of neck scarf seen for the first time; no association with animals known.

5. *M.*, 11 mos. Shrank and cried at the approach of an old friend with a fur trimmed coat; when this was removed fear vanished.

6. *F.*, 1. Was run over by a big dog, and feared every kind of fur long afterward; in 5 cases this association with a fright from dogs, cats or other animals is the obvious source of the fear.

7. *M.*, 1. Cannot touch a sheepskin rug without horror, but lies on it all right unless his hands feel it.

8. *F.*, 16 mos. Showed instant terror on touching the curly hair of a new doll, but was very fond of bald-headed ones; she could never wear a fur cap or trimmings.

9. Six children expressly associate biting with the touch of fur.

10. Three obviously fear the blackness of fur, like seal; but—

11. There are two good cases of early dread of white furs.

12. *M.*, 2. Was always "deathly afraid of the least little bit of fur;" he never would go near his mother when she wore a feathery white Angora bonnet.

13. Three cases report fur apparel as abandoned for children on account of their great fear of it.

14. One writes if the cat is thought scratchy, or the child has had unpleasant experiences with animals, they fear fur.

15. Eleven cases express the opinion that this fear was instinctive.

16. Three saw it in young children who had never seen even a dog or cat.

17. *F.*, 2. The fear is not looking at fur, but if she touches anything fuzzy or woolly, she shrieks with terror.

18. *F.*, 3. Caught horror of all furs from visiting a menagerie.

19. *F.*, 13. Always shuddered at everything furry.

20. *F.* A single hair upon her dress still gives her a strong creepy feeling.

21. *F.*, 4. Fears only black furs. And another fears only white and gray.

22. *F.*, 4. Fears only mottled fur.

23. Two report love of looking at fur, but dread of touching it.

24. *F.*, 14. Long had a special horror of seeing fur parted or blown so as to show the skin beneath.

25. *F.*, 5. Dreads only coarse or long fur.

26. *F.*, 14. Reports early dread of buffalo robes, of touching cows or horses, because they had hair like bears, which she did not outgrow until 12.

27. *F.*, 16. Only outgrew this fear when presented with a fur jacket.

28. *M.*, 4. Shows his horror of touching fur by putting both hands behind him and spitting vigorously.

29. *F.*, 5. Cannot be induced to touch cotton or have it near her, even calling it "kitty."

30. *F.*, 8. Associated fur and musk in her fear.

31. *M.*, 8. Was cured of this fear by seeing a cow killed and skinned.

32. *F.*, 17. Still has, and always did, a violent dislike of having fur touch her skin; it produces a strong feeling she can only describe as "queer."

33. No insects excite it, even in crawling, except fuzzy caterpillars.

34. Several report more or less strong dislike of sleeping between blankets.

35. *F.*, 14. Has a horror of wool, and will not wear it in inner or outer garments.

36. *F.*, 15. I can never bear to touch velvet, peaches, or anything fuzzy; sometimes they suggest dirt and disease.

37. *F.*, 16. Dreads to touch peaches, although very fond of them, until another has pared them.

38. *F.* A woman cannot wear mittens; when a child a nice pair of white ones were made for her, but at the point a hair was knit in with the yarn; this sickened her so that no pair has gone on her hands since.

Sometimes this fear seems to be aroused chiefly or only by touch, 1, 7, 8, 23, 26, 32, 33, and to be irradiated to blankets, feathers, velvet, etc., 29, 34, 35, 36, 37, or even to a single hair, 20, 38. This involves the strange tickle sense and suggests it as a cause. There is a novelty about the touch of fur, but whether this and such associations as 9 explain all or not, we do not know. In 2, 5, and also in 12, 28, 29, sight alone seems concerned. Some love to look at, but cannot touch it, 17, 23. Painful experience is the chief factor in many cases, 3, 6, 14, 18, but denied in more, 4, 15, 16. It may be associated with biting, 9; color, 10, 11; musk, 30; dirt, 36; be specialized to fear of only black, 21, or mottled fur, 22; to parts showing the skin beneath, 24, or to coarse fur, 25, 26. Perhaps it is really the far more common love of fur that most needs explanation, but both this love and fear are so strong and instinctive that they can hardly be fully accounted for without recourse to a time when association with animals was far closer than now, or perhaps when our remote ancestors were hairy.

XVI.

Fear of Feathers.

1. *M.*, 2. Is reported as always afraid of feathers, especially lest they should get on him; a bit of down one day came out of the quilt and floated off, while he was stiff with fear.

2. *F.*, 2. Screamed with fear; this was noticed several times.

3. *M.*, 3. Would never go near any kind of feather, and his fear was made worse by often being teased with one.

4. *F.*, 18. Dreaded feathers up to 5; as one blew past her in the

hall she screamed, ran, fell, and only very slowly learned that they were harmless and not alive.

5. *F.*, 4. A feather in the cupboard is sure to keep her out of mischief in it, where she is very fond of going.

6. *M.*, 15. "My very first fear of feathers was at 3, especially soft, fuzzy, gray ones.

7. "The nurse would keep me in a room by putting a feather in the keyhole; if I wanted to come in, and a feather was on the door, I would just stand and yell."

8. *F.*, 2. Saw a feather come out of a pillow, and had such a paroxysm of fear that at last all pillows had to be removed from her bed for some time.

9. *F.*, 24. Knows a poor mite of a girl who turns pale at sight of feathers in a ladies' hat.

10. A teacher could never touch cotton or feathers, or go near a closet where they were kept.

11. *F.* If she passed through a room containing either, she hastened and did not look that way.

12. *F.* Another girl has a horror if the least piece of thread or fuzz gets on her dress; holds her hands far away and screams until it is removed.

13. *F.* An English woman writes: "When 1 or 2 I had great horror of feathers of any kind, if loose, but not when growing on birds; I once sat on the floor rigid because a bit of eider-down from a quilt moved towards me."

14. *F.*, 4. Was greatly terrified by a leaf floating in the bath tub.

15. *F.*, 3. Has great awe of the feather duster.

16. *M.*, 18 mos. A mother writes: "If I have a feather my boy will do anything I want."

17. Another lays a feather on anything she does not wish her child to touch.

Most, if not all these cases, seem sufficiently explained by what the child thinks to be the power of self-motion, association with insects, tickling, etc. Self-motion is the most distincive feature of animal life, and Darwin, Brooks and others have described the fright of dogs at things moved by a very light breeze or invisible string.

XVII.

Special Fears of Persons.

1. *F.*, 16. Never can see strangers without flushing and stammering.

2. *F.*, 44. Has never quite recovered from the painful bashfulness of childhood.

3. *F.*, 46. Can never step up and meet strangers cordially; this is worse with the opposite sex, as less sympathetic and more critical; can almost never look people in the eye; dreads a stare instead of a smile.

4. *F.* The great dread of an English girl was being taken from the nursery into the drawing room among the grown-ups.

5. *F.*, 7. Laughs and cries hysterically by turns if a person, or even an animal, fixes his eyes upon her.

6. *M.*, 14. Would go around through the fields half a mile to avoid meeting a man.

7. *F.*, 30. English, always had fear of grave, solemn people, but most intensely so of those with positive, decided or sharp manners.

8. *F.*, 23. Felt tiny, insignificant and terrified before her older cousins; was often so restrained and oppressed that she would break out with some hideously gawky or desperate act or speech, or even a lie to assert herself.

9. *M.*, 17. "Never dared go anywhere or do anything for fear of being laughed at; would even say white was black."

10. *M.*, 10. Played with girls, and never with boys, for fear he should see them fight.

11. *F.*, 19. From 8 to 12 had a dreadful fear of girls from 15 to 16, because they had such superior ways and looked down on little girls.

12. *F.* Some little girls fear all boys, either because they may not be kind to them, or will talk about them, or do not care for what they do.

13. *M.*, 14. Is so shy that he does not speak to a girl lest he should make a fool of himself, or they should laugh; it makes him think too much beforehand what he is about, and what he will do and say.

14. *M.*, 18. Always had great dread of his father, disliked his presence; could not be free, and was made nervous and stupid.

15. *F.*, 31. Is frantic if blamed; her father's displeasure and standards for her always took the place of conscience, and her impulse still is to do what will not displease others rather than to do right.

16. *F.*, 52. Could never be at ease with those of whose kindly disposition she was not well assured, and would still sacrifice almost my good or gain rather than be blamed.

17. *F.*, 27. Once found her love of a teacher changing without cause to fear; her hands would grow cold or wet, and her eyes twitch and turn away if they tried to meet the teacher's; sleep was broken, and she had to leave school a year; she thought the fear to be nervous self-consciousness.

18. *F.* At 7 or 8 a cultivated lady used to think several old women witches and their eyes dangerous.

19. *M.*, 6. The chief fear was that older boys would make their hands like claws and claw at him.

20. *F.*, 42. When 12 or 14 used often to have a sudden sense that there was some one in the room; she would turn quickly around; often thought she saw a shadow vanishing, and felt sure she was not alone.

21. *M.*, 12. If the door knob did not turn felt sure some dreadful person was holding it without.

Beginning with animals, 19, children's fears of persons are often at first chiefly directed to black, lame, ugly, or espe-

cially deformed people, to gypsies, rag men, Chinamen, policemen, coal men, tramps, tinkers, doctors, teachers, peddlers, and often extend to almost all strangers. They dread people with decided, 7, or superior, 8, manners; those who dominate and dwarf them, 15, 16; are often suspicious of the other sex, 11, 12, 13; develop horror of blame, 16, or ridicule, 9, and perhaps shrink from everybody of whose good will they are not well assured, 16.

If there ever was a time when, as a rule, all strangers were dangerous, it was an age of war of all against all, such as Hobbes postulates, or of a severe struggle for existence among men. Many still live by the principle of treating even friends as if they might become enemies. In the country, with sparse population, awe of strangers, so obliterated in the impudent city gamin, is still seen and in all degrees and forms. With this group of fears more than with any others, I think, we must connect the phenomena of blushing. From returns to another syllabus, to be reported on later, it appears that no part of the body is exempt from blushing. The blush storm may be immediate or long delayed, may start in sharply defined points and spread, often passes from the epigastrium or even the feet upward, like an aura, may alternate with pallor, be so intense as to cause a rash afterward, and, in rare cases, it may amount almost to vesication; be so inordinate as to make even men recluses and compel them to change their vocations. The heart beats violently, there may be constriction in the chest and even globus. The mind is confused, there is a sense of helplessness, weakness, tremors, perspiration, the eyes blink, look down or sideways, and, in some cases, tears are shed; there is tinnitus, twitching, awkward movements, the breath stops, and sometimes the face is covered and the blusher turns away in flight.[1] Now, most of these symptoms are those of fear. In some languages the word for blushing and shame is the same, as in the Swedish *blygsel*, and Oken, long ago called shame, "a partial fear."[2] Nearly if not quite all our reactions to an intense blush are the same as those that follow a fright.

The most blushes reported are directly or indirectly related to sex. Women blush far more and far later in life than men, and most of all in adolescent years, and chiefly at the mention, in the presence or at the advances of the other sex. That

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[1] See "Morbid Blushing: its Pathology and Treatment," by H. Campbell, M. D., in *Wood's Med. and Surg. Monographs*, 1890. Also, Camille Melinard in the *Chautauquan*, 1893.

[2] "*Naturgeschichte*," IV, S. 205.

this diathesis originated in part from an ancestral sex fear is entirely consistent with the fact that such blushes may be also now often attended with pleasure. Shyness, coyness, maidenly modesty, owe their charm to the female reluctance born of fear. Even if these blushes are a widely irradiated or penumbral glow of sexual erethism, it is the inhibition of fear that must have been the chief agent in checking and irradiating or discentralized them far from acts or organs, and these fears of observation, of consequences, of betrayal of inclination, operate on both sexes, and may extend even to thoughts that cause blushing in solitude. Even the blush at compliment may have been because once the sense of being admired was associated with greater danger. Other causes of blushing most often mentioned in our returns are: being looked at, laughed at, accused, suspected, native bashfulness, awkwardness, breach of etiquette, being talked of, criticised, and even the fear of blushing. Self-consciousness of body or mind arises, and people become so sensitive to the opinions of others that they cannot be natural in the presence of those of whose sympathy and good opinion they are not well assured. They must be among friends, whose very thoughts they do not fear, or the vaso-motor system still reverberates with the echo of old dreads of alien faces long after the voluntary muscles or their cerebral centres need not be flushed for flight or fight. That this is in accordance with the law of the stages of forgetting, I shall try to show later. The blush of surprise and shock has a very different origin, and that of pleasure is to be explained in a still more different way. We attempt here no theory of blushing generally, but only of one element of the problem. Whatever may be thought of our plea for paleopsychic elements in explaining other groups of fears, we surely have here phenomena which no one would think adequately accounted for by individual experience. That there are instinctive fears as well as instinctive attractions for strangers, few will doubt.

XVIII.

Fear of Solitude.

1. *F.*, 22. Up to 16 could never be left alone, and never was. I was not usually afraid, but had a lonely feeling that was simply dreadful.

2. *F.*, 17. From about 8 to 12 had a horror of even momentary solitude; *e. g.*, in picking berries, if for an instant she lost sight of her mates, she would scream and sometimes lose consciousness.

3. *F.*, 21. Has always loved to wander off into lonely places in

the country, yet sometimes a creepy feeling of solitude springs upon her and she is almost paralyzed with dread.

4. *F.*, 23. All through her school days had a nameless dread of being left alone in the house, as she often was; everything within seemed gloomy and awful. Every few minutes she would go out and look every way to see if someone was not coming. Every effort at diversion was vain. The clock ticked so loud that she could feel the silence, which almost stunned her. "It felt as if everybody was dead. I would sing and do the most unusual things, watch the clock, the approach of night, dread every preposterous accident, seek companionship with the animals in the barn, and even with the flowers in the garden."

5. *F.*, 17. Long suffered from panics that all her friends and relatives would desert her.

6. *M.*, 16. Got a panic at the age of 7 that his parents were planning to run away from him; this haunted him for four weeks; he would wake up nights thinking they had gone, etc.

7. *F.*, 7. Often used to wake up dreaming that she was alone in the house; she would scream, but never told till in answer to this syllabus.

8. *F.*, 20. Instead of being filled with the terror of solitary places, which clouded all her childhood, has now come to find a peculiar and indescribable charm in forest gloom, gorges and every kind of solitary place.

9. *F.* An English woman, after being for sometime absorbed in reading, often suddenly awakens to a sense that she is alone, and perhaps night coming on, although the house is full of people. "At such moments a feeling of unseen beings crowding around would overcome me. I would often stand in the middle of the room unable to move till, with a great effort, I could just reach the door and fly, not daring to look behind."

Sometimes the sense of being alone seems to spring more or less suddenly upon the mind as if it awoke spontaneously to it, as in 3 and 9; a little solitude may be intolerable, 2 and 4; friends may desert us, 5; mates run away from us, 6; dreamed solitude brings a panic, 7; companionship with flowers and animals is consoling to four in a way that suggests the palpitating interest of the imprisoned Picciola in a plant, the juice of which saved his life, and Silvio Pellico's love of the ants, flies and spiders in his cell. Gregarious as man is, every individuality grows solitary in proportion as it becomes defined, and great and new thoughts, as Zimmermann and Alger have so well shown, make men feel apart. The desert and its penance of solitude has always been the bulwark of great souls nursing great thoughts, but weaker souls, Trappists, Caspar Hausers, etc., it stultifies. Children during their long infancy have been most of all animals dependent on others, and in their horror of being alone we see, often in arrested and hypertrophied form, the fear that has much to do in making the fashions, parties, and sects of the most imitative of all creatures.

XIX.

Fear of Death.

1. *F.*, 25. Up to 14 could never think of death without tears. It would often come over me with tremendous force what an awful thing death is; it cannot, must not be, that we must all die and give up this beautiful life, and I would cry and cry.

2. *M.*, 6. Used to cry hopelessly and with absolute and wild abandon because he must die. It was far worse nights.

3. *M.*, 15. Deems death so unspeakably terrible that he cannot speak or think of it with steady voice.

4. *M.*, 46. A clergyman has been haunted and hampered all his life with the thought of death; his only consolation is the hope that he may live to Christ's second coming and not taste death.

5. *M.*, 9. Dreads death because "you can't see, hear, think, or have anything to eat."

6. *F.*, 7. Had such morbid terror of death from her "Now I lay me" that each night she asked all to forgive all her chance sins, and suffered terrors of hell and judgment day.

7. *F.*, 7. I saw two sweet girls watching a man on a high roof. One said: "Oh, I wish he would fall right down backwards and kill himself;" "And they pick him up all bloody," giggled the other; "His bones all broke," said the first; "And put him in a black box in the ground," said the second; "And all his children cry," said No. 1; "And starve to death," added the other. They were getting more excited, awed, and spoke lower as they passed out of my hearing.

8. *F.*, 8. At once showed great fear of her sick sister when told she might die.

9. *F.*, 17. The horror of a room where any one has died is intolerable.

10. *M.*, 6. Can go into a room where a corpse is and even touch it, "because it is not so dead as when buried."

11. *M.*, 10. Kissed his mother's corpse without reluctance, but jumped back when his lips felt it cold, and first then had horror of corpses that lasted years.

12. *F.*, 19. Dreads death almost hysterically, but only in revivals.

13. *F.*, 34. Has always felt death to be better than all, and the sight of death does not weaken the pleasure of anticipating it as the best thing life has to offer; this sense that it is a triumph is not born of theology or distaste for life, for health, surroundings, joy of life have always been the best; there is no thought of anything after life, but death itself she feels a consummation devoutly to be wished.

14. *M.*, 30. Has twice been at the point of death, but was perfectly reconciled and had no fear.

15. *M.*, 25. Struggled against drowning, but sank satisfied and curious to learn the new experience of death; after rescue the fear was intense.

16. *F.*, 7. Her mother was chopping meat and fell in a faint; she sprang to chopping, saying: "Now she is dead, and I must chop meat."

17. *M.* From 18 to 25 was constantly saying to himself, "Let's see if I can stand the thought of death now." Its horror to him is in its unreasonableness; it was a melancholy and not a terror.

18. *F.*, 45. Dreads death most in winter, and always prays to live till spring; fall is bad enough, but to be buried in snow is an intolerable thought.

19. *M.*, 28. Dwells much on death, which he associates with eternity of time and space; to live on and on is a thought absolutely not to be endured; to think of infinite time (he is a student of philosophy) makes a lump rise in his throat.

20. *F.*, 6. Ponders death, and gets so excited and afraid that all allusions to the subject in family prayers, reading, etc., must be avoided.

21. *F.*, 28. When 9 overheard the doctor tell her mother she could not live to grow up; she said nothing, but grew serious, dwelt on it, applied all details to her own case; first thought 10 would be "grown up," then 12, 14, 18, etc., and is now well, but sadder than she should be.

22. *F.*, 23. Has a chronic fear that her father is to die; although he is well, she fancies all the details and suffers over and over as much as if it were real.

23. *F.*, 18. Has spells of fearing her mother will die; it gets worse and worse, and in a few days breaks like an ulcer and vanishes.

24. *F.* From 6 to 9 had a fear that people were to die one by one and that she would be left alone on the earth, and then the end of the world would come when all the rest were gone.

25. *F.*, 25. The thought of her own or her friends' death often comes suddenly and persists tenaciously; she sat, *e. g.*, at the age of 13, in church near her sister, when the thought came that she had not moved and was dead; she could not look for fear it was true and grew rigid, when a motion relieved her fear, profuse perspiration followed; this period of clouds and dark ages was ended by putting her trust in God.

26. *F.*, 12. Grew so afraid to pass a graveyard on the way to school that she grew sleepless, lost flesh and became literally afraid of her shadow, and was cured slowly by memorizing Longfellow's "God's Acre."

27. *M.*, 45. A college professor cannot pass a country graveyard familiar in his boyhood at night without the old panic; he has often tried to force himself to go through it, but desisted because "it would use up too much energy more useful in other ways."

28. *F.*, 18. When she became convinced that the person ended when put in the grave and there was no future life, her fears of death, which had been morbid, ceased.

29. *F.*, 21. Her mother used to sing, "When this poor lingering, faltering tongue lies silent in the grave"; this gave her a vivid image of her mother in a coffin and a horror of death unfelt before.

30. *M.* A young man could not board in the house with a young lady because she worked in an undertaker's factory.

31. *F.*, 2. Saw her mother in her coffin, and this caused life-long horror of all black boxes and even boats, although she retained no memory of her mother alive.

32. *M.*, 10. Decided to go to hell when he died; rubbed brimstone on him to get use to it, etc.

33. *F.*, 18. Feared death because she felt sure she should tire of heaven and visit the other place for change and excitement and find it more painful than she could bear.

Dread of death is apt to focus, now on fear of crape, on touching it, on a black dress, now on hollow eye-sockets, grinning teeth, or matted hair, or again on the creepy feeling of worms, being buried alive and being nailed in, shouting underground for aid, cremation, dread of dying away from home, sudden or slow death, coffin, shroud, etc. The young are apt to fear death for themselves, the old for others. Only eleven reported specific fears of hell. In nine cases religion has removed fear of death, but in far more of our returns it has caused or increased it.

Out of our 299 cases of fear of death, the above are typical, but the reader is commended to a fuller treatment of children's feelings about death by Dr. C. A. Scott,[1] who has had access to these data. Compared with its magnitude this subject is as yet almost unknown. Most young children seem at first to have no instinctive feeling about death, as in 16, which is typical of a large class. The inherited dread of it may be evoked suddenly and almost reflexly by touch, as in 11; may long remain very inadequate, 7, 10, or break out with the greatest intensity, perhaps periodically, 1, 2, 3, 12, 17, 18, 20, 21, 25; burial is often far worse than death, and the fear may extend to the room, 9; very sick people, 8; the employee of an undertaker, 30; graveyards, 26, 27; a black box or boat, 31. It is often chiefly feared for others, 22, 23, 24, 25. It may dismalize life from the most unexpected causes, 6, 21, 29, and be intensified by thoughts of eternity, 19. Sometimes these fears are defied, 32. Cowardice may be cured, 26, or reduced by belief in annihilation, 28, or welcomed as a mere physical consummation, 13. Heaven itself may be dreaded, 19, 33.

The horror of death seems most intense in the years just preceding the great altruistic tide of adolescence, which brings mildly melancholy, Thanatopsis' moods of euthanasia, the reaction of which against the predominant selfishness of earlier years may settle into some such form, as 13. I know two academic instructors who take pleasure in following out in thought scientifically the processes of decomposition. One, like Richard Jeffreys, wishes his ashes strewn on many winds and streams, so as to touch nature as widely as possible, and the other watches the flames of a cremation furnace as a kind

[1] American Journal of Psychology, Vol. VIII, 67.

of transfiguration scene or apotheosis. The interest of one in the fates of the physical elements of his own body is great, and, he says, so satisfying and consoling, that anything good which the future may have in store for his soul will be a welcome but not needed surplusage. Perhaps this is seen in 28, which is hardly dread of eternity like 19, or of monotony like 33, and ought not to be psychologically surprising in view of the consolation Buddhists find in the thought of extinction. The development of the doctrine of immortality, and its utilization as a moral motive, vast and preponderating as is the service it has rendered, has also brought a body of terrors, which work havoc with many nervous systems, not tonic enough to react properly to them. How rightly to administer this fear, which has always been one of the chief problems of religion, seems to be looming up again to pedagogy. For practical as well as scientific reasons, further studies are urgently needed here to give eschatological problems a firmer and more natural foundation.

XX.

Fear of Diseases.

Children, as is well known, fear all prevalent diseases, and often have long spells of imagining, now one, now another group of symptoms.

1. *F.*, 18. Can discover symptoms of every disease she hears of, and have symptomatic pains anywhere; the word symptoms has a dreadful sound for her, and cancer makes her shiver.

2. *F.*, 20. Strong and normal, has vividly imagined that she had every disease she read of, cancer, pneumonia, consumption and diphtheria being the favorites, with which her imagination became very intimate.

3. *F.*, 18. If she has a pimple or scratch, she thinks it a cancer, feels sick, and sometimes kneels and prays.

4. *F.*, 8. Heard tomatoes caused cancer, and although very fond of them ate none for about two years; later, fearing consumption, and hearing that fatty things cured it, ate fat meat, well oiled lettuce and other loathed things till she was sick.

5. *F.*, 10. Would eat no butter for fear of pimples.

6. *M.*, 15. For years feared his heart would stop beating; was always counting his pulse, fearing it was getting low; starting up at night thinking the end was at hand; avoiding violent exercise, etc.

7. *F.*, 10. For years would eat no candy nor frostings nor sweets; never told why, but now writes it was from fear of kidney disease.

8. *F.*, 15. From a quack circular on skin disease imagined all its symptoms; was miserable, tried dangerous cures, etc.

9. *F.*, 18. Had read of lock-jaw, and thought her jaw getting

stiff if she talked less or had sore throat; when she was nearly dead with diphtheria, she was greatly relieved to be told it was not lock-jaw.

10. *M.*, 22. Life has been colored by fear of trance.

11. *F.*, 18. Fear of fits has done the same.

12. *F.*, 19. Has frantic horror of dirt because it may bring contagious disease.

13. *F.*, 14. Would hold a handkerchief to her nose, run past a house where anyone was sick; never touch a letter containing news of a death, study the direction of the wind, etc., fearing to catch disease.

14. *F.*, 6. Long feared she would burst like Judas Iscariot, and she could see the blood coming out.

15. *F.* A kindergartner hopes heaven will reward her for fighting her uncontrollable aversion for dirty garments and dirty-faced children.

16. *F.*, 12. Who had read of leprosy, thought it appeared in a red spot on her arm; wondered how long before people would find it out, or it would turn white, or the flesh drop off.

17. *F.*, 15. Long fancied she was bleeding at the lungs; would wake up nights tasting blood; formed a bad spitting habit.

18. *F.*, 11. Saw a case of St. Vitus' dance, and was terrified almost into having it.

19. *M.*, 10. Had a too vigorous lecture on catching cold, so that he would not coast nor run lest he should get sweaty; dreaded cold, stayed in, hurt his health.

20. *M.*, 7. Has heard of wounds, and thinks the least bruise or scratch will kill him; is getting too careful of himself.

21. *M.*, 28. An accomplished graduate student of philosophy and a father writes in substance: "The one greatest fear of all my boyhood was connected with my sexual organs; the big boys would expose us little ones, and said mine was too small; I began to brood over this, age 8; felt disgraced, and haunted with forebodings; one day there seemed a very slight inflammation, age 12; I thought I had done a nameless sin, and prayed God to let me get well, which I soon did, but a morbid association between it and a hen's neck long persisted; I read literature on lost manhood, self-abuse, etc.; fancied I had all the diseases, and had committed the unpardonable sin; the first spontaneous emission nearly paralyzed me, but although I found myself still alive, felt that my days were numbered; I corresponded with a quack, and later began to study my urine with great alarm, and found plenty of marks of disease; there were reddish and whitish settlings, lack of color and over color, strong smell and no smell, it was too clear, too thick, too copious, too scanty, or, worst of all, had an iridescent scum; when 14 I gradually settled to the fact that I was sexually abnormal, might possibly live seven years, till 21, and then find what I had heard was a sure cure in marriage; I found encouragement from quack advertisements, which said the wretched beings sometimes held out for years; I lived on, and people said I was in robust health, but it was years before I realized that I was perfectly normal; Bible passages greatly aggravated my fears, such as one in Deut. xxiii, and others; as I look back my entire youth from 6 to 18 was made miserable from lack of knowledge that anyone who knew anything of the nature of puberty might have given; this long sense of defect, dread of operations, shame and worry has left an indelible mark.

These fears sampled from 241 cases show how baseless fears, especially if untold, may modify diet, regimen and health, 4, 5, 6, 7, 19; different diseases are focused on, 2, 6, 8, 9, 10, 12, 16, 18. Case 21 is from a large class which often have painful and unprintable details. Altogether this group brings home to us what is coming to be apparent from several other sources, that all the departments of personal morality can in no way be so effectively taught as from the standpoint of the new hygiene as the science of wholeness or holiness, to which these studies are now broadening. Unlike death there can be no question about the propriety of utilizing to the uttermost these fears if they are wisely shaped to meet the requirements of the new ethics, which I believe is at the door. While some of the old fear groups, like those of animals, are generally declining, dread of death and disease seems on the increase. Animals and even savages are not haunted by these far future fears as we are. The suddenness with which these fears may spring up to overmastering power shows a deep hereditary root copiously watered by superstition. But life was never so rich and joyous as now, and so, by contrast, death never so black. I have personally witnessed a painful and certain death in the midst of health faced with a courage, which, it is no detraction from the praise of it to suggest, must in part have been made possible by heredity from a time of ancient relative indifference to death, before men learned to worry about it and a future state. Before modern medicine and surgery, and nursing too, the association of wounds and disease with death was closer, and forms of illness have increased so that the ratio of illness and invalidism to each death has also increased, and with it dread, and also appreciation of the blessings of health.

That psychic states condition and control health more and more as civilization advances; that attention to any part or function of the body modifies its metabolism so that somatic introspection is fraught with danger of hypochondria; that heart, liver and uro-genital consciousness, etc., illustrate the principle that the weaker an organ is the more it comes to the front, and the healthier it is the less conscious we are of it, and that the imitative instinct is nowhere more richly illustrated than in the field of morbid symptoms,—all are now practically agreed. While utterly rejecting most of the theories and the preposterous claims of Christian science, mind and faith cures, it seems safe to assume that the mind may cure all the diseases it makes. This is no more than Kant held in his essay on "The Might of the Gemüth." If fear of apparitions, noises, or even touches, favors illusions of the senses involved, how much more must fear of the more

subjective sensations symptomatic of disease favor belief in their presence. In states of full euphoria, when we feel the joy of just being alive to transcend the pleasure of every sense, or the gratification of every special desire or ambition; when we best realize the old epigram of Martial that life is not to live, but to be well; when even knowledge, power, sex and fame grow pale beside the feeling of full and abounding life;—this is wholeness, holiness, health, and death and disease never seem so far or so black by contrast. Fear of these, however, which is perhaps the chief fear of adult life, presses upon souls almost in exact proportion to their feebleness. To be weak is to be fearful. Not only were disease and death never before so feared as now, but the imagination, which has created many horrors in the past that the world cannot soon forget, was never more actively creative of spectres of the mind than in this new field, where it checks the free, outdoor hardihood of children and youth, and hedges us about with precautions and things we cannot be, eat, do, attempt, till life is sometimes but a mean and craven fragment of what it might and should be. Many real cures ascribed to the mind, faith, etc., I think we must thus really ascribe to the natural physical regeneration that comes from breaking the insidious pareses of fear.

A class of cases in this group of fears has a peculiar interest as being at the opposite extreme from those of shock in that they supervene so gradually as not to be recognized in the full light of consciousness as existing at all. Over against the traumatic fears, these must be considered as slow, chronic and constitutional. Even if there is a malingering element at first, it is evanescent. The approach has been so gradual and all the processes of restriction of the life-sphere so instinctive and unreflective that the real origin of the fear diseases is unsuspected. As in some geologic processes now active we can study how older formations must have grown, so from these contemporary phenomena we may infer the mode in which some of the more archaic fear-neuroses and psychoses slowly became fastened upon the race. More than any other class, perhaps, such fears are the stigmata of degeneration, and for this reason again, as well as for their cryptogamous nature, harder to cure. But the decadence that begins at the obscure middle level, while less easily exorcisable than fears of the highest level of full consciousness, is of course far more so than those that are of purely somatic origin. What to the ordinary consciousness may well seem a miracle of faith is quite within the domain of psychologic laws now well understood.

XXI.

Moral and Religious Fears.

1. *M.*, 14. The greatest fears are conscience fears; he believes heaven rewards and punishes our deeds on the spot.

2. *F.*, 14. Used to have dreadful fears of conscience, but has now learned better.

3. *M.*, 10. Put to test his teacher's statement that if he played on Sunday he would get hurt; in doing so he injured his knee, and for ten years kept Sunday.

4. *F.*, 12. Whenever she fears anything, like breaking her doll, she prays about it, and all goes well.

5. *F.*, 12. If she did anything wrong she was sure to meet a policeman, and so became good.

6. *M.*, 9. The dread which he has of the policeman is a good and true index of his conscience.

7. *F.*, 12. If she has done anything wrong she fears the moon will fall on her.

8. *F.*, 13. If she has been naughty she fears a brick will fall on her, or that she will cut herself, or fall from a bridge; this she did not connect with any divine being, but thought the world was made that way.

9. *M.*, 9. Read of the earthquake, and was told it came to punish him; he afterwards put away all his toys over Sunday.

10. *F.*, 16. Is sure to miss every lesson she studies on Sunday.

11. *F.*, 6. Thought every one must cross a chasm over a fire by walking a hair, and kept good so she could get across.

12. *F.*, 45. An English lady was robbed of the joy of childhood by religious fears; finding God did not answer prayer she tried the devil and found him kinder; then had a terror of the unpardonable sin; images of the great white throne, sheep and goats, one taken and the other left, memories of Donati's malignant comet of 1858, imminent dread of the crash of collision, boom of the judgment trump, etc.; after years she slowly developed the thought that she might find some obscure niche where God would overlook her, and when tired of being all alone might find a boy who had also escaped, and they would be forever rich and happy on the abandoned food and goods.

13. *F.*, 19. When in church or company often feels she will say some terribly wicked thing.

14. *F.*, 18. Has a horror that never leaves her lest she should commit some awful sin; this comes out whenever she hears or reads anything particularly horrible.

15. *F.*, 45. Is often seized by the fear that her senses may suddenly leave her, she may hit some one and say or do something terrible; these fears are spasmodic.

16. *F.*, 8. Was so impressed by hearing a minister say that all were like a woman clinging to a cross-shaped rock amidst angry waves in a picture he showed that she got great horror of water, and felt destined to die by drowning.

17. *F.*, 21. Teacher, when 14, found her conscience so troublesome that she finally resolved to kill herself, took a carving knife, slowly made a big hole in her dress, when her courage failed, and

she decided that bad as she was, the world would have to bear with her a while longer.

18. *F.*, 11. Went to camp meeting, joined the church, later thought herself a hypocrite, grew nervous, thin, sleepless, confessed everything she had even thought, imagined the end of all things, and long pondered whether she ought to go with the sheep or goats; finally she dreamed the end came, and the sky was written over with maps and names; she stepped aside into a corner between the good and bad, and was unnoticed; these fears colored her temper and made her selfish.

Little children often think the world is so made that their bad deeds are punished on the spot, 1; by getting hurt, 3; meeting a policeman, 5, 6; having the moon, 7, or a brick, 8, fall on them, or that an earthquake will come, 9, etc. They often test this and find it false, 2, or true, 3, 10. The dread, often spasmodic, of breaking out with bad acts or words, 13, 14, 15, indicates a lack of control, which is often the psycho-neural analogy of the more objectified dread that the elements will break out, and the world end. These probably indicate more morbidity than the religious artefacts seen in 11, 12, 17, 18, although the two are often connected. The tendency to see rewards and punishments in weather, common events, etc., is the root from which has sprung a vast body of religious superstition, but it represents a stage in the development of the moral consciousness that is indispensable to the growth of every conception of the universe as being moral, and the disposition to test it is the same that when grown up suggests the prayer gauge. The pedagogy of ethics and religion waits for us to ascertain how to treat such factors.

Very closely connected with these are the two following great groups:

XXII.

End of the World.

1. *F.*, 11. Has caught from neighbors the fear that the world will end in 1899; plans to do everything before then, and pictures how the event will occur.

2. *F.*, 33. When 9, caught from Bible prophecies the way of interpreting current events as signs of the end; the world was very wicked, God very angry, the longer the *awful* punishment waited the more dreadful it would be, and the more surely every little sin would be punished; what she liked best made God angriest; this cast a gloom over every day for years.

3. *F.*, 18. No tongue could tell the anguish she suffered from this fear at all the little weather signs; it hurt her health.

4. *F.*, 19. Long saw the end coming when the clouds or moon were red or fire bells rang; this fear was of great value, made her good and always ready to die.

5. *F.*, 22. This horror was intensified because she believed it would come when no one was thinking of it, so felt everything hung on her keeping it steadily in mind, and she always tried to keep awake nights.

6. *M.*, 13. Dreaded it so he felt it was hypocrisy to pray "Thy kingdom come," and so changed it.

7. *F.*, 25. Thought the end would begin with a thunder storm, which would grow intense, and so had horror of these.

8. *F.*, 16. Thought it would develop out of a hot spell.

9. *M.*, 16. Saw signs of it in all the crimes in the newspaper.

10. *M.*, 13. Saw it coming in shooting stars.

11. *F.*, 17. Thought things would freeze up, and so dreaded cold.

12. *M.*, 10. This gave him horror of fires and even matches, lest he might precipitate the end.

13. Fears of celestial collisions are often elaborately developed, and this gives many children intense interest in the weather.

Like XIX and XX, these fears are most frequent from 13 to 18, or during the early stages of the adolescent ferment, and objectify in the most interesting way the instability of its profound transformation.

XXIII.

Ghosts.

Probably the large majority of children pass at least a stage of fearing ghosts, although we had but 203 good cases.

1. *F.*, 18. As a girl for a time knew, thought, talked of nothing but ghosts; would imagine something heavy moving on her bed, fancy eyes, noises, and re-enact all the stories she had heard in a cold sweat and with hair on end.

2. *F.*, 23. A college girl says no one can ever make me cease to believe in ghosts; I have done so since I was 2, and always shall.

3. *F.*, 17. When she hears people say there are no ghosts she knows better, for she has seen one.

4. *F.*, 17. Thought the house full of ghosts, that they were always moving on the stairs and in the halls, till she grew sickly; finally the servant who taught her was discharged; her father took her to a meeting of Spiritualists, and "they let him talk to his dead daughter Bertha through a tube; now he never had a daughter Bertha, and this cured me."

5. *F.*, 23. When 8 was told she might meet the spirit of her mother, who died when she was 2 days old; she longed to see her, but was so afraid that thereafter she would not look at her picture lest she should see her ghost, and everything about death and her mother became fearful.

These fears must have taken their rise in the early human period. Dreams, hypnagogic images, trances, entoptic projections upon the dimness of night, the dominance of retinal interpretation by other senses, the tricks of early priestcraft,

the anthropomorphic vigor of primitive, visually thought imagination, and we know not what other factors of hope, love and fear have created a world of beings, more or less belief in which is now a stage in the development of nearly every human being, and the energy of persistence of which in the most cultured of adult minds now has the most refined and valuable documentation in the collections of the English Psychic-Research Society. For children who live with imaginary companions, for people who are haunted with a "sense of presence," or who have seen ghosts, 2, 3, all disillusioning tests like 4 are idle. That to the pre-potent bias which we all inherit from a savage human ancestry and which haunts the very nerves and pulses of the most cultured to believe in ghosts, is now, in these later psychogenic ages, added the passion for individual survival, which, although often harried by science, has steadily increased with every step in the progress of personal liberty, and with the growing sense of the worth of the individual in the universe and the integrity of consciousness, so that to use Kant's phrase, the dreams of sightseers are now explained by the dreams of metaphysicians;—this has caused one of the most formidable of all presuppositions, the proper comprehension and utilization of which seems to await the avatar of some great genius in the psychopedagogico-religious field who shall reformulate the whole doctrine of immortality.

If to the last three groups of fears we were to add the allied but more degraded forms of folk-lore among children, which will be reported on later, we should have rank reminders of a state of abject and craven Lucretian superstition strongly suggesting that which Lenormant[1] describes as perhaps the most primitive of all known religions, and most purely the product of fears, that of the Shumero-Accads, the predecessors of the ancient Hebrews, where hosts of demons, ghosts, and the seven awful Maskim from the abyss always strive to bring confusion, subvert nature, spread disease and overwhelm man with terrors, against which he can only appeal to certain forms of conjuration and exorcism, and seek a friend in the sun as father of light, till slowly the idea of the unseen Elohim, the strong ones, quellers of these phantoms, is evolved, and the career is opened for the Hebrew monotheism, wherein the power of good becomes stronger than all the demons. Whether all races of men have at some stage quailed and quaked with supine fear of spiritual or supernal agents, and how far primeval religions are born of fear, we

[1] "*La Magie et la Divination chez les Chaldéens*," 1878.

may, perhaps, never know, but fear sublimated to awe, reverence, worship, a sense of absolute dependence on powers above us, must forever be an indispensable ingredient of religion, which even love can only temper, but not banish. We ought to fear things below us, and those above should attract and elevate and not degrade, as do most of the fear-born superstitions.

XXIV.

Morbid.

1. *F.*, 18. A favorite horror is a rough looking man always peering through the window, or from behind chairs, lounges, or under the table.

2. *M.*, 12. Used to imagine some one was looking at him through the register, and must always have it shut.

3. *F.* A teacher has for years feared to see some one hanging from a beam or hook whenever she enters a vacant room; can assign no cause.

4. *F.*, 18. Has from childhood hated to touch people, and never shakes hands if she can avoid it.

5. *F.*, 17. Has a chronic fear she will not get enough to eat sometime; it is not poverty, but that there will not be enough.

6. *M.*, 10. On reading of Joseph saving corn for the famine in Egypt, he began to save up bread, beans, potatoes, pop-corn, etc., under bed and wash-stand till their decay was offensive.

7. *F.* A young woman is pursued by the fear that there will soon be no more wood, and that the coal mines are nearly exhausted.

8. *M.*, 12. Thinks the sun will be exhausted and go out.

9. *M.* A wealthy farmer fears poverty, borrows money and pays interest on it, and keeps it ready if his home is taken away; his daughter and granddaughter have this fear.

10. *M.*, 16. Has a morbid dread of being poisoned; rinses the glass three times when about to drink.

11. *M.*, 17. Thought he was poisoned, fancied all the progressive symptoms, yet it was not quite real.

12. *F.*, 19. Thought some one would catch her if she stirred when alone; counted ten before every movement, etc.

13. *F.*, 25. A teacher suffered agonies of fear, about 6, for a year lest some one would break her ears, which she thought were glass.

14. *F.*, 40. A college teacher got the idea that the steam asphalt roller was alive; it would puff, glide around and return in a bravado style as if saying, "Who are you?" Each time she thought the last till she feared it would jump on her; grew afraid of all street noises, thought teams would fall on her; gave up work and was cured.

15. *F.*, 35. Teacher at about 10 got a horrid fear that she was under a spell, was saying aloud everything in her heart; this gave place to fear of another spell that she could never put on clothes enough to be modest; this lasted years; people looked pityingly at her; third came the fear that she was an idiot, and no one dared tell her; this horror still occasionally recurs.

16. *F.*, 20. In the early teens had long fears, especially when fatigued, of doing little things that would cause the death of others; misplacing medicines, dropping banana peels, opening the door to burglars instead of callers, were favorite forms among very many.

17. *F.*, 35. A college teacher would gaze at a frozen lake till she feared to go crazy; on the train the sight of ice made her desperate; the sight of running water impelled her to do something to stop it.

18. *F.* Another lady teacher was made sick and fearful of many ills by the sight of snow.

19. Another by bright sunlight, and had to have a north room.

20. Another has nameless fidgets if in a north room, or if the weather is cloudy.

21. *F.*, 39. Teacher, as a child had terrible fears nights that she was becoming an animal; could feel the face changing, horns and beard growing like a goat; for weeks she dared not look in a glass except to just peer in at twilight, when she saw all she imagined; it was so dreadful that even yet she can hardly bear to speak of it.

22. *M.*, 30. Has a very cranky aversion to dust and sweeping.

23. *F.*, 23. Has a special horror of moist hands.

24. *F.*, 16. Of dry skin.

25. *F.*, 57. Had such horror of dirt, as a child, that she could never play in sand.

26. *M.*, 14. Had convulsions from having his teeth sand-papered by the dentist.

27. *M.*, 7. The greatest fear is the noise of tearing cloth.

28. *F.*, 15. Has great horrors of sharpening slate or even lead pencils; the scratch of a pen or the squeak of a slate pencil gives her the cold shudders.

29. Fear of the *vox humana* stop of the organ, which seems unearthly, keeps an English woman from church.

30. Street cries, as of the oyster man, the scissors grinder, impress some children with morbid dread, seeming to be unearthly wails from another world with no words audible.

31. *F.*, 18. Is haunted by the fear of being run over; must get very far away from trains, cross roads ten rods ahead of the slowest vehicle, faints at fast driving, and dreams about it.

32. *F.*, 40. The pet horror is of big wheels in motion, belts, gearing, etc.

33. *M.*, 18. Has a panic if he can hear nothing; dreads stillness, cannot have his ears stopped.

34. *F.*, 38. Ever since she can remember has shivered at points and edges.

35. *F.*, 18. If she has a sharp thing, even a pin in her hand, cannot walk for fear of falling on it.

36. *M.*, 17. Has what he thinks an innate horror of a knife, and dreads to see one handled.

37. *M.*, 30. Otherwise normal, can never bear to have knives and forks at table point at him; it is the same with pins and pens.

38. *M.*, 18. Always shudders at sight of large knife or very sharp small one, and does not know how he can ever shave himself or be shaved.

39. *F.*, 21. Faints at every nose-bleed in school, every slight cut which she sees; cannot read of vaccination, or pass a surgical hospital, etc.

40. *F.*, 19. Has long had dread of any kind of conflict, and gets symptoms even if people disagree.

41. *F.*, 21. Faints if she hears any talk of fighting.

42. *F.*, 14. Dreaded most of all things to see boys fight, or to hear people have words.

43. *F.*, 13. "Was the naughty member of our family."

44. *M.*, 16. Never fears punishment, but the thought of it makes him wild with terror.

45. *M.*, 8. Was horrified to know that he had blood inside; thought himself a bag of blood, and that the least scratch might let it all out.

46. *F.*, 18. Always fainted at the sight of blood; cannot bear to see prominent veins anywhere; has difficulty in reading the word blood.

47. *F.*, 8. Is one of five girls, all of whom and the mother faint at the sight of blood.

48. *F.*, 17. Faints easy at it, but does not mind it, and is not afraid.

49. *F.*, 25. Is sick at the sight of raw meat; cannot see it touched.

50. *M.*, 5. Almost has spasms at the sight of a mask, or if anyone makes faces; a mask he once saw has haunted him for two years.

51. *F.*, 8. Has a strange aversion for noises; the ticking of a watch or clock makes her fidgety, and seems uncanny; the noise of wind in the pines makes her picture ghosts among the branches; at church her fear is that the organ will be played loud till the church will tremble and fall.

52. *F.* A cultivated lady was looking at a red light of a craft at sea, when the rays seemed a long red dragon's hand; she could not shake off the fancy, and lost control of her nerves.

53. *M.*, 1. The points of the pillow terrified him so that he could never rest till they were pushed in.

54. *M.*, 19. For many years in childhood he always feared at night an immense man with a long, sharp knife, a black cloak, black eyes, rough beard and white teeth.

55. *F.*, 11. Always feared a little black curly-headed dog which her imagination had created, and which she thought just behind her.

56. *F.*, 17. For years lived in constant dread she would do something to get blamed or punished.

In the above we recognize more or less developed forms of several of the familiar phobias of the text-books, *e. g.*, fear of points and edges, 34, 35, 36, 37, 38; fear of blood, 39, 45, 46, 47, 48, 49; of conflict, 40, 41, 42, 43, 44; of contact with dirt, or contagion, 4, 22, 23, 24, 25; *follie de doute*, 12, 15, 16, 20; hypochondria, 13, 15, 21; illusion of sight, 1, 2, 14; of taste, or possibly of persecution, 10, 11; morbid sensitiveness to visual, 17, 18, 19, 20, or auditory, 27, 28, 29, 30, 51,

impressions; baseless fears of starvation, 5, 6; poverty, 9. We have classed a large group of our returns as morbid, conformably to medical standards for adults, despite the fact that they show such symptoms to be far more common than is thought among children. To have any or even all of these fears and with considerable intensity, is not abnormal for them, but perhaps a sign of abounding vigor, provided only the reductives are forthcoming and speedily effective. In the absence of these they persist and increase until they interfere with self-control. The Herbart-Taine view that any or all impressions tend to grow to illusional intensity unless restrained by competing or opposite images, is convenient to illustrate the countless ways in which one fear restrains another. When the senses and fancy are at their strongest, and the "sum of arrest" largest, it is no more surprising that the balance is sometimes lost for a moment than that children fall in learning to walk. In most of the adult cases quoted above, the correctives were too weak, too late, or fatigued out of function. How often needless fears are due to overwork is illustrated by school fears, like 25 and 28 above, and the following:

XXV.

School Fears.

1. *F.*, 9. In the school reader read, "And ever near us, though unseen, the dear immortal spirits tread," when it flashed into her mind that dead people were walking around unseen; thereafter she could never be alone, grew sleepless and timid.

2. *F.*, 28. To her About's "Man with a Broken Ear" and Hawthorne's slight point in Donatello's ear made awful impressions, which show the terror slight disfigurement may excite if made mysterious.

3. *F.*, 10. Hearing of a Russian war grew nervous and sleepless, fearing invasion.

4. *F.*, 6. "Red Riding Hood" made her fear everybody whose face she could not see was a wolf dressed up.

5. Another child caught terror of being lost, and of woods, from "Babes in the Woods."

6. *F.* From 6 to 16 dreaded ridicule so that she could not recite what she knew; never dared ask questions about what she wanted to know.

7. *F.*, 15. Developed a morbid terror of losing her rank, of failing in examination; she lay awake nights imagining her mortification, and what others would say; this fixed her mind more on marks than knowledge, and finally broke down her health.

8. *M.*, 7. For him the front hall was an object of terror; the figure of the wall paper looked like horrid grinning men he named "gubbernoses."

9. A picture of some saint gazing at a skull in a church was specially dreaded.

10. *M.*, 15. When he first learned about petrifaction, he long had a fear that he was becoming stone.

11. *M.*, 10. On learning of earthquakes, often fancied he felt it tremble, would pause in walking, etc.

12. *F.*, 8. Feared that small cracks where mud had dried would open and swallow her.

13. *F.*, 6. Learning the earth was round developed chronic dread of falling off.

14. *F.*, 8. Feared to go far from home lest she should reach the edge where earth and sky joined and drop off.

15. *F.*, 9. Had such fear of the pictures of the animals in the school geography that this subject was dropped.

16. *F.*, 13. On learning in school about the physiology of the eye, developed an intense fear of blindness, and did absurd things to prevent it.

17. *F.*, 14. From a physiology lesson developed persistent fear of swallowing her tongue and being unable to talk.

We sample finally a few cases showing the struggle against fears, and the interest it gives to objects.

XXVI.

Repressions of Fears.

1. *F.*, 45. Till about 12 she had horror of locomotives, yet frequented the station, crossed pins on the track, and one day danced in front of the engine, getting more excited and terrified as it approached, yet fascinated and unable to leave till rescued by others; this effort to overcome her fear made it worse.

2. *F.*, 17. Loved horrible stories of every kind, yet suffered horrors from them at night; by day she would always invite them to cure herself; some boys of 6 slowly developed some giants ten feet high; first Mr. Pupicles, then added Mr. Fox, Pie, and others; these creatures were thought cowards when we chased them, but would crawl up behind or stab us asleep; we organized hunting parties, and when one would cry, "There is Pie," we would all rush for him.

3. M., 17. When he is skulking or quailing, he says to himself, "You're afraid;" this kills fear.

4. *F.*, 14. She is timid, but will do any dangerous thing rather than be called a coward.

5. *M.*, 15. Makes faces at his little sister, makes believe pound her, and does everything to make her less cowardly.

6. *M.*, 14. Thinks if teachers would never threaten, but explain things, there would be no fears.

7. *M.*, 16. Has been taught that it is safer in the dark than in the light, and his chief fear is lest he should be afraid.

8. *M.*, 8. Was a coward until once his brother said, "You cannot be any more than killed;" by repeating this he has grown brave.

9. *F.*, 16. Has learned now to merely dislike all that she used to fear.

10. *M.*, 15. Lies awake playing with his fears by thinking how bold he would be in all kinds of foolhardy situations.

11. *M.*, 17. Never fears things at the time, but at night shivers to think how bad things might have turned out, till many a night he dresses and goes out to shake off fear.

12. *F.*, 16. Has peculiar interest in an old Quaker meeting-house, which she now loves and visits because of an interest created by a childish fear there were ghosts in it.

13. *F.*, 6. Is beginning to play, with peculiar interest, with a window stick of which she used to have an inexplicable fear.

14. *M.*, 6. A big wooden spoon, feared because it seemed to be made to slap with, afterwards became a toy of special interest to him.

15. *M.*, 6. Just entered an empty room alone, stamped his foot and shouted, "Go away, everything that's here."

The physical expressions and symptoms of fear are very often mentioned in our returns, but in terms too popular and undiscriminating to have great value. The word creepy occurs 73 times, and is used mostly by females; words designating weakness, or loss of power to speak, move, paralysis, etc., 70 times; tremor, shaking of jaw, limbs, etc., 58 times; stiffening and rigidity, or tonic as distinct from clonic tensions, 50 times; pallor, 44 times; respiratory changes, as holding the breath, panting, choking, deep breath, 43 times; heart action, palpitation generally, sometimes arrest of pulsation, 42; chills, without mention of shivers, but often associated with "creepiness," 35; sweating or flushing, 28; convulsive shock movements, 28; feeling unusually strong to fight or fly, 25; nausea, 21; shut eyes, cover face, or double up, 21; fascinated or entranced, 12; transient blindness, deafness, or insensitiveness, 11; noises in ears, or flashes or colors, etc., in the eyes, 9. Three mention tendency to micturition or defecation. Young children scream and cry loudly. Three infants, frightened at dog and cat, spit at them, and general nervousness is common. Some of these expressions show some marks of being nascent excitement of once useful acts, but for others we have only conjectural explanations, like, *e. g.*, Wundt's, that the face may redden to save the brain, etc.

Ever since Marcel's great thesis on the subject in 1847, alcoholic delirium tremens has been generally recognized as embodying more of the strongest expressions of fear than any other known symptom-complex. Fear with most of its syndromes may enter through every sense and dominate every group of muscles, striated and nonstriated. Magnan,[1]

[1] "Alcoholism and the Various Forms of Alcoholic Delirium," tr. London, 1876, pp. 33. See also his "*Vorlesungen*," 1891, Heft 1, XI.

Ziehen,[1] Kräpelin[2] and others describe these symptoms as both extreme and characteristic. Especially in the prodromal stages of this form of acute hallucinatory paranoia, fears of animals of many kinds, bugs, spiders, worms, snakes, rats, dogs, lions and imaginary monsters play an important rôle. Dr. C. F. Hodge, after a prolonged and careful study of alcoholism in dogs, soon to be published, informs me that excessive fear is the most characteristic psychic mark of the inebriate dogs, distinguishing their acts and attitudes in every case from the non-alcoholic members of the same litter. Magnan has also shown how this cause may lead to delusions of persecution, from the stage of general suspiciousness to the time when the victim turns on his imagined foes and from being persecuted becomes a persecutor. Here is, no doubt, the best field for studying the manifestations of fear writ large, where disease of the higher level has caused denudation and put man mentally on all fours again.

The dominant impression left by such a study as the above is that of the degrading and belittling effects of excessive fears. They suggest dew-claws, or the filmy castings or harder fossils of long since outgrown psychoses. A feeble boy of 10 enumerates fifty-seven objects of which he has great fear, and adds that there are others he fears some. A girl of 12 feared the sun because it gave sun-stroke, clouds because of cloud-bursts, the moon because it might burst and fly, the sun lest it should get lost or burn us all, and cold weather lest ears and fingers should drop off, and her life activity was greatly restricted accordingly. An ignorant but vigorous boy of 14 feared bubbles in puddles when it rained, thinking them devil's fingers, a forbidden bridge because told the bad man lived under it, scrubbed his neck clean because told that otherwise onions would grow in the dirt there and leave dangerous holes when pulled, feared to open the hydrant because told an ugly green snake would come out and bite him, and thought a telephone too dangerous to monkey with. A girl of 13, thought not abnormal, dreaded big eyes and robbers because they were sneaky, all reptiles because they were creepy, northern lights because they were shivery, could not bare to to look at a picture of the crucifiction, nor enter the parlor alone for fear of a picture of hounds and a fox. For a girl of 17 all telegrams meant death; she dreaded to go out lest a comet should dash down, feared all women who wore big earrings, and a mythical black man who rode in a buggy with a sword, etc. Spring-heeled Jack, the Black Bull of Wild's

[1] "Psychiatrie," 1894, p. 355.
[2] "Psychiatrie," 1893, p. 539.

Hill, the Hairy Lunatic, the Ghost with Grizzly Gore, and unnumbered other fear-fetiches suggest that there may develop a passion for horrors and shudderings as strong as alcoholism. The courageous child will not succumb to fears, and has a passion for overcoming them.

The imperfections of both the methods and results of all this work are very obvious, and everything depends on keeping them all in sight throughout. This cannot be said too distinctly, emphatically, or too often. Most returns are not made by experts, but by young people with little knowledge of psychology or of the dangers of loose and inaccurate statement, and who are peculiarly prone to exaggeration in describing their feelings. Some returns are seen to be of no value, and are rejected at the start. Many of the floridly described fears are filmy and no doubt far less real than the language would indicate. Some, too, no doubt, are almost purely imagined. The data have all degrees of value from nothing up to very great. Much, of course, depends on the common sense and experience of the person who does the preliminary sifting, and in this work the writer can only say he has done as well as he could. On the other hand few psychic activities are so certain and real to those who experience them or so obvious in others as fear, while the dread of being thought timid or cowardly generally makes against confessions of it. Many hundred fears are reported by college or university students of psychology, by friends of the writer, in whose competence and reliability he has the greatest confidence, and particularly those from Miss Williams are made by a method calculated to eliminate very many at least of the possible defects and errors. Whether the attempt to avoid all harmful suggestiveness in the questionnaire was successful or not, the reader can in part judge for himself. The few hundred cases printed are from what is thought to be among the more reliable of the vast body of returns, although chosen to show distribution rather than quality. Less fragmentary, fuller, more finished and much more valuable returns generally would be those made by experts on their own children, individually studied, or on themselves. Indeed, almost any increment of expertness, medical, anthropological, psychiatric, etc., and any degree of familiarity with the child up to companionship every hour of every day, would increase the value of observations. We are, however, happily past the stage of the tyro who would pronounce such well meant returns on such a topic wholly good or wholly worthless. Glimmerings of most of these fears nearly all have probably had, and these will always be one factor in their evaluation.

This latter I deem very high, and my own confidence in most of the data has, upon the whole and making all deductions, steadily increased with growing acquaintance with them. I have printed many because they show the fresh spontaneity, the genius of child and folk thought, and the rich suggestiveness of my anthology of cases is to my reasonings about them as are the sacred texts of Scripture to Barnes' notes or Doddridge's commentaries. Even the simpler and more homely of them are nuclear and their photosphere is wide and bright. Some of them are almost perfect psychograms. I have tried to avoid not only the grout, but the adiaphora of the subject.

Most of my comments and inferences, too, are of course intended more as suggestions than as finally formulated conclusions. Nothing is finished here, and little is conclusively proven. These rich fields are just opening to pioneer work, and the mining is first by surface methods, which are very different from those at the bottom of the shafts, which further specialization is certain soon to sink. The processes of Eshcol grape gatherers are very different from those of settled traffic on the main thoroughfare of psychology, which will soon traverse all this region. To keep all soft and plastic, and to retard inspissation, or the secretion of too many hard parts, is imperative in order that everything be left open to this growth in all directions. This means, too, that crasser minds can sense nothing palpable in it all, and also that everything be left unprotected and open to attack; but the vitality is too protoplasmic to be easily impaired. Samples from the vast mass of data, according to the most objective rubrics under which they so readily grouped themselves, and then a glimpse at some of the larger aspects and problems which all the data in hand, printed or unprinted, seemed to suggest, appeared at least a method worth trying on one of our topics. There is not a single group of fears that does not almost cry out for further investigation with the larger numbers, better distribution over wider ranges of age, still further precautions and progressive exactness, the more practical pedagogic applications, etc., that will soon come. The present paper, too, merely touches a very few aspects only of this vast theme.

Most current text-books on psychology contain little or nothing helpful on fear. Many of them barely mention it; others theorize on the symptoms popularly ascribed to it, using its common phenomena for picturesque illustrative material; others have much to say concerning feelings, instincts or emotions generally, but are not specific enough to discuss any single feeling in detail; others are chiefly concerned with

nomenclature and definitions, or the place of fear, etc., in some scheme of psychic activities. What problem could better illustrate the crude scholastic stage of the contemporary psychology of feeling and emotion than the elaborate recent discussions of the problem whether they are the results of tension of muscles, vessel-walls, etc., or the latter are primal and causative? No problem is more unsolvable; hence some of its speculative charm. Solution, moreover, if it could ever come, would be attained in the very different direction of what Kirschmann used to call the method of further delineation and description, to which everything discoverable is sure to yield in the end. In text-books on psychiatry, phobias are less and less prominent, and the elements that once entered into this symptom-complex are usually distributed among other diseases. From Mosso's[1] great yet charmingly popular work, which is largely devoted to descriptions of the physiological accompaniment of fear and to its expression, the impulse to further study has been less than was to have been expected. Miss Calkins[2] tabulated the fears of 202 children, and found that in those under six, sound fears predominated; out of 122 cases she classed 23 as innate and 9 more as inherited. Binet[3] discusses 110 answers to a questionnaire on fear, but in a tentative, timid way, which is certainly all his data warrant. His conclusions that fear depends largely on the vividness of imagination and his pedagogic inferences, agree with our own better than does his opinion that the degree of intelligence has little to do with fear.

Of the more theoretical discussions of fear, by far the best, as it seems to the writer, is that of H. M. Stanley,[4] who is both fuller and far better then Ribot's *Psychologie des Sentiments*. The former conceives fear as anticipatory pain, the pre-perception of which constituted the first emotion, marked a great step upward, because it was the first utilization of past experience, and is the chief spur to know and do. Not only do the timid survive, but the suggestion of past pains gives power to anticipate and avoid danger. Fear, too, has its own pain, which is distinct from the pain of the object feared, but the former is less, and there is economy in the substitution. When fear is very intense, knowledge, which is anticipatory of it, breaks up in dissociation. There is

[1] "Fear," by Angelo Mosso, tr., London and New York, 1896, pp. 278.

[2] "The Emotional Life of Children," by Mary Whiton Calkins, *Pedagogical Seminary*, Vol. III, 319-323.

[3] "*La Peur chez les Enfants*," *l'Année Psychologique*, 1895, pp. 223-254.

[4] "Evolutionary Psychology of Feeling," chaps. VII and VIII.

much fear that does not rest on experience. Fears slowly become differentiated first in degree, as intense and evoking the greatest possible activity, or as slight. Here the personal differences are vast, as a phobometer that measured the saturation point at which all control was lost, would show. Another individual difference is between those far and those near-sighted for fears. The law, "inversely as the distance," does not hold alike for all. Finally, awe and sublimity are perhaps the most refined forms of fear.

From this larger view we see how essential to every soul, brute or human, fear has been. It is no less universal now. There is no one without fear, and those few who so emphatically disclaim all fear, and the psychologists who tabulate the percentages of fearless people, are thinking of shock or panic or acute fright, or special physical dread, etc., but not of the subtler forms, like fear of God, of dishonor, failure of their highest purposes, for themselves or others. Not only does everyone fear, but all should fear. The pedagogic problem is not to eliminate fear, but to gauge it to the power of proper reaction. Fears that paralyze some brains are a good tonic for others. In some form and degree, all need it always. The difficulty is to adjust to the vast range of individualities and the very different stages of development. A true curriculum of fears would by no means omit all lower and more drastic forms, but be always intent on substituting its higher and wider ranged spurs for its more degraded and primary ones up to reverence and worship of the sublime and awe-inspiring. Here fear must be reduced, there abated, here made more tenuous, there more crass. We fear God better because we have feared thunder. Without the fear apparatus in us, what a wealth of motive would be lost! Aristotle's conception of education as learning to fear in due proportion those things worthy of being feared, would not serve badly as a definition also of courage.

Again, fears are necessary because they are the roots of so many of the strongest intellectual interests. Never is the child's charm in an object so great as at the moment when he is just getting the better of his fear of it. One of the chief spurs to knowledge and science is to overcome fear, and many of the things now best known are those that used to be most feared (XXVI). To feel a given fear no longer over but beneath us, gives an exquisite joy of growth. Even love may begin in special timidity. Those reared under religious terrors are sometimes most irreverent, or if *aufgeklärt* are especially fond of dissertating on old religious sanctities from new found radical standpoints. With children foolhardiness is a favorite form of showing off. Fear is necessary first to

focalize attention and educate in concentration. Even food, perhaps, has less acuminating power. Whether to fly or fight is the problem, and adjustment must be ready for either. Interest involves a general act of the attention to an object with the pain element reduced, and curiosity is a form of interest. Complete knowledge often eliminates not only fear, but even reverence. Love does not cast out fear as if there were an amphiboly between them, nor yet as if fear were transpeciated into love, but a trace of fear toned down to respect lingers not as a mere flavor, but as contributing a part of its essential reality to the object loved. As Fichte thought the ego posited its own self-limitations and then transcended them, we may conceive the soul as self-limited by object fears, which it transcends in knowledge and turns to again in interest and love, when both self, object, knowledge and love owe part of their actuality to the old radical fear. If pain is diminished action, and pleasure is greater perfection in action, then the *love of natural objects* must be considered no less fully as the complementary part of this paper. The report devoted to this obverse side of the subject is essentially complete, and will soon appear, and only then can the reciprocal relations between love and fear be more fully treated, where, I think, it will appear that while fear is the mother of all superstitions, it is also the rudimentary organ on the full development and subsequent reduction of which many of the best things in the soul are dependent; that the philophobic thesis, antithesis and synthesis are essential biotonic motives, that a childhood too happy and careless and fearless is a calamity so great that prayer against it might stand in the old English service book beside the petition that our children be not poltroons.

Fear is pathic, obsessive, so concrete that it is no wonder it was long held to be a morbid entity, or even that Brown-Sequard thought he could inoculate its bacilli. In many forms of deliriums, especially tremens, fear is a dominant element. Horror even has its art, as in Poe, Hoffmann, Wiertz, etc. The timid do not resist disease, and fear seems to invite it. So important did Pinel think it in psycho-neural disturbances that he always specially questioned every patient as to fears. Fears profoundly affect not only the lives, but even the theories of great men, as in the case of Hobbes, and in a different way Schopenhauer. One of the very worst things about excessive fear seems to me to be that it makes people selfish, profoundly and dominantly selfish, as few other things do. This and its frequent association with weakness lie at the root of the instinctive aversion to tell our fears. Few better indices of individual strength and of

soundness and vigor of heredity can be found than the phagocytic power of eliminating baser fears, or of incessantly working them over into higher forms. Bad and even dangerous as its grosser forms are, there is no possible way of developing the higher without them. Not extermination, but education is the need. Every element of soul and body is a factor in determining how much and what kinds of the baser metal each individual can transmute into the higher.

One fundamental assumption in this paper is that the experience of the individual, and even that of his nearer forebears, while it can explain many of the fear phenomena, more no doubt than most of our reporters think, cannot explain all. This view, like its opposite, it is impossible to demonstrate conclusively. The naked eye may be utterly unable to tell whether a light near the horizon comes from a fireside candle or a star. Psychic elements generally, and feelings particularly, are in some respects like the soft parts of animals of which the paleontologic record preserves but few traces. Interest in problems of the soul used to centre in its future state; now it centres in its present, the instantaneous now, to which epistemological tendencies which give us an officinal psychology with no perspective would shut us up, or the larger present of the individual, or the historic period. Weismannism has, perhaps, also done something to countenance the disposition to make contemporary psychology a cross-section of the adult soul and to delay the full recognition of evolution in this field. It has had a limiting influence on psychology not without analogy to DesCartes' theory that animals were mere automata. This was, perhaps, well, for the study of the near should precede that of the far. But long before and after Plato, even in the church, doctrines of pre-existence of the soul were so inseparably bound up with those of post-existence or immortality that both stood or fell together, and from the metempsychosists to Wordsworth, from Clifford to Cope, paleopsychic or archæsthetic views of many kinds have been strongly held. There seems now a growing sentiment toward a more unfrontiered standpoint, showing that however different soul and body may be, they have been associated like twins from the first, so that if there have been metempsychoses there have been parallel metasomatoses, that as organization or brain is found increasingly complex, we must look well to it that our conceptions of soul do not leave it mean, parasitic, or even epigenetic, but make it no whit less involved and venerable than the body, with rudimentary and vanishing organs like it, and like the living soma subject to incessant change, to know the laws of which is the goal of psychology. As the

notochord, *e. g.*, performs its function in the embryo and is transformed, so we may find psychic functions or elements very important for a developmental stage, but with no trace in the mature mind, or we may have to postulate such, like, *e. g.*, Haeckal's fruitful hypothesis of the gastrea stage.

In view of this I think we shall find among the most valuable lines of new psychogenetic research that of what may be called the stages of forgetting. Like waning consciousness, lapsing memory by no means involves degeneration, but is sometimes most rapid at the very *cone d'acroissment*. Perhaps we shall never know how, or even whether acquisitions, in growing automatic, pass to basal ganglia or down the meristic levels toward reproductive efficiency as knowledge becomes cryptonoetic. That there is some such a tendency, however, few will doubt, and must we not hold that no acquisition is complete until it has somehow so pervaded the soma that the reproductive elements are modified? These modifications of heredity may have perhaps almost innumerable sub-threshold degrees before either consciousness or spontaneous action would be directly caused. As infants, although they cannot speak, yet, unlike apes, have a capacity to be taught language, so we must assume the capacity to fear or to anticipate pain, and to associate it with certain objects and experiences, as an inherited *Anlage*, often of a far higher antiquity than we are wont to appeal to in psychology. To learn what to fear so as to fear wisely and effectively, although it is a school as old as the instinct of self-preservation, is still a chief part of education.

Again, as soft parts are always older than hard parts, and make or condition them, and the unicellular and protozoan forms of life are geologically older and more unchanging than the larger metazoan species, so faint stimuli from more constant causes must have been far commoner than strong ones. We may assume, too, that long repeated impressions through geologic ages would cause deeper and more durable effects than intense and infrequent ones, on a principle analogous to the greater deterrent effect on crime of slight but certain penalties. Much of the education of germ plasma, as well as in cases discussed above in XX, is by the method of frequent but faint iteration, often approaching almost constant tension. As in geology, again so here, the greatest results are often achieved by the slightest and slowest causes operating incessantly. There is a peculiar prepotent quality about some of these fears that suggests some such ancient origin, and points to the persistency of cells or protoplasm rather than to the more formed and therefore more transformable tissues of later stages. As some cases of spontaneous blushing and of

pavor nocturnus suggest the results of long ago shocks, quite distinct from those other cases of parasitic personality or of the submerged experiences that hypnotism expiscates from the unconscious depth of the soul, which point to more recent shock fears, so the fears toned down to awe of the forest, of the gloaming of night, of the heavenly bodies, of solitude, etc., seem to bear the stigmata of antiquity. If we assume any backward perspective in the soul at all, of what else in it have we a better right to postulate age, self-evidenced as by first intention?

Without assuming far wider ranges in the past, psychology can make but slow and hard progress in exploring feeling, instinct and the rich mines of unconsciousness just opening. The careful study of fear thus leads us to results that aid in the solution of some of the profoundest problems of mental life and are at variance with certain of the most approved views of modern psychology. In his remarkable work on Salpa[1] Professor Brooks thinks the deep sea bottom was discovered and colonized some time after life had been developed near the surface. Food was obtained easier, and sedentary life when once established there was more favorable to growth and reproduction. We can now hardly conceive the capacity of the sea floor for sustaining life, nor the rank abundance of it there in many vast areas, or the new forms that arise there. The instinct-feelings now opening to psychologists are such a bottom, far fuller of life and growth than all the surface phenomena of intelligence, where many forms originated, but now, as lapsed consciousness, hard to get at, our method, to carry out the faint and halting analogy, being a new form of dredge, and fear like Salpa being a typical form especially inviting a discussion of its relations to the evolution of the psychic life in general, which, however, we must here postpone. At every step the sense deepens that the conscious ego is but a very inadequate and partial manifestation of the soul, that it is a feeble, flickering taper in a vast factory full of machinery and operatives, each doing its work in unobserved silence, and which the epistemological method of discussing the nature of light will never illuminate.

The best of all evidences of the high antiquity of the fear *Anlage* of the human soul rests not on any one fear group, nor on the summated evidence of all together, but on the proportional strength of different fear elements and tendencies. Their relative intensity fits past conditions far better than it does present ones. Night is now the safest time, serpents

[1] "Salpa," by W. K. Brooks, Baltimore, Johns Hopkins Press, 1893, pp. 123-177.

are no longer among our most fatal foes, and most of the animal fears do not fit the present conditions of civilized life; strangers are not usually dangerous, nor are big eyes and teeth; celestial fears fit the heavens of ancient superstition and not the heavens of modern science. The weather fears and the incessant talk about weather (p. 177, and VI generally) fits a condition of life in trees, caves or tents, or at least of far greater exposure, and less protection from heat, cold, storm, etc., than present houses, carriages and even dress afford. Yet, again, the intensity of many fears, especially in youth, is out of all proportion to the exciting cause. The first experiences with water, the moderate noise of the wind, or distant thunder, etc., might excite faint fear, but why does it sometimes make children on the instant frantic with panic? Must we not conclude that, as Palmén found that the eider ducks in their annual migration from northern Europe to Africa crossed the Mediterranean over wide and therefore more dangerous paths because they fly where land used to be, and that their topographic instincts are thus older than the present geological configuration of the old world, so the human instinct-feelings, incalculably more ancient than the intellect, have been felted and macerated into their present general form very gradually by social telluric and cosmic influences, some of which still persist unchanged, but more of which have been either modified or are now extinct? Adjustment is thus one of the deepest problems of pedagogy. It is especially hard because the full scope of the more basal fears rarely comes to expression in consciousness, but only partial aspects of them, as illustrated by the principle of fetichism, so akin to, if not at the root of the naming instinct, which eternally puts a part for the whole, underlies symbolism, make us cling to our categories after they have become mere clinkers in the ever burning fire of flux and change, of which body and mind are alike phases.

The fact that some of these fears are so very tenuous that they almost seem to be nothing but flitting fancies, and have an air of such unreality as to suggest a distinct class of pseudo-phobias, and that we often say in reading them that we could have imagined, but never could have truly felt certain of the fears above recorded, by no means disproves their antiquity, and can never do so till we know how much of the work of the imagination is purely creations out of nothing, and how much is in reviving obsolescent traces of remote experience. Beccari thinks each philum, although being very plastic for permanent and transmissible impressions in its early stages, loses this power, so that conservative heredity is the rule later, while the oldest traces are surest of

transmission. This strengthens the suggestion that the oldest psychoses would be likely to be the dimmest, despite their potency, and that the influence of earlier inheritance dominates that of later, still and small though its voice be. To make these all products of present experience is not unlike accounting for fossils on mountains as God-made, for it ignores not only their peculiar structure, but a past of psychoses radically different from those of the present, functioning under conditions no less changed. How much the true Aristotelian katharsis consists in very highly suggestive restoration of such far past conditions in conformity to a law that these traces must be re-excited as a necessary condition of their transformation to the next higher stage, as the soul "builds itself larger mansions," the next article will seek to show.

Once more, if among our psychic functions fears are peculiarly liable to become morbid, they only follow the law of rudimentary organs of the body which are especially prone to become diseased. This point will have fuller treatment elsewhere.

There is no normal organ or tissue which we do not inherit from an anthropoid ancestry. Besides organs at the apex of function in the adult, structures like the lanugo, polymasty, the coccygeal vertebra with both muscles and nerves that once moved a tail, the pineal gland, the nictitating membranes, ichthyosis and perhaps 120 other embryological forms, often hypertrophied in teratological cases, etc., now make a position like that of Agassiz, who saw the facts, but failed to see their significance, quite obsolete. No less so is sure soon to be that of those who in the presence of facts now so fast being made known still fail to see that the doctrine of evolution is just entering a new and higher psychic field, where it promises soon to give us a clear and simple doctrine of mind, the evidence of which is so plain that all can see, and which is thus fit to be the national philosophy of a democracy because it does not depend on mystic or esoteric insight, but its obscurities are those of the subject matter itself, and not artefacts of method. As at great crises in history, unhallowed ghosts stalk abroad from old graves, so just at the threshold of epochs in science, effete theories may be resurrected for a brief day. Surely these signs of better things do not fail us now.

One of the chief desiderata of psychology now is a function analogous to the Kantian criticism applied to the instinct-feelings to distinguish what is pure or transcendental in them from what is due to individual experience. What kind of *Anlage* must we assume as the necessary presupposition of

concrete experiences of fear, anger, love, etc. ? The concrescence of empirical and *a priori* factors is closer here than in the field of the understanding, and he must be a bolder and yet more skillful timoneer who shall force a passage between them and give us a true map of their conterminous frontiers. As Weismann to Locke, on the one hand, and as Spencer and Eimer to Leibnitz and Berkeley, on the other, so much greater is this problem than was Kant's. Let us hope that whenever any solution or even adjustment is reached, whether by the signal achievement of some great personality, or, as is more likely, by the method of slow collective formulation, it will not be like the Kantian system a crystallization of rich knowledge and deep and brilliant aperçus about the castings of old and borrowed categories, and hence with a surd at its inmost core, but by the effective and well ordered grouping and mobilization of the facts and laws of life and growth of body and soul, youth as well as maturity, animals as well as men, the past as well as the present, it will show us in the very fossils of instinct and automatism sermons against easy indulgence in a sense of finality, and give faith in and suggestions and motives to an indefinite future progress.

Further returns upon this subject will be gratefully received by the author, who would hope to utilize them in a final report.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY.

COMMUNICATED BY E. B. TITCHENER.

XI.— LOCALISATION OF CUTANEOUS IMPRESSIONS BY ARM MOVEMENT WITHOUT PRESSURE UPON THE SKIN.

BY PROFESSOR C. S. PARRISH, A. B., A. M.

This article gives the results of a series of experiments made during the academic year 1895–96. The investigation grew out of the work of Dr. W. B. Pillsbury[1] in the Cornell laboratory during the year 1893–94, and that of Prof. Margaret Washburn[2] published in 1895. The object of this investigation was twofold: (1) To determine as nearly as possible how accurate was the localisation of cutaneous impressions by arm movement *without pressure on the skin;* and (2) to test in this connection the influence of the visual image, which both Mr. Pillsbury and Miss Washburn had found an important factor in cutaneous space judgments. The method used was very similar to that employed by Mr. Pillsbury (E. H. Weber's second method), but differed from it in one important particular. An impression was made on the skin, and the subject was asked to indicate the point touched as accurately as possible by carrying a charcoal point over it, but *pausing in the air above the arm.* In Mr. Pillsbury's work the arm had not only been touched by the subject in the act of localisation, but he had moved about after touching, until he thought he had found the point stimulated.

A. EXPERIMENTS.

Except in the case of one subject, the investigation was restricted to an ellipse on the volar side of each forearm,

[1] "Some Questions of the Cutaneous Sensibility," AMERICAN JOURNAL OF PSYCHOLOGY, VII.

[2] *Ueber den Einfluss von Gesichtsassociationen auf die Raumwahrnehmungen der Haut.* Phil. Stud., XI, 2. Separately: Engelmann, Leipzig, 1895.

beginning just above the wrinkles at the wrist. The major axis extended about 10 cm. in a longitudinal direction, the minor axis being decided by the volar breadth of the subject's forearm. In order to avoid the visualising tendencies produced by operating upon definite and known lines, no permanent division of the area was made; but care was taken that no impression should be in the immediate neighborhood of that just preceding. The arms were taken in alternation. In the earlier part of the work not more than ten experiments were made upon one arm at the same time, and no series for one arm contained at any time more than twenty experiments. With these precautions no disturbance from the after-effects of pressure was noticed. In order that the subjects might not know the arm area operated upon in terms other than those in which they localised, nothing was said to them of the ellipse. Each subject, therefore, in experimenting upon the writer (the exception mentioned above) made the impressions anywhere on the volar side of the forearm, from the first wrinkle at the wrist to a line about 12 cm. above it; the area operated upon being roughly an oblong instead of an ellipse.

During experimentation the subject sat with the arm on which the experiments were made resting on a low table at his side, the elbow being ordinarily a little in front of the trunk and the arm extending along the edge of the table. As it was desirable that there should be no distractions arising from physical discomfort, the exact angle of the arm with the edge of the table was not regulated. There was a variation of 0°-30° approximately. The arm with which the localisation was made either hung by the side or rested on the corresponding knee, when movements in flexion were desired. When movements in extension were tried, as was the case in a few experiments, the arm was held against the chest. The eyes were closed or open, as the experiment required. As has been said, the experimenter touched the arm with a charcoal point; the reactor indicated the point on the skin touched by carrying another charcoal point as nearly as possible over it, but not purposely touching the skin,—thus cutting off the normal ending of the localising movement.[1] The experimenter then dropped a perpendicular from the charcoal point in the subject's hand to the skin, and determined the amount of the localisation error by the aid of a millimetre scale. The charcoal point with which the skin was touched was kept one millimetre in diameter. As in Mr. Pillsbury's experiments, the directions were divided into eight groups

[1]Wundt, "Human and Animal Psychology," pp. 139, 140.

for convenience of record : right (R), left (L), peripheral or towards the wrist (P), central or towards the elbow (C), and the directions midway between these: L P, R P, L C and R C. The subjects were Messrs. Pillsbury (*Py.*), Manahan (*Mn.*), Moyer (*Mr.*) and Miss Parrish (*Ph.*), the latter being experimented upon by all the other reactors.

Since, in our experiments, no definite divisions of the area operated upon were made, and it was desirable to have a method similar to that of Mr. Pillsbury for purposes of comparison, we have chosen the general form of Table I of his work.[1] We have given, however, in the same Table, not only the average magnitude, but the number of displacements in any particular direction, and have separated the experiments on the right and left arms. We have introduced, also, ratios between the *number* of central and peripheral displacements as well as between the average *values* of these. The same thing has been done with right and left displacements.

As in the investigation out of which this grew, the subjects differed very much in their power of voluntarily controlling visualisation.[2] (1) From careful introspection both in this and previous experimentation, *Py.* thought that he was not able to excite or to shut out the visual image at will. The results obtained from him show no appreciable differences of the averages in the visual and non-visual series. When he attempted to pause in the air just above the stimulated point, he had a strong tendency to touch the arm, and frequently did so,—though he did not move the charcoal point after contact. His localisation was always quite close to the arm; but this was especially true in the series with the eyes open. No constant ratio, however, could be established between the distance above the arm at which the movement concerned in localisation ceased and the amount or direction of cutaneous displacement. Table I shows the results obtained from this subject.

In the experiments tabulated under "Normal," the subject was not instructed in what terms to localise, but was left to his own method, simply being asked to localise as accurately as possible. In the series marked "With Visualisation," he was requested to form as vivid an image of the arm as possible and to localise by means of that. In the series marked "Without Visualisation," he was requested to make a direct attempt to shut out the visual image. In the experiments "With Eyes Open," he looked at the arm as the impression was being made, and then, closing his eyes, attempted to localise.

[1] American Journal of Psychology, VII, 1, p. 46.
[2] American Journal of Psychology, VII, 1, pp. 46 and 47.

TABLE I.

Reactor *Py*. Unit = 1 mm.

	Normal. Four Series, 120 Exp.				With Visualisation. Four Series, 140 Exp.				Without Visualisation. Four Series, 160 Exp.				With Eyes Open. Four Series, 200 Exp.			
	Right.		Left.		Right.		Left.		Right.		Left.		Right.		Left.	
	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.
Peripheral	9	10.5	10	17.3	14	16.1	8	15.5	22	22.7	27	33.1	26	11.4	28	14.2
Central	2	10			2	8									2	6.5
Right	3	14					3	11	3	11			5	10.3		
Left	3	17	5	10.4	2	11.5	9	16.7	9	16.7	4	12.5	9	10.5	5	13.8
Right Peripheral	7	18.6	11	14.7	17	16.6	2	15	2	15	25	19.5	12	11.6	19	12.9
Left Peripheral	32	23.5	25	18.6	32	15.4	40	26.2	40	26.2	24	22.8	42	17.5	43	17.3
Right Central	2	18.5	1	14	2	14	1	35	1	35			2	6.5		
Left Central	2	7	8	16.7	7	11.7	3	13.3	3	13.6			4	11.3	3	3.6
Ratios of Cent. to Peripheral Displ.	.125	.665	.195	.606	.180	.908	.193	.857	.062	.760			.073	.435	.056	.227
Ratios of Right to Left Displ.	.324	1.075	.363	.628	.227	.722	.463	1.079	.116	1.079	.893	.552	.340	.723	.352	.371

The ratios given in the last line of each table were obtained (*a*) by dividing the *number* of right by the number of left displacements, and (*b*) by dividing the average *values* of displacements to the right by the average values of those to the left. In the line next above the lowest, peripheral and central displacements were also treated in the manner just described. Since in, *e. g.*, the "Right Peripheral" displacements, every displaced point was on the right and also peripheral with regard to the original impression, and a similar thing would be true of all the oblique displacements, these were used twice. "Right Peripheral" was added with "Right," and also with "Peripheral." This, of course, would make the average displacements toward the right or toward the wrist too great; but as the averages were used in the way described only in obtaining the ratios, and as nothing is claimed for these beyond a rough indication of the direction of displacement, the larger values do not appear except as involved in the ratios, and need not be misleading there. The occasional large ratios of right to left average values, particularly observable in the Table of *Mr.* given a little later, are not an indication of greater displacement toward the right, as may easily be seen by dividing the sum of right by the sum of left displacements. The arms indicated in the Tables are in all cases those *on* which the localisation was made.

(2) The subject *Mr.* thought from introspection that he was habitually a strong visualiser, and other work done by him in the laboratory tended to confirm this. In order to shut out the visual image of the arm in the non-visual series, he at first kept a Japanese color-scheme before him, and tried to get an image of that to persist while his eyes were closed. This proved to be a distraction; and he then left himself to the fleeting memory images which happened to be passing, ordinarily seizing upon one at the moment of localisation. He frequently fixed upon the image which was in the forefront of consciousness as his hand was going down in the act of localisation. (It may be noted here that the other subjects thought that when the charcoal point touched the arm the visual image of the part stimulated tended to arise in the mind; but *Mr.* did not notice this tendency, nor was the image of the arm, as in the case of *Py.* and *Ph.*, superposed upon what he was voluntarily visualising.) The results obtained from him show very little difference of average displacement between the non-visual and the visual series with the eyes closed. With open eyes, the average displacements are somewhat smaller. It seems probable that *Mr.* visualised with practically the same degree of vividness in

both the normal and visual series; that he was not as well able as he thought he was to shut out the visual image in the non-visual series; and that in the series with the eyes open the visualising tendency was strongest. The results obtained from him are given in Table II.

(3) The subject *Ph.* substituted another visual image in order to shut out the image of the arm, generally selecting some centrally excited image which harmonised best with the mood of the moment, and fixating that when the signal for the experiment was given. In the intervals between the experiments the attention was turned away from anything connected with the work, and not recalled until the signal was given. Frequently, when there was a very strong tendency to visualise the arm area operated upon, the outer surface of the cheek or the upper surface of the foot was substituted and the impression to be localised was seen on that. The subject was in the habit of voluntarily calling up visual images of colored expanses, and these were frequently seized upon at the moment of localisation. The contact of the charcoal point tended very strongly to arouse the visual image of the area touched, and sometimes, in spite of efforts to the contrary, this image was superposed upon that voluntarily fixated. There were a considerable number of experiments in which the subject was conscious of involuntary visualisation from this sudden superposition or interposition of the image, but the results of those experiments showed no diminution in the amount of displacement. Introspection showed that the intrusion of the visual image of the arm generally took place either simultaneously with the movement necessary for localisation or during the sweep of the arm toward the point touched. This would probably indicate that visualisation took place too late to affect the estimation of the movement. In this case, as in that of the other subjects, no connection could be established between the amount of displacement and the distance above the arm at which the subject usually paused in the act of localisation. See Table III.

(4) The subject *Mn.* made no visual substitution for the arm area. He thought from introspection that he did not visualise at all, but that he localised in terms of movement, shutting out all visualisation with reference to the touch of the charcoal point. It would seem from his introspection that he was able to separate entirely the visual from the organic factor; and the greater amount of displacement in his non-visual series as well as the much smaller displacement in his series with open eyes harmonise with this, and suggest the theory given hereafter of the influence of the purely visual factor. The results will be found in Table IV.

TABLE II.

Reactor *Mr.* Unit = 1 mm.

	Normal. Four Series, 120 Exp.				With Visualisation. Four Series, 140 Exp.				Without Visualisation. Four Series, 140 Exp.				With Eyes Open. Four Series, 190 Exp.			
	Right.		Left.		Right.		Left.		Right.		Left.		Right.		Left.	
	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.
Peripheral	15	23	28	30.9	6	21.4	12	22.4	7	27.1	14	23	7	15.1	34	17.6
Central													7	24		
Right	4	17			5	15.2			5	30	1	5	7	15.6		
Left	2	15			1	15					1	14			6	7
Right Peripheral	23	24	8	32	22	17	2	30	48	29.4	25	25.7	78	20.6	4	12.3
Left Peripheral	16	22.6	24	30.5	15	18.8	46	26	10	40.3	28	24			46	16.6
Right Central					6	7.8							2	25		
Left Central					5	13.3					1	14			45	10.5
Ratios of Cent. to Peripheral Displ.					.409	.372					.014	.192	.105	1.390	.059	.226
Ratios of Right to Left Displ.	1.500	1.090	.333	1.049	1.375	.801	.043	1.153	.827	1.463	.827	.896			.070	.360

TABLE III.

Reactor *Ph*. Unit = 1 mm.

	Normal. Thirteen Series, 470 Exp.				With Visualisation. Eleven Series, 440 Exp.				Without Visualisation. Nine Series, 360 Exp.				With Eyes Open. Twelve Series, 450 Exp.			
	Right.		Left.		Right.		Left.		Right.		Left.		Right.		Left.	
	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.
Peripheral	46	18.4	77	28	34	21.8	99	23	9	15.6	41	29.7	44	13.8	85	16.3
Central	6	9.3	1	25	10	12.9	2	11			2	16	19	10.9	7	5.6
Right	1	15	1	6			4	15.6	1	7	12	24.8	7	11	6	9.8
Left	41	17.9	30	24	80	16.2	5	11.6	67	43.4	14	22.7	33	12.5	21	11.5
Right Peripheral	15	14.2	11	23.6	11	16	55	22.9	9	24.6	72	39.8	40	12.5	51	17.7
Left Peripheral	105	24.3	114	29	71	21.7	49	19.2	62	42.5	28	33.5	44	15.5	43	13.1
Right Central	6	22	1	31	1	8	1	25	2	14	3	31.3	5	9	4	5.2
Left Central	15	15.6			13	18.2	5	9	20	29	5	26	33	12.2	8	11
Ratios of Cent. to Peripheral Displ.	.166	.827	.009	.694	.213	.657	.039	.691	.369	.529	.070	.711	.445	.791	.108	.461
Ratios of Right to Left Displ.	.136	.885	.090	1.143	.073	.427	1.010	1.596	.075	.380	1.643	1.208	.473	.806	.847	.918

TABLE IV.

Reactor *Mn*. Unit=1 mm.

	NORMAL. SEVEN SERIES, 254 EXP.				WITH VISUALISATION. FIVE SERIES, 200 EXP.				WITHOUT VISUALISATION. FIVE SERIES, 200 EXP.				WITH EYES OPEN. SEVEN SERIES, 260 EXP.			
	Right.		Left.		Right.		Left.		Right.		Left.		Right.		Left.	
	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.
Peripheral	42	24.3	24	26	51	29.1	11	27.6	20	42.5	5	40.8	23	9.5	12	9.3
Central	2	6.5	3	19					4	22.5			87	8.2	1	9
Right	1	8	2	6	2	4			4	25	2	9.5	19	8.2	2	4
Left	5	22.5	13	18	1	17	4	23.3	4	25	16	32.2	1	8	2	11.3
Right Peripheral	14	16	10	14.4	25	28.8	5	24	29	56.5			35	7.6	8	8.2
Left Peripheral	51	21	68	22.3	20	21.7	77	23.9	15	31	71	42.1	14	6.5	57	9.1
Right Central	4	13.7							12	31.5			18	10.6	1	4
Left Central	8	10.5	5	12	1	15	3	14	12	25.6	6	24.6	13	11	27	13.5
Ratios of Cent. to Peripheral Displ.	.130	.500	.078	.494	.010	.188	.032	.060	.437	.612	.078	.296	.569	1.254	.298	.995
Ratios of Right to Left Displ.	.296	.685	.139	.139	1.227	.610	.059	.117	1.451	1.384	.021	.096	2.571	1.034	.127	.478

(5) In Table V we give the average error corrected as suggested by Mr. Pillsbury[1]. The values for the right and left arms are given separately, and then averaged. It may be noticed that in the case of *Py.* and *Mn.* the error is larger in the visual series than in the normal. This is probably due to the fact that both visualised normally, and when requested to make a distinct effort to do so, found the introspection necessary a distraction. *Py.* was so sure that he could not shut out visualisation that his somewhat larger average in the non-visual series seems best explained also by the distraction due to introspection and a strong effort to perform a difficult task. The difference between the average values in

TABLE V.

	Unit = 1 mm.	Right Hand.	Left Hand.	Average.
Py.	Normal	20.7	21.2	20.9
	With Visualisation	20.5	26.6	23.5
	Without Visualisation	27.02	30.6	28.8
	With Eyes Open	15.8	15.8	15.8
Mr.	Normal	23.6	43.5	33.5
	With Visualisation	21.7	36.4	29.0
	Without Visualisation	44.3	24.6	34.4
	With Eyes Open	28.0	17.9	22.9
Mn.	Normal	19.6	23.5	21.5
	With Visualisation	26.8	28.1	27.4
	Without Visualisation	45.3	41.5	43.4
	With Eyes Open	12.3	11.9	12.1
Ph.	Normal	23.8	33.3	28.5
	With Visualisation	24.9	23.9	24.4
	Without Visualisation	35.1	39.06	37.08
	With Eyes Open	16.9	15.6	16.2

[1] American Journal of Psychology, VII, 1, pp. 43, 44.

the normal and non-visual series of *Mr.* is hardly greater than might be accounted for by mere chance.

The *great difference between the limina* as given by us in the Table and found by Mr. Pillsbury (AM. JOUR., VII, p. 51) is worthy of notice. In the experiments of the latter the subject moved about on the skin until the sensation was judged to be like that roused by the stimulus. In our work this normal ending of the localising movement was cut off. In the absence of a familiar group of elements (cutaneous sensations and visual associations connected with the second contact), recognition is not so easy as before, and, consequently, large errors are made in the judgment. Striking evidence of this was the fact that when the perpendicular was let fall from the point of localisation, the subject, as soon as the second contact was sensed, almost always recognised the direction of his error, and very frequently its approximate value. With some of the subjects there may have been a slight tendency to correct the direction of displacement ascertained in this way. In the case of the subject *Ph.* this source of error was eliminated by dropping the perpendicular after the metric rule was laid on the arm. When the experiment was tried of laying the metric rule on the arm after the stimulus, but before the localisation, the subject requested that it should not be done, since it effaced the impression to be localised.

B. GENERAL RESULTS.

An examination of the Tables will show that the displacements were mainly toward the wrist. Mr. Pillsbury gives as one important factor in the direction of displacement the overestimation of movements due to flexion when approached from extension, and the underestimation of those due to extension when the arm is much flexed, and quotes Loeb[1] in support of this view. The latter had explained the errors in estimation by the differences in extent of movement for the same amount of *innervation*. Mr. Pillsbury says, however: "It is not that equal innervation sensations correspond to equal lengths of movement, but that equal lengths of movement give greater amounts of motor sensations, and these are taken to mean greater distances on the visual space diagram." The fact that at least one subject in this investigation and one in Mr. Pillsbury's were able to shut out the visual space diagram in the act of localisation, would militate against the theory of any *constant* translation of motor sensation into visual

[1] *Untersuchungen über den Fühlraum der Hand.* Pflüger's Archiv, XLI, pp. 107-128. *Untersuchungen über die Orientirung im Fühlraum der Hand und im Blickraum. Ibid.*, XLVI, pp. 1-46.

space. Loeb thinks that movements in flexion, either with or without visualisation, give a greater amount of organic sensation than movements in extension of equal range when the arm is much flexed. A very simple introspection of ordinary experiences seems to make this evident. It may be, then, that the movement accompanying the greater amount of sensation is simply judged greater. Our normal judgment of distance, largely in terms of visual space, may have become so habitual that it will influence more or less any space judgment even under artificial conditions; but the fact that any form of a visual space diagram may be shut out and movements in flexion still be overestimated, may probably be interpreted to mean that a visual translation is not necessary. The results of this investigation, however, appear to confirm the general theory. The arm previously extended on the knee or hanging by the side was flexed in the act of localisation: the movements were overestimated, and the localisation fell short of the point stimulated. The arm resting on the chest, and in that position much flexed, was extended in the act of localisation: the movement was underestimated, and the localisation went beyond the point touched.

Table VI shows some results obtained from the various subjects with movements in extension.

Only a few experiments of this kind were made, as it was evident from the first that the results were of the same type as those in flexion. It may be noticed that there is not the same predominance of left over right displacements as in the preceding Tables. The small number of experiments would, of course, make any average a very crude one; but in any case the fact easily admits of explanation. The hand with which the localisation was made rested on the chest, approximately in the median plane. The movement concerned in localisation was largely a movement toward the front. The results are therefore significant mainly for peripheral and central displacements. For three of the subjects, however, "right peripheral" displacements predominate on the right arm and "left peripheral" on the left, a fact which is entirely in keeping with our theory of the underestimation of movements in extension.

The predominance of displacements to the left over those to the right on the right arm (see Tables I, II, III and IV) falls easily under our theory. This predominance is seen in all the subjects except *Mr.* The left hand in localising on the right arm stopped short of the point stimulated, as a result of the overestimation of movements in flexion. But on the left arm the left displacements are also dominant, and this seems to contradict our theory. Examination of the Tables, how-

TABLE VI.

Reactor: Py. Mr. Mn. Ph.

	TWENTY EXPERIMENTS.				THIRTY EXPERIMENTS.				FORTY EXPERIMENTS.				FORTY EXPERIMENTS.			
	Right.		Left.		Right.		Left.		Right.		Left.		Right.		Left.	
Unit = 1 mm.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.	No. of Displ.	Av. of Displ.
Peripheral	4	8	1	10	5	13	17	22.5	10	21.8	12	17.9	8	13.3	16	16.7
Central			1	6	2	7										
Right			4	7.9	3	9.3			5	12			10	17	2	11.5
Left	2	10	1	9					1	6	5	17.6	2	8		
Right Peripheral	2	11	8	10.6	18	14.9			16	15.3	4	15.4	8	16.8	9	16.1
Left Peripheral	12	20	2	6			13	18	6	25.6	19	14.9	7	13.6	13	13.3
Right Central			3	9	1	10			1	20			2	23		
Left Central					1	7			1	4			2	11.5		

ever, shows that these left displacements on the left arm are not so largely in the ascendency as on the right arm. Two influences were apparently at work. The right arm tended to make a greater excursion than the left, as will be explained hereafter, and so to pass beyond the stimulated point; but this tendency was counteracted in part by the influence of movements in flexion. It should be noted that in our work the movements of the right and left arms were made in series, and so were neither simultaneous nor immediately successive. The intervals between two series with the same arm were from ten to twenty minutes.

Loeb[1] describes some experiments which, though made for a different purpose, give substantially our conditions and are confirmatory of our results. His object in the special part of the investigation from which we quote was to show that in simultaneous movements of the hands in the same direction, the one moving laterally[2], the other medianly[3], and equal movements being intended, the median excursion is always greater than the lateral. In describing his work, Loeb says: "Die Versuchsperson steht wieder so vor dem Faden, dass derselbe ihre Medianebene im Kernpunkt unter einem rechten Winkel schneidet. Dagegen ist Ausgangspunkt der Fühlstrecken diesmal nicht der Kernpunkt, sondern je ein durch eine kleine Klemme markirter Punkt 200 mm. nach rechts und links vom Kernpunkte. Dieser Abstand entspricht beim erwachsenen etwa der Entfernung des adducirten Armes von der Medianebene; die linke Hand der Versuchsperson liegt an der linken, die rechte Hand an der rechten Marke. Der Faden ist wieder mit Daumen und Zeigefinger gefasst." He continues, and for his purpose this is the important point: "Die Aufgabe der Versuchsperson besteht darin, *gleichzeitig auf Kommando beide Hände nach derselben Richtung entweder nach rechts oder nach links bei geschlossenen Augen mit gleicher Geschwindigkeit zu bewegen.* Die Bewegung soll wieder so erfolgen, dass nach dem Urtheil der Versuchsperson der Abstand beider Hände vom Ausgangspunkt in jedem gegebenen Augenblick gleich ist. Die Bewegung soll sistiren, sobald die eine der beiden Hände an der vom Experimentator angesteckten Grenzmarke anlangt. Der Versuchsperson wurde gesagt, auf welcher Seite sie die Grenzmarke treffen wurde. Der Abstand war ihr aber unbekannt."

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[1] *Untersuchungen über den Fühlraum der Hand.* Pflüger's Archiv, XLI, pp. 116-119.

[2] Laterally = from the median plane outward.

[3] Medianly = from the side toward the median plane.

We have selected the "Mediale Fühlstrecke" from one of Loeb's typical series, and give the results :

LEFT HAND.	RIGHT HAND.
185	300
250	200
215	210
120	220
190	240

These "Mediale Fühlstrecken" were evidently obtained under conditions very similar to our own, as far as concerns the relative length of the excursion of the two hands ; and we find that the right hand made on an average a much greater excursion. From further experimentation by Loeb for the purpose of showing that it is important for the result whether the point which marked the limit of the excursion of one hand lay on the lateral or median side of the axillary line, we can again compare the "Mediale Fühlstrecke" when this mark lay on the lateral side. The excursion of the right hand is here, too, larger than that of the left. The explanation of this, since it is not entirely germane to our discussion, we reserve for an appendix.

It will be noticed that for all the reactors there were some central displacements. The introspection of one of them showed that in some of these cases there was inattention, and consequently random localisation. Observation on the part of the experimenter showed that there were now and then accidental changes of position which brought the arms into such relation that *less* movement in flexion was necessary to make a central than a peripheral displacement. Some centrals were, no doubt, due to absolute chance. In the experiments with the eyes open, central displacements are more numerous than elsewhere. Nearly all of these occurred in the earlier series. There was probably confusion resulting from the failure, at first, to translate into the more extended visual space, now introduced quite importantly, the cutaneous space which was predominant in the non-visual experiments. The visual extension from wrist to stimulus-point, obtained when the eyes were open, would be likely to bring about an overestimation of the movement centred necessary for localisation. Some of the smaller central displacements were obtained as vacillations of the hand after localisation. There seemed to be indifference of localisation within certain limits, the hand often wandering about a more or less circular area with a radius of perhaps 4–10 mm., though no attempt was made to determine it exactly.

The average displacement for all the subjects is smallest with the eyes open. For two of them, that for the non-visual

series is the largest. Visualisation apparently lessens the amount of displacement. The visual factor being now given a place in combination with the other factors concerned in localisation, the constant error is smaller.

C. Summary.

(1) The displacement toward the wrist found in these and the related experiments of Mr. Pillsbury seems to be due to *overestimation of movements in flexion and underestimation of those in extension.* We have suggested in explanation of this that as flexion, approached from extension, gives a greater amount of organic sensation than extension, approached from flexion, the *amount of sensation* is in the one case judged a greater, in the other case, a smaller distance.

(2) When the normal ending of the localising movement (pressure upon the skin) is cut off, *the limen of localisation is much greater.* We have explained this by showing that the removal from the total experience of one or a number of familiar elements, artificially or otherwise, makes recognition more difficult, and that this difficulty of recognition is expressed in a greater error of localisation.

(3) *With visualisation the amount of displacement is lessened.* This greater accuracy results, in general, from the emphasising of a factor which, in ordinary experience, is very influential in tactual localisation.

(4) In movements not simultaneous, for distances estimated as equal, *the right arm tends, for movement in flexion, to make greater excursions than the left.* (Cf. Appendix.)

D. Appendix.

Before attempting to suggest even a tentative explanation of the tendency of the right hand (as found in these experiments) to make the greater excursion, it would, perhaps, be better to give the evidence for it as found here and elsewhere. In this investigation, three of the subjects show the tendency. Some crude experimentation in the general drill-work of the Cornell laboratory showed in the case of a large majority of the eighteen subjects a slightly greater excursion of the right hand than of the left. An arrangement of Loeb's tables, so as to bring them approximately under the same conditions as our own, tends to confirm our results. In the experiments mentioned above, however, the movements were made from the side toward the median plane. They were movements in flexion. The question arises as to which arm would make the greater excursion when moving from the median plane outward—movement in extension. The drill-experiments in the labor-

atory showed that for the majority of the subjects, the *left* hand made the greater excursion in the movements last described. In the table given by Loeb (p. 110 of article previously quoted) we find a greater excursion for the *right* hand, when moving from the median plane outward, for four out of six subjects. On pp. 112 and 113, the greater excursion is shown for the right hand in the case of three out of four subjects; yet it must be remembered that Loeb quoted results which were typical as regards his own question, and that they were not selected with any reference to ours. On p. 114 of the same article he says, with reference to movements from the median plane outward, that for right-handed persons, not mechanics, the *left* hand makes the greater excursion. Sanford[1] makes, tentatively, a similar assertion. Hall and Hartwell[2] experimented upon a large number of subjects, but chiefly upon two right-handed and two left-handed persons. They say that in simultaneous movements from the median plane outward, the "preferred hand" made the greater excursion. However, when the movements were successive instead of simultaneous, there was a tendency to reduce the excess of the preferred hand, and, *in some individuals*, to make an equal or even a greater error in favor of the non-preferred hand.

It is, perhaps, well to note that Mr. Pillsbury[3] found in all of his subjects a tendency to a larger number of peripheral displacements when localising with the right hand than with the left. This would seem to indicate that the left hand made the greater excursion in movements toward the median plane. In our own experiments two of the subjects have similar and two have contrary results. However, as has already been hinted, the exact position of the arm operated upon, relatively to the other, would materially affect the interpretation of these results, and this position was not regulated with any reference to our present question, either in the experiments of Mr. Pillsbury or in our own.

That there are inconsistencies and apparent contradictions in the outcome of the investigations just quoted, is not surprising. None of them, except those of Hall and Hartwell and the drill-work of the Cornell laboratory, were conducted with any view to Bilateral Asymmetry of Function. A large number of factors other than those affecting the question at issue would enter into such experimentation, and would, to a greater or less degree, vitiate the results for our purposes. Yet there are in them some suggestions. Hall and Hartwell

[1] "Laboratory Course in Psychology," p. 35.
[2] "Bilateral Asymmetry of Function," *Mind*, O. S., IX, pp. 93-109.
[3] Am. Jour. of Psychol., VII, p. 52.

say that the right arm is sometimes one-third stronger than the left. Loeb and Sanford agree that, in the case of mechanics, the right arm makes the greater excursion. This may point to a loss of sensation (automatism, lapse of attention) due to habituation; the less noticeable amount of sensation being judged the smaller distance, the right hand would move too far. We find in the various results quoted some indication that with right-handed persons, not mechanics, the right hand makes the greater excursion for movements in flexion, but the left hand for movements in extension. This might also be explained upon the assumption of loss of sensation due to habituation. The movement of the right hand in flexion, though still giving distinct sensations and requiring effort, is underestimated as compared with that of the left, because the right hand, being used more frequently, has been reduced to a greater degree of automatism. In movements of extension, *i. e.*, from the median plane outward, the movement is one of relaxation, the sensations caused by the flexion being lost as the hand moves outward,—at least, through small distances. Since, when both hands are held in the median plane, less sensation results from the flexion of the right arm than from that of the left, there is less to be lost in the outward movement, and the right hand does not go so far as the left. We admit, however, that this, the only explanation which we can now offer, is not very satisfactory, and that it applies, in any case, only so far as the outward movement is a relaxation of tension.

The mixed results before us can be, at best, only suggestive. Continued and careful experiments upon a large number of subjects under conditions from which, as far as possible, all factors except those directly affecting the relative movements of the two arms have been eliminated, would be necessary to give sufficient data for any definite theory. Indeed, it may be true, as suggested by Sanford in connection with the same subject[1], that the judgments of symmetry of position and motion rest upon such complex combinations of cutaneous and organic sensations that the results will always be variable from one subject to another and in the same subject at different times. There must, however, be conditions for this variation, and the complexus of sensations may not be able to resist all analytical attacks.[2]

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[1] *Op. cit.*, p. 36.

[2] Experiments upon this question are now in progress in the laboratory of the Randolph-Macon Woman's College.

A STUDY OF CONVERSION.[1]

By Edwin Diller Starbuck,
Fellow in Psychology, Clark University.

Throughout Christianity, down to the modern "revival meeting," a phenomenon has been prominent, commonly called "conversion." In the Greek, Roman Catholic, Lutheran, Anglican, Episcopal and some other churches, it has a correspondence in "confirmation." It is characterized by more or less sudden changes of character from evil to goodness, from sinfulness to righteousness, and from indifference to spiritual insight and activity. The term conversion is used in this study in a very general way to stand for the whole series of manifestations just preceding, accompanying and immediately following the apparently sudden changes of character involved. This is an attempt to get at the mental and spiritual processes at work during conversion rather than to establish any doctrines or definitions.

In order to get together a number of typical cases of sudden awakenings, to compare them, to discover what life forces are at work and to see where they belong from the standpoint of modern psychology, the following list of questions was sent out promiscuously:

"This inquiry is undertaken in the belief that religious experience is the deepest, most sacred and important of life, and that collating a large number of facts will help much in understanding the laws of the spiritual life. You are earnestly requested to assist by recording your own personal experience, anonymously if preferred, in the exactest manner. The confidence should be full in replying, and will be most sacredly respected.

"The results of the research will be sent to those making returns, if desired.

"You need not be confined to the outlines. If you cannot answer all questions, notice those only which appeal most strongly to your experience.

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[1] The following article is a continuation and extension of two lectures given before the Harvard Religious Union Nov. 19th, 1894, and March 11th, 1895, respectively.

I am indebted to Dr. G. Stanley Hall for sympathy and helpful suggestions in carrying out the following research, both before coming to Clark University and while here; my wife has given much valuable assistance in the preparation of the article; Prof. Lillie A. Williams of the New Jersey State Normal School has furnished much of the raw material for the study from her classes; Dr. John Bigham of De Pauw University has assisted in the same way. I wish to thank not only these persons and several members of Clark University, but all those who have been self-sacrificing enough to furnish the facts used out of their own experience.

"A. Conversion, Confirmation, or any Sudden Awakening.

"I. What religious customs did you observe in childhood, and with what likes and dislikes? In what ways were you brought to a condition to need an awakening—faulty teachings, bad associations, appetites, passions, etc.? What were the chief temptations of your youth? How were they felt and how did you strive to resist? What errors and struggles have you had with (a) lying and other dishonesty, (b) wrong appetites for foods and drinks (c) vita sexualis; what relation have you noticed between this and moral and religious experiences? (d) laziness, selfishness, jealousy, etc.

"II. What force and motive led you to seek a higher and better life:—fears, regrets, remorse, conviction for sin, example of others, influence of friends and surroundings, changes in beliefs or ideals, deliberate choice, external pressure, wish for approval of others, sense of duty, feeling of love, spontaneous awakening, divine impulse, etc.? Which of those or other causes were most marked and which were present at all?

"III. Circumstances and experiences preceding conversion:—any sense of depression, smothering, fainting, loss of sleep and appetite, pensiveness, occupation disturbed, feeling of helplessness, prayer, calling for aid, estrangement from God, etc.? How long did it continue? Was there a tendency to resist conviction? How was it shown?

"IV. How did relief come? Was it attended by unnatural sights, sounds, or feelings? In what did the change consist:— breaking pride, public confession, seeking the approval of others, feeling God's forgiveness, sudden awakening to some great truth, etc. How sudden was the awakening?

"Did the change come through or in spite of your own thought, deliberation and choice? What part of it was supernatural or miraculous?

"V. Feelings and experiences after the crisis:—sense of bodily lightness, weeping, laughing, joy, sorrow, disappointment, signs of divine pleasure or displeasure, etc. How differently did you feel towards persons, nature, ideas, God, etc.? Did you have unfulfilled expectations or disappointments?

"VI. Comparison of life before and after:—changes in health, habits, motives, conduct and in your general intellectual and emotional attitude. Did you undertake any private religious acts, as Bible reading, meditation, acts of self sacrifice, prayer, etc.?

"VII. Were there any relapses from first experience? Were they permanent or temporary? Any persistent doubts? What difficulties from habits, pride, ridicule or opposition of others, etc., had you, and what methods did you adopt? Do you still have struggles in your nature? Does that indicate that the change was not complete? How have you and how will you overcome them? What needed helps, if any, were wanting at any time?

"VIII. Did you always find it easy to follow the new life and to fit into its customs and requirements? If not, how did you succeed —by habit, pressure and encouragement of friends, a new determination, a sudden fresh awakening, etc.?

"IX. State a few bottom truths embodying your own deepest feelings? What would you now be and do if you realized all your own ideals of the higher life?

"X. What texts, hymns, music, sermons, deaths, places and objects were connected with your deepest impressions? If your

awakening came in a revival meeting, give the circumstances and methods used. What do you think of revivals?

"XI. If you have passed through a series of beliefs and attitudes, mark out the stages of growth and what you feel now to be the trend of your life.

"B. Gradual Growth.

"If your moral and religious life has been a more or less steady growth, kindly describe it, including the following points and any others of importance which occur to you, in addition to I, II, IX and XI above:

"I. Influences, good and bad, which have been especially strong in shaping your life: — parental training, work, friends, church, music, art, natural phenomena, deaths, personal struggles, misfortunes, etc.

"II. Were there periods at which growth seemed more rapid; times of especially deepened experience; any sudden awakening to larger truth, new energy, hope and love? At what age were they? How did they come:—some crisis, a death, meditation, some unaccountable way, etc.?

"III. Have you had a period of doubt or of reaction against traditional customs and popular beliefs? When and how did it begin and end, if at all? Have you noticed any relapses or especially heightened experiences? How did they come and with what were they connected?

"IV. Have you felt or known any special revelation of thought or feeling to come to you, and in what way? Has your growth come through, or in spite of, your own thought, deliberation and choice.

"C. Supplementary Facts.

"(*a*) Describe any faults or acts you have committed in which you knew at the time they were wrong. Why did you do them?

"(*b*) What sudden awakening of power have you noticed in yourself, in others or in animals:—speaking, singing, playing, loving, hating, reasoning, etc.? How sudden was it? How do you explain it?

"(*c*) Describe any sudden changes which have come into your character or in your attitude toward things or persons. How and why did it occur?

"(*d*) Have you ever had a time of great uncertainty which of possible courses to pursue,—in choosing a calling, in love, whether to do an act or not, etc.? Describe accurately and minutely your feelings preceding, during and after the struggle.

"(*e*) If you have ever broken a habit, describe all the accompanying experiences and feelings.

"Always give age, sex, temperament and nationality."

The present article concerns itself only with groups A and C. It has been difficult to separate the cases into the two groups of sudden awakenings and gradual growth. Unless there has been a rather marked change, they have been put in the latter class, except in those cases of revival experience in which the real religious life was thought to begin there, although the contrast in habits and feelings was not great. After separating them the number of sudden awakenings sufficiently complete to use at all in tabulation was 137. Of these, 51 were from males, 86 from females. The difference between them makes it necessary to treat them separately for the

most part. By far the majority were records of conversions occurring under 27 years for males and under 23 for females. For this reason the scattered ones from that age up to 70 years are omitted in all places where per cents and averages are used, and always, unless otherwise stated. The following is thus very largely a discussion of adolescent conversion. (Adolescence extends to about 25.) Of the whole number, by far the majority are Americans, and pretty evenly distributed among the states. Besides there are 6 English, 3 Canadians, 2 Japanese, 2 negroes and 1 German. In most instances the church connection was not given. Almost all, however, are Protestants, and nearly all the denominations appear to be represented. At least 4 are Episcopalian. Nearly half were conversions occurring at revival meetings. The rest were in regular church service, at confirmation, and at home. The per cents showing the circumstances under which the conversions occurred are given in:

TABLE I.

CIRCUMSTANCES UNDER WHICH CONVERSION OCCURRED.	Male. %	Female. %	Both Male and Female. %
At revival or camp meeting,	48	46	47
At home after attending revival,	5	6	5
At all under revival influence,	53	52	53
At home and generally alone,	32	16	21
At regular church, or prayer meeting, or confirmation,	4	25	18
Circumstances not given,	11	7	9

Among other things, it should be noticed from Table I that revival meetings play an important part in conversion, either by directly inducing a change in the life, or in leaving impressions which are worked out immediately afterwards; but that conversion is a phenomenon which so far belongs to growth that about one-fifth of the entire number (21%) have taken place independently of immediate external influence. When it is remembered that revivals are generally carried on with much emotional pressure in the way of exhortation, songs, music, prayers and personal influence, it is significant that the per cent. of revival conversions is about the same for males and females; that of the remaining number more of the male than of the female conversions (32% vs. 15%) work themselves out at home; and that one-fourth of the female conversions, as against only 4% of males, occur under the more quiet influences of the usual church services.

THE AGE.

The four curves below, in Figures I and III, show graphically the frequency of conversions for different years. Spaces to the right show the ages from 7 to 27 years. Distance upward stands for per

cent. of the whole number for each year. For example, in the case of males 20% of the conversions were at 15 years.

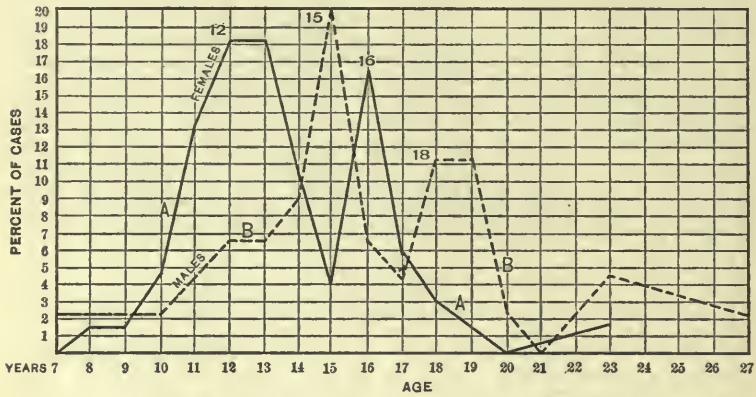

FIGURE I. *Showing the periods of greatest frequency of conversions.*

Since the females were nearly all above 18 and the males above 20 years at the time of making the record, the probability is the same that any conversion would fall within any year previous to that. The curves would then be straight lines parallel to the base. The value of the curves is in their irregularity. Curve A for females shows that below 10 years of age there are very few conversions. The number increases from 10 years, to 12 and 13, which is the period of greatest frequency. From that time they become less frequent until 15 years. At 16 the curve rises almost to the height of the first rise. Beyond 17 there is a gradual decline. Similarly, curve B for males begins at 7, rises gradually to 14, culminates at 15, declines to 17, has a second elevation at 18 and 19, and gradually falls after 19.

The character of the curves is so striking that some of their more significant features will be considered:

(*a*) *The years of greatest frequency of conversions correspond with periods of greatest bodily growth for both males and females.*

Curve B, for males, begins earlier, rises more gradually and culminates 2½ years later than A. These points have an analogy in physical development. Roberts[1] shows that in the degree of physical maturity of men and women, 12½ years in females corresponds to 16 in males.

The analogy between the greatest height of A and B and the period of most *rapid* growth is also of interest. The curves in Figure II are adapted from Donaldson,[2] and are from Stephenson's[3] averages of the measurements of Bowditch[4] and Roberts.[5]

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[1] Chas. Roberts, "Physical Maturity of Women." *Lancet*, London, July 25, 1885. Roberts' report is based on the researches of Bowditch, Chadwick and himself.
[2] H. H. Donaldson, "The Growth of the Brain." New York, 1895.
[3] Stephenson, *Lancet*, 1888.
[4] Bowditch, "The Growth of Children." Report of the State Board of Health of Massachusetts. Boston, 1877.
[5] Roberts, "*Manual of Anthropometry*," 1878.

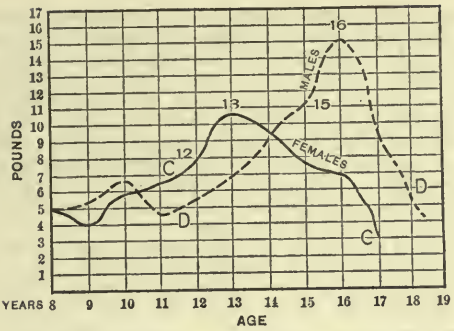

FIGURE II. *Showing annual increase in weight of boys and girls.*

They show that females increase in weight 10½ pounds between 12 and 13, and that males increase 15 pounds between 15 and 16, which is 2½ and 3½ pounds, respectively, more than the gain between any other years. In the case of females this exactly agrees with curve A. For the males the increase in weight comes a little later than in the conversion curve; but the difference is not so great, if it is noticed that the greatest increment in D is close to the 15th year.

(*b*) *There is a correspondence between the periods of most frequent conversions and puberty in both sexes.* The time of accession to puberty varies slightly. The phenomena by which its advent is judged are also variant. Table II is based on the age at which the menses appear. Using other physical signs to indicate its advent, would doubtless make the average age somewhat less. "In infantile cases (of *true menstruation*) the attention of the mother is

TABLE II.

Comparing the age of accession to puberty with the time of conversion. (Females.)

FEMALES.	Age of greatest frequency.	Average age.
Accession to puberty—		
Italians[1] (wealthy), }	13	14.5
Italians[1] (artisan), } 2,760 cases,	13	14.8
Italians[1] (rustic), }	15	15.5
English[1], 500 cases,	?	14.7
American[1], 575 cases,	14	14.8
American[2], 125 cases,	?	13.7
Grouping the foregoing; total,	13.7	14.7
Age of conversion—		
Those at revivals, 46 cases,		13.1
Those not at revivals, 40 cases,		14.6
All together, 86 cases,	12.5	13.8

[1] Chas. Roberts, "Physical Maturity of Women."
[2] Helen P. Kennedy, M. D., *Pedagogical Seminary*, June, 1896.

generally attracted by the womanly development of the child before there is any appearance of the menses."[1] The normal age of puberty is, in fact, generally given in medical records at from 12 to 14 in case of females, and about 2 years later in males.[2] Taking the general group of physical signs[3] as the indication of dawning adolescence, making it 12 or 13 for females and 14 or 15 for males, the agreement with the culmination of curves A and B is of interest.

There is, of course, room for indefinite mental gymnastics in using such statistics. In a general way their points of agreement are interesting. The average age of female conversion, 13.8, differs only by a small fraction from the age of most frequent accessions to puberty, as shown from nearly 4,000 cases. The average age of revival conversions is 1½ years earlier than of those which occurred at home and under the quieter church influences. The average age of conversions not at revivals, 14.6, differs by one-tenth of a year from the average age of puberty. If one should regard these as the normal conversions which take place in the absence of emotional pressure, the coincidence is important. The points of disagreement in the statistics are evident and will be noticed later.

The observations on boys have been too few to obtain tabular results as to the age of puberty. It is generally agreed to be from 2 to 2½ years later than that of girls. It will be noticed that curve B follows curve A by 2½ years and repeats most of its details. The average age of male conversions is 15.7 years, as against 13.8 for females. If the female conversions come near puberty, this difference of about 2 years throws the average age for males at about the corresponding period. It thus appears that there may be a normal age for conversion at about the beginning of adolescence. It is suggestive to notice in this connection that nearly all people, including the savage races, have ceremonies upon the advent of puberty, such as torture, circumcision, knocking out teeth, tattooing, changing the name, nearly all of which are religious rites and intended to initiate the child into a new life.[4]

If the correspondence appears so close between puberty and the average age of conversion, then what of the very early conversions and also those which come much later?

(c) *Early conversion.* It is possible that in the case of the conversion of children, it may be accompanied by, or be the accompaniment of, the awakening on the physical side. The facts have not yet been gathered sufficiently to establish a law of growth in regard to the time of the awakening powers of the youth in general. They are quite satisfactory concerning the age distribution of the time of accession to puberty. The instances are numerous of the precocious development of the reproductive system, and the range extends all the way from 1 or 2 years upward.[5] The distribution, according to years, of the 575 American cases of females from Roberts' report used in Table II are representative. Taking them on a basis of 100 cases, they extend from 10 to 20 years, inclusive, according to the following series: 1, 5, 9, 18, 25, 20, 14, 3, 3, 1, 1. This is approximately the range of female conversions. Other sug-

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[1] R. P. Harris, *Am. Journal of Obstetrics*, 1870-71.

[2] S. S. Herrick, "Reference Hand-book of Medical Sciences," VI, p. 70.

[3] For a description of the bodily changes at adolescence, see G. Stanley Hall, "Training of Children and Adolescents," *Ped. Sem.*, June, '91. Dr. Burnham, "The Study of Adolescence," *Ped. Sem.*, June, '91.

[4] Daniels.

[5] For an introduction to the extended literature of the subject, see Index Catalogue of the Library of the Surgeon General's Office, United States Army, Washington, 1890, XI, p. 761.

gestive comparisons appear: 63% of the males converted before 14 mention sexual temptations among those of childhood, and generally as the most prominent; the rise of curve A just preceding puberty is more sudden than that of B, which agrees with Harris' statement that "infantile puberty is more common in the female than in the male sex;" the more gradual rise of B throughout than of A, is also true of D as compared with C; male conversions begin at a correspondingly earlier age than do the female, and a study of precocious puberty seems to show the same thing.[1]

Other causes for early conversion may be seen from these extracts:

F., 11.[2] "Had deeply religious parents; was always in some sense a Christian; a sermon by my father in childhood thoroughly frightened me, and its effects never left me; was tormented with fears of being lost."

F., 11. "Deep impression was made by a story of a woman who died saying, 'A million dollars for a moment of time;' I was overcome by fear of sudden death."

F., 11. "My early life was careless and happy as a bird's; first time religion seemed meant for me was at a revival, when Mr. M. preached on the crucifixion; he drew a vivid picture of it, and told the congregation they had nailed Him to the cross; my childish heart was broken; felt I could do nothing to atone for making Christ suffer."

F., 10. "Was a naughty child, and was left early without a mother and without education; at a revival meeting several women urged me to go forward; they told me mother could see all I was doing and wanted me to go."

M., 7. "Heard one person tell another of a third person 'confessing her sins;' resolved I would do the same.'"

M., 11. "Was mostly the influence of my seatmate; when he went to the altar I thought, 'Why, if he can be a Christian, I can, too.'"

M., 8. "Sickly as child, prematurely developed intellectually, and called the 'boy preacher' when 8."

F., 11. "When 8, the death of my brother made a deep impression on me; it awakened thoughts of the future; at 9 years of age I attended a revival, and wanted to become a Christian; did try to be better."

M., 11. "Had a sudden sexual awakening at 7 years; it came over me all of a sudden that there was more to life than I had expected."

These instances are typical. Prominent among the forces at work to bring about the conversion of children are overtraining, emotional excitement, mere imitation and precocity. Looking through all the cases before 12 and 14 for females and males, respectively, and estimating the number of them in which any or all of these four causes are present, we have Table III. The per cents show the frequency rather than the importance of each of the causes. For example, in one-half of the cases of females converted before 12, imitation was present.

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[1] I feel like throwing out the caution here that although these sets of phenomena are closely related in time, they probably have very little causal connection. The development of the reproductive system is perhaps, biologically, at the basis of this growth crisis in early adolescence, but is only one of the phenomena in the general awakening.

[2] *F.* indicates females, *M.*, males. The number following always stands for the age at conversion.

TABLE III.

Showing the frequency of certain causes leading to early conversion.

CAUSES HASTENING EARLY CONVERSION.	Females. %	Males. %
Intense religious training in childhood present in	71	64
Strong emotional pressure present in	86	73
Imitation present in	50	64
Precocity, or hastened seriousness through deaths, etc., present in	43	36
Any one of the above forces present in	100	100
Permanent results,	57	40
Temporary results ("backsliding"),	53	60

That is, in every instance of early conversion, at least one of these causes was acting. The table is only intended as suggestive. The separation by years may lead to false impressions. Many conversions at 11 appear more mature and healthy than others coming much later.

(*d*) *The second rise in the curves.* Both curves rapidly decline after the first culmination, and have a second rise at 16 and 18 respectively. So close is the correspondence that the time between the climaxes of each is the same (3½ years), the depressions are about equal, and the relative heights of the first and second rise of each curve are similar. This came as a surprise, and I am able to find nothing like it in physical growth. The cases themselves seem to throw some light into it. A few of them mention an impulse to conversion at about the beginning of adolescence; it then dropped out of their thought and was revived again later. The following are typical:

F., 16. "When 12 I had an impulse to go to the altar with two girl friends, but something kept me back; (when 16) in a little meeting I felt serious; my friend near me wanted me to go to the altar, and I thought on it and went."

F., 16. "When 12 or 13, at the advice of an old woman, I asked God to take my heart; did feel very happy (was confirmed at 16); never have felt so sincere and earnest, and anxious to be good."

F., 17. "Had made start at 15 in revival meeting, but did not join church, and let it all pass over; (when 17) I felt the love and mercy of God; after an hour of pleading and prayer, I felt relief from my sins."

F., 16. "I began to feel conviction at 11 years of age."

F., 16. "I experienced a sort of half conversion two years before."

From these quotations it would appear that there is a normal age for conversion at about the beginning of adolescence. If that is

not complete or is resisted, a relapse follows. Then there is another time of aroused activity from two to four years later. This appears to be a normal ebb and flow of religious interest. Curve B shows signs of a third fluctuation at 23 years, but the data are too few at that period to allow any inference.

Another cause of the second increments at 16 and 18½ years seems to be that, through some accident, or some defect in early training, the person is not sufficiently developed to respond to spiritual influences at the first normal period.

F., 16. "When 10 years old mother died; I lost interest in everything; I felt dazed and lived in a sort of dream until 16, when I attended revival; had intense remorse; with tears came relief and joy; my whole life was changed from that hour."

F., 17. ("I was carefully trained and taught to pray); when 14 I had companions who laughed at religion; I became like them; often had stings of conscience; (when 17) attended meeting; felt that God had forgiven my sins."

F., 18. "As child of 9 was petted and spoiled; was much with people who cared little for religion; when 18, the downfall and death of a friend I had trusted set me to thinking; cried to God for mercy and forgiveness."

F., 16. "Parents were agnostic; no Christian influence, but the contrary; felt need of religion."

M., 16. "Was a wild, wicked boy; father took pride in my wildness; had been to an uproarious wedding; when I got home I felt condemned; awful impression that death had come; unspeakable joy sprang up."

M., 18. "Was not raised in a religious family; was the first of my family, except mother, to become a Christian."

Almost all the cases occurring at the later periods fall under those two headings. There are various other causes, as suggested in the following:

F., 17. "Had made many resolutions to be a Christian, but pride kept me from telling it."

F., 18. "Had suffered for years wanting to be a Christian and not knowing how."

M., 19. "From earliest boyhood had longed to be a Christian; lived a careful, good life, in hope of being accepted of God because I refrained from evil."

F., 16. "From 10 to 16 I only cared to have a good time, and let myself drift along."

M., 18. "I called myself morally upright, never believing what I said exactly."

It is possible, also, that there is a normal period of intellectual awakening which follows the physical and emotional disturbances at the beginning of adolescence. The later cases seem to be more mature.

We may say that in some the cause of the second increments in the curves may be: an intellectual ripening for religious insight; a natural fluctuation of religious interest; some defect in early training; some accident which retards growth; or some trait of character, such as reserve, pride or willfulness, which has prevented a response to the first impulses.

Putting together the male and female cases, and plotting them on a scale to show the per cent. at different years, gives curve E, Fig-

ure III; the average of all the ages is 14.4 years. Using that as the height of another curve which disregards the minor irregularities in E, we have curve F, which is very roughly the curve of frequency of adolescent conversions. If the cases which constitute this study are representative, it appears that early adolescence is the golden period at which there may be a definite, radical readjustment of one's religious nature.

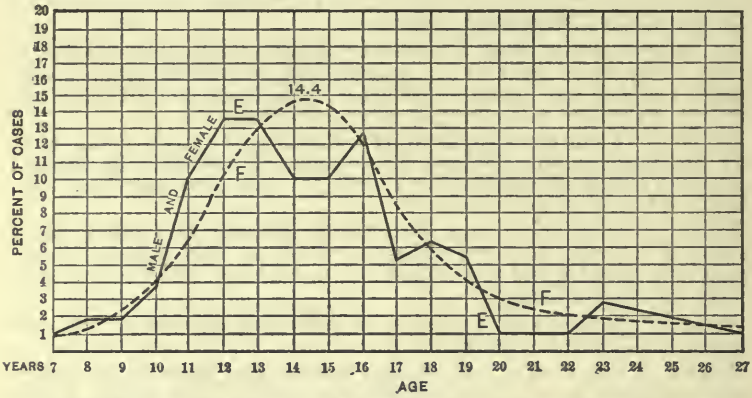

FIGURE III. *Showing the frequency of adolescent conversions for males and females taken together.*

The character of F might be changed with a greater number of cases. Many returns were made by persons 18 or 19 years of age. The chances are thus slightly decreased that conversions would fall between 17 and 27 years, which doubtless places the height of the curve too early. The fact that more returns were from the female sex, which naturally develops earlier, would also tend to make the general average of 14.4 too early. Many more returns are needed to make generalizations entirely reliable.

THE MOTIVES AND FORCES LEADING TO CONVERSIONS.

A study of the motives and forces which occasion religious awakening is not of much importance, perhaps, as furnishing insight into the nature of the developed product, but it is of value from both the scientific and pedagogical standpoints. When brought together, the motives and forces seemed to fall pretty naturally into eight groups: fears, other self-regarding motives, altruistic motives, following out a moral ideal, remorse and conviction for sin, response to teaching, example and imitation, and urging and other forms of social pressure. The illustrations given below are a few of the representative (not the striking) instances:

1. Fears: *F.*, 12. "Terrors of hell dwelt on at revival until I became so scared I cried." *F.*, 14. "Had I died, had no hope, only eternal loss." *M.*, 15. "Fear of God's punishment." *M.*, 22. "Fear of death and waking up in ——." In many instances fears were declared to be entirely absent. *M.*, 18. "Two ministers told me I'd go to hell if I didn't make a stand; I said I'd never be a Christian to dodge hell."

2. Other self-regarding motives: *F.*, 17. "Wanted the approval

of others." *F.*, 11. "Father had died, and I thought I would get to meet him." *M.*, 7. "Ambition of a refined sort." *M.*, 18. "The man who is best is strongest and happiest."

3. Altruistic motives: *F.*, 19. "Wish to please minister counteracted my negative attitude." *M.*, 18. "Wanted to exert right influence over pupils at school." *F.*, 16. "Felt I must be better and do more good in the world." *F.*, —. "It was love for God who had done so much for me."

4. Following out a moral ideal: *M.*, 14. "Feeling of duty." *M.*, 16. "Wanted to be good and control anger and passions." *F.*, 17. "An inner conviction that it was a good thing to do." *M.*, 15. "Had a yearning for higher ideal of life." *F.*, 13. "Spontaneous awakening to a divine impulse." Groups 3 and 4 run into each other. The sense of duty which was not referred objectively is included in the latter.

5. Remorse and conviction for sin: *F.*, 17. "Remorse for past conduct was chief motive." *M.*, 18. "Was thoroughly convicted of sin." *F.*, 14. "My sins were very plain to me; thought myself the greatest sinner in the world." *F.*, 18. "The downfall and death of a friend I had trusted set me to thinking; I wondered if I were not worse than she."

6. Response to teaching: *F.*, 11. "Mother talked to me and made the way of salvation plain." *F.*, —. "A sermon that seemed just meant for me set me to thinking." *M.*, 23. "The teaching of Christ appealed strongly to my reason and judgment." Evangelical sermons described as emotional are included in the last group below.

7. Example and imitation: *M.*, 15. "It began largely as imitation." *F.*, 16. "I saw so many becoming good that I just had to become a Christian." *F.*, 13. "For the first time I came in contact with a Christian family; their influence induced me to become a Christian." *M.*, 16. "I thought only the power of religion could make me live such a life as brother's." This group ranges from mere imitation to sympathy with a great personality, where it closely approaches group 4.

8. Urging and social pressure: *M.*, 15. "The girls coaxed me at school; estimable ladies and deacons gathered round me and urged me to flee from the wrath to come." *F.*,13. "I took the course pointed out at the time." *F.*, 14. "A pleading word from my teacher helped me." Imitation and social pressure are frequently so intense that the individuality of the subject is entirely lost. *M.*, —. "It seems to me now hypnotic." *F.*, 16. "The sermon moved me; they sang; before I realized what had happened I was kneeling at the altar rail; I never knew what was said to me." In such cases there is one of two results: the forced position is accepted as the right one, or the person rebels when partial independence is gained. The former are included in this study. The cases in which the person appeared entirely to lose his or her individuality, and immediately to react against a forced conformity, are rejected. M., 50. "It was the buoyancy of the atmosphere that made me go forward; I had nothing to do with it; I could have done the same thing every week without any change in my character."

Table IV shows the relative prominence of the eight classes of motives and forces illustrated above as determined by the frequency with which each was named by the subjects. The evaluation was made in three ways: (1) Taking only the motives mentioned as most prominent ones; (2) trying to form an estimate

of the value of all the motives wherever mentioned, by duplicating those apparently very prominent; (3) simply counting their frequency. The first method made the self-regarding motives about one-third more prominent than the other two ways, and subtracted from the moral ideal class. The last two methods gave nearly the same results. Table IV is the result of the third method. It is arranged to show the difference between male and female conversion, and also to compare those taking place at revivals with the others.

(1) *The relative prominence of the different motives and forces:* This is best seen from column 17. Self-regarding motives make up one-fifth of all the causes and one-third of all the subjective forces. The sum of the altruistic motives, 6%, and the response to a moral ideal, 16%, forms a group which may be called distinctively moral motives. The sum is 22%, or about the same as the total self-regarding group. Conviction for sin plays about the same part. Fears are a large factor, and when estimated according to the various ways they present themselves to each person, instead of counting them once for each, they are nearly doubled. Hope of heaven is nearly absent. Fear appears to be present about fifteen times as often as hope. Only 6% are altruistic motives. Of these only 2% mention love of God or Christ as leading them to a higher life. This is significant in view of the fact that love of God is central in Christian theology. The subjective forces are one and a half times more frequent than external forces. Of the objective forces social pressure is greatest. Account was taken of it only when it was actually mentioned. Had the fact of about half the conversions occurring at revivals been taken as evidence that social pressure was really exerted, this per cent. would have been much greater. The same would be true also of example and imitation, which now make up 15% of the forces. Arranging the forces into three groups, according to their frequency, we have, beginning with the highest per cent.: (*a*) Response to a moral ideal, conviction for sin, and social pressure; (*b*) fear, and imitation; (*c*) following out teaching, and altruistic motives. It is of interest to compare fear of hell and conviction for sin, which are prominent, with hope of heaven and love of Christ and God, which are almost absent. These four are all central in Christian theology, and might be supposed to be about equal as religious incentives. It appears that those which are racial and instinctive are very much more prominent than the others. The average age at which the conversions occur in which these forces are present, tends to show the same thing. As a rule those which are racial and instinctive come earliest. The series of the forces which occasion conversion, arranged from the earliest to the latest, are the following: imitation, social pressure, conviction for sin, fear of death and hell, response to teaching, following out a moral ideal and altruistic.

(2) *Comparison of male and female cases:* Three groups of motives appeal about equally to males and females; they are: fear of death and hell, conviction for sin and the altruistic. Two groups appeal to the males more strongly: the self-regarding and moral ideal motives; three to the females more than to the males: response to teaching, imitation and social pressure. The greatest diversity is in the response to a moral ideal, which is 7% greater for males, and social pressure, which is 6% greater in the case of females.

(3) *The revival cases compared with the others:* Fear of death and hell, self-regard, altruistic and moral motives are about the same in both. Imitation and social pressure are greater in revival cases. Response to teaching and conviction for sin are greater in those

TABLE IV.

Showing the frequency of certain motives and forces which occasion conversion, and the average age for each motive.

MOTIVES AND FORCES PRESENT AT CONVERSION.	A. MALES.						B. FEMALES.						C. MALE AND FEMALE.					
	Revival.		Non-Rev.		Total.		Revival.		Non-Rev.		Total.		Revival.		Non-Rev.		Total.	
	%	Av. Age.	%	Av. Age.	%	Av. Age.	%	Av. Age.	%	Av. Age.	%	Av. Age.	%	Av. Age.	%	Av. Age	%	Av. Age.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Fear of death and hell, etc.	16	15.5	13	17.4	15	16.1	14	13.7	17	13.5	15	13.6	15	14.6	16	14.6	15	14.6
To gain heaven	3	14.4	3	16.5	3	15.4	1	13.1	1	13.3	1	13.2	2	13.6	1	15.1	1	14.4
Other self-regarding motives	4		5		4		4		3		3		4		4		4	
Total *self-regarding* motives	23		21		22		19		21		19		21		21		20	
Love of God or Christ	1		3		2		3		2		2		2		2		2	
Various other altruistic motives	2		5		4		4		3		4		3		4		4	
Total *other regarding* motives	3	17.6	8	17	6	16.4	7	14.2	5	16.2	6	15.2	5	15.7	6	16.5	6	15.8
Response to a moral ideal	18	14.8	24	16.9	20	15.8	13	14	13	15.6	13	14.6	15	14.5	16	16.3	16	15.2
Total *ideal & other regard'g* motives	21		32		26		20		18		19		20		22		22	
Remorse, *conviction for sin*, etc.	19	14.8	19	16.3	19	15.3	16	13.5	20	14.2	18	13.8	17	14.1	20	15	18	14.5
Total SUBJECTIVE forces	63		72		67		55		59		56		58		63		60	
Response to teaching	5	17	8	17.2	6	17.1	7	13	10	14.9	8	14.1	6	14.6	9	15.5	7	15.1
Example, imitation, etc.	15	14.1	9	15	13	14.4	16	13.5	15	14.5	16	13.8	16	13.8	14	14.6	15	14.1
Social pressure,—urging, etc.	17	14	11	17.5	14	14.9	22	13	16	14.4	20	13.5	20	13.4	14	15.3	18	14.2
Total OBJECTIVE forces	37		28		33		45		41		44		42		37		40	

which occur in more quiet surroundings. Although social pressure is greater in the revival cases, the sense of sin and fears are even less frequent than in the non-revival cases. This is evidence that the charge we so often make against revivals, that they stir up unduly lower religious incentives, such as fear, is not altogether just. They do not so much *awaken* these highly emotional states as appeal to those instincts already at work in the consciousness, and which would probably show themselves spontaneously a year or two later. The average ages at which the different motives arise show that the effect of revivals is to hasten the working of specific motives. The same motives culminate earlier as a decisive factor in conversion in nearly all the revival cases, sometimes by as much as two years.

There seems to be a normal age when the various motives should assert themselves. This is best seen from Figure IV, in which the various subjective influences at work at the time of conversion are

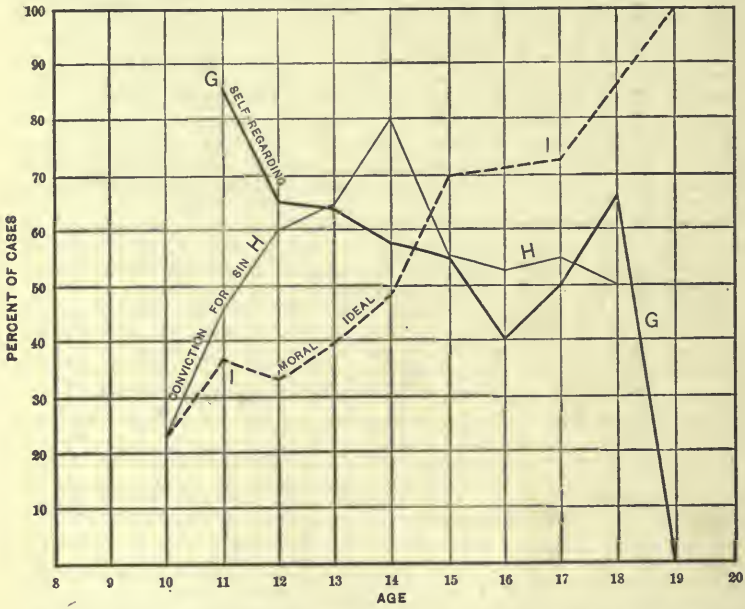

FIGURE IV. *Showing the frequency of various motives for different years (females).*

plotted to show their frequency for different years. Curves G, H and I are made on the basis of the ratio in hundredths between the number of times each motive was said to be present and the number of conversions for each year. Before 10 and after 19 the cases are scattering and the curves too irregular to be of value.

In earlier years the self-regarding motives, of which a large part are fears, are by far in the predominance. They gradually decrease. Curve I, for altruistic and moral ideal motives, exactly contradicts G. It represents the dawn of the moral consciousness. After 15, moral and other regarding incentives are present in almost

every case. The sense of sin, curve H, increases up to the early years of adolescence, then gradually decreases. It may be connected with the rapid nervous changes of early adolescence and the corresponding arousal of new, large, confused, organic impressions, the mental unrest and uncertainty, the undefined and unclarified ideas that come at this period when fresh life is making itself felt. The rapid increment of moral motives at the time when the sense of sin declines is worthy of notice.

The males did not make as full a record of motives as the females. They were also fewer. The curves for them were not complete enough to publish. The curve for moral motives was very similar to that for females, but it was clear that the self-regarding motives did not decrease as in the case of females.

Experiences Preceding Conversion.

Just before the apparent break in the continuity of the life, there is usually a mental state known in theological terms as conviction, or the sense of sin. It shows itself by various mental and bodily affections, such as the feeling of separation from God, depression, restlessness, anxiety, loss of sleep and appetite, a weight on the mind, a burden of heart, and the like. The quotations below will furnish a picture of the general mental and bodily states. The frequency of their occurrence is given in Table V. Remorse and conviction for sin, which are very prominent, are not included in these groups in cases where they were given among the motives.

Prayer: *F.*, 18. "I grew so distressed I cried to God for mercy and forgiveness." *F.*, 17. "I felt a weight of sin; prayed not to die until I became better." *F.*, 15. "I fought and struggled in prayer to get the feeling that God was with me."

Estrangement from God: *M.*, 15. "Sense of sinfulness and estrangement from God grew on me daily." *M.*, 16. "Felt that God despised me." *M.*, 16. "Felt a lack of harmony with the Divine Being and sense of continually offending Him." There is often a feeling of separation from friends; this is doubtless of the same sort, and grows out of the individual's feeling of detachment from the whole.

Restlessness and uncertainty: *M.*, 12. "Everything went wrong with me; it seemed like Sunday all the time." *M.*, 15. "Constantly worrying." *F.*, 14. "Thought something terrible was going to happen." *F.*, 23. "Felt wrong mentally and morally." *F.*, 17. "Could not keep my mind on anything." *F.*, 12. "Couldn't work." *M.*, 19. "Felt a want, an unrest, an aching void the world could never fill."

Depression and meditation: *F.*, 13. "Thought of my condition was terrible." *F.*, 16. "For nights and days my mind was troubled." *M.*, 20. "Secret meditation while at work." *F.*, 16. "Began thinking and thinking by myself."

Self-distrust and helplessness: *F.*, 23. "Was discouraged, and felt it was no use to try." *F.*, 18. "Had suffered for years, wanting to be a Christian and not knowing how." *F.*, 16. "Awful feeling of helplessness." Other less frequent affections are: desire to better life, earnestness, seriousness, doubts and questionings.

These states are not infrequently described in physical terms: "Couldn't eat." "Would lie awake at night." "Was excited." *M.*, 19. "Felt I was carrying the world on my shoulders." *M.*, 19. "Often, very often I cried myself to sleep." *M.*, 10. "Hymns would sound in my mind as if sung." *F.*, 15. "Had visions of

Christ saying to me, 'Come to Me, my child.'" *M.*, 17. "Just before conversion I was walking along a pathway thinking of religious matters, when suddenly the word H-e-l-l was spelled out five yards ahead of me."

Tendency to resist conviction: The cases arrange themselves naturally in a series from those in which there has been a continued, earnest effort in the direction of a higher life which finally dawns, to those at the other end of the series in which there has been a more or less wayward life, the awakening of an ideal which contradicts it and a stubborn refusal to follow it. At one extreme is the striving *after* something; at the other is the struggling *against* something. All the way between these extremes are hazy conceptions, an undefinable sense of imperfection, a "wanting something and not knowing what," which give rise to the feelings of restlessness, anxiety, depression, helplessness, and the like, as shown above. Perhaps in the tendency to resist conviction one sees reflected something of the nature of conversion and the explanation of some of the phenomena following it. *M.*, 15. (Carefully trained, fell into bad associations, and came under the influence of revival.) "I resisted as long as possible by finding fault with the church and its members, saying I didn't believe the Bible, or that there was a Hell; was afraid to go to church or to bed; saw a flood of light; so happy I sang all night and couldn't sleep." *M.*, 15. "I strictly avoided any conversation tending in any way toward moral or religious topics; conviction became torture, yet I could not yield." *M.*, 12. "Sort of inward tendency to resist, which did not show itself outwardly." *F.*, 16. "I stayed away from revivals and prayer meeting for fear of giving way to my convictions." *F.*, 17. "Tried every way to escape a friend interested in me, and the minister; in prayer meeting would hold on to the seat with main force to keep from rising for prayer." *F.*, 16. "Often fought against crying, the conviction was so strong." *F.*, 12. "Would tell myself, 'You ought to join church;' then I would say, 'No, you can't be good enough.'" *F.*, 18. "Dreaded to go forward." *F.*, 13. "Knew I would have to act differently at school and make up with my teacher, whom I had offended." *F.*, 17. "I tried to throw off the feeling by saying all sorts of reckless things about God and religion."

The frequency with which the various kinds of affections show themselves is given in Table V. The worth of the per cents is more in their relative than in their absolute magnitude. Many of the records were not complete, else the per cents might all be greater.

It is evident that depression and dejection are almost always present. The disturbances are described more often in mental terms than physical. The sense of remorse, restlessness, sadness, anxiety and the like are much more frequent than earnestness and a clearly marked purpose to enter a new life. The impressions are confused and organic.

Comparing the males and females, it is evident that the duration of conviction for sin is more than twice as long in case of the former. Doubts are more common in males, and resistance to conviction is about twice as frequent. Helplessness and humility are more common in females.

It is an interesting fact that the mental and physical disturbances are greater in the revival cases among the males and in the non-revival cases among the females. Studying through the female cases alone, it is pretty clear that one reason the stress is greater with the females who are not influenced directly by revival serv-

TABLE V.

Showing the frequency in per cent. of cases of different mental and bodily affections preceding conversion.

EXPERIENCES IMMEDIATELY BEFORE CONVERSION.	FEMALE.		MALE.	
	Revival. %	Non-Rev. %	Revival. %	Non-Rev. %
Remorse, conviction for sin (recognized as a motive)	16	20	19	19
Tendency to resist conviction	33	40	80	41
Prayer, calling on God	31	40	70	70
Sense of estrangement from God	17	32	30	16
Restlessness, anxiety, uncertainty	30	60	53	16
Depression, sadness, meditation	90	80	82	70
Helplessness, humility	15	6	—	8
Desire to be a Christian	13	11	12	8
Earnestness, seriousness	9	9	—	—
Doubts, questionings	—	6	6	30
Loss of sleep	17	35	60	40
Loss of appetite	17	20	35	16
Nervousness	6	6	12	—
Weeping	6	9	6	—
Ill health	6	—	—	—
Affection of sight	—	9	12	—
Affection of hearing	6	—	6	8
Affection of touch	12	12	24	—
Average duration of sense of sin	15 wks.	36 wks.	74 wks.	63 wks.

ices is that they lack the stimulus of the crowd to carry them through difficulties that are at work in their lives when they are left to work them out alone. Modesty and reserve keep them from making their struggles known. *F.*, 11. "I began to think deeply on religious subjects. I longed for some one to talk to about them." *F.*, 16. "I began thinking and thinking by myself." *F.*, 13. "I used to lie awake and cry over my sins." The strength of sermons, the rhythm of music, the encouragement of friends, the force of example and all the impetus that comes from a religious service, often furnish the last stimulus needed to carry the restless, struggling life through its uncertainty and perplexity. *F.*, 14. "The sermon seemed just meant for me." *F.*, 23. "Was wretched and discontented. Thought it no use to try. The music appealed to me. While they were singing, was much moved and rose to my feet." Similar instances are numerous. It will be noticed from the table that in many groups of affections, they are about twice as numerous in case of non-revivals and that in these the duration of conviction is more than twice as long.

The fact that the males contradict nearly everything in the columns for females is difficult. It may be due, in part, to the larger place intellection has in males and intuition in females. These are some of the evidences. Table IV shows that the subjective forces leading to conversion are greater in males, while imitation and social pressure are greater in females. In Table V those disturbances, such as anxiety, sadness and helplessness, showing the

working of large undefined forces in the life, are more frequent in females. Doubts and questionings are 36% for males as against 6% for females. Resistance to conviction is twice as frequent in males, which is evidence of the action of contradictory ideas, or of convictions which oppose habits. The duration of conviction is much greater in males. In beginning a new life, therefore, the male, being more self-dependent and working his way more by his own insight, may find it a more bitter ordeal to conform his will to a social or moral order outside his own, and rebels. The female accepts the help of the external institutional system in working out her own life problems.

For the purpose of seeing farther into the nature of the sense of sin (using the term broadly to include depression, helplessness, and the like), the male and female cases were grouped to find how far it is the result of bad moral training and actual waywardness. Only such were used as showed in a rather pronounced way the presence or absence of immorality and of the sense of sin. Among the males, when conviction for sin or what is described in kindred terms is present, it follows actual waywardness in two-thirds of the cases. When the previous life has been fairly upright, the sense of sin is present and absent in about the same number of cases. When conversion has been preceded by waywardness, the sense of sin is absent only in one-tenth of the cases.

Among the females it is different. When there have actually been marked evil tendencies before conversion, the conviction phenomena are nearly always present, and in that the females coincide with the males. But out of the whole number of females there are more instances given in which they follow a fairly moral life than those in which they follow a distinctly wayward one. Of the cases described as of good training and of moral and even religious observance, more than two-thirds show in a marked way the sense of sin.

These facts seem to show that although the sense of sin comes naturally as the sequence of bad habits and conscious evil, it is not occasioned wholly by them, and perhaps has other causes. Its greater prominence among females of good moral training may be traceable, in part, directly to imperfect physical conditions. Hysteria and other nervous and other circulatory disorders are more common among adolescent females than males, and far more common during adolescence than later.[1] Many of the symptoms of these diseases are the same as those shown before conversion. There are evidences, too, that the extreme dejection, self-distrust, self-condemnation, and the like, are traceable, in part, to physiological causes in males. About one-third of the males gave sexual temptations as among those of youth, and nearly always it was said to be the chief temptation. In nearly all these instances the phenomena during conviction are remarkably similar to those which follow the sexual evil. These are typical: *M.*, 12. "Everything seemed dead." *M.*, 19. "Before conversion I had not a single happy day because of dread of the future." *M.*, 15. "Had fear of being lost; was pensive and worried; was greatly depressed and could not sleep." *M.*, 18. "Was troubled with fears. Thoroughly convicted of sin; was filled with remorse, and was ashamed of my condition. Had uneasiness, and for days longed for God's forgiveness." In 90% of these cases did remorse, fear of death, depression and the like enter prominently among the conviction states. A few gave escape from passion among the motives for conversion.

[1] W. R. Gower, "Diseases of the Nervous System." Vol. II. p. 985.

THE CHANGE ITSELF; CONVERSION.

(*a*) *Mental and bodily accompaniments.* The cases would easily arrange themselves into a series from those where there is almost no feeling accompaniment, to those at the other extreme in which there is intense struggle, the height of pain and joy, and vivid experiences quite out of the range of ordinary life. A few definite changes seem to work themselves out quietly somehow in the depths of the nature and are given ready made without emotion. *M.*, 15. "My conversion was attended by nothing unusual." *M.*, 18. "No emotion; it was a calm acceptance of the power of Christ to save." *M.*, 12. "It was simply a jump for the better." They shade off rapidly, however, into those which are wrought out with high emotion. When the feelings attending conversion were collated and compared with those during the conviction period, they were found, in general, to be much more intense. They are described oftener in physical terms than are those during the period preceding. There is evidence that the whole nature is in a high state of tension, and that the senses are much more acute. The attention is narrowed and fixed. The exact appearance of objects, the presentation of unusual sights, the exact words spoken and heard, the hymns sung, imaginary sounds, and the like, are frequently recalled with great minuteness. The experiences are more intense in the revival cases than in the others among both males and females. In the case of males this is in line with the greater intensity of the conviction phenomena in revival conversions. In the case of females it seems at first to contradict the facts given in the preceding section, viz., that the disturbances preceding conversion were greater in the non-revival cases. Here there are almost no vivid experiences among the non-revival female conversions. The explanation here may be in line with the one given in the preceding section. Females are more impressionable, and controlled more by large instinctive feelings. Left alone there is less power of positive activity in the presence of spiritual difficulties. A slight external stimulus is helpful. In the presence of the stronger forces of a revival, she is thrown often into the intensest emotion. *F.*, 16. "As the choir began to sing, I felt a queer feeling about my heart which might be called a nervous tremor. There was a choking sensation in my throat, and every muscle in my body seemed to have received an electric shock. While in this state, hardly knowing what I did, I went forward. On second night was converted and felt as if God was pleased with me." *F.*, 12. "On the impulse of the moment I went to the altar. After an hour of pleading and prayer, I felt something go from me which seemed like a burden lifted, and something seemed floating nearer and nearer just above me. Suddenly I felt a touch as of the Divine One, and a voice said, 'Thy sins are forgiven thee; arise, go in peace.'" There are several cases quite as vivid in all except the non-revival female group.

There are almost invariably two opposite kinds of feeling shown at the time of conversion. The first are those of the conviction period, magnified until the subject is brought to the last degree of dejection, humility, confusion, uncertainty, sense of sinfulness, and the like. The second seems to be the relief from the first and is characterized by such feelings as joy, elevation, free activity, clarified vision and oneness with God. It appears to be the intensest form of those feelings which shade off into the post-conversion experiences. These two kinds of feeling are often completely mingled and blended. *M.*, 75. "Was despondent; went out of doors and cried; felt my heart lifting and couldn't sit still." *F.*, 12. "Felt

sad over my sins, yet an inexpressible feeling of gladness came over me." *F.*, 19. "I read books and reflected; saw my lack; knelt and prayed, putting happiness into every breath, and beauty into everything." *F.*, 16. "With tears came relief and joy."

That the feelings within this point of great mental tension, and activity are so blended, and that so much is worked out in so short a time, makes adequate self-analysis impossible and increases the difficulty and interest of the study.

The two opposite kinds of feeling are more often successive, and their point of separation is pretty clearly marked. In throwing the cases together, each of these divisions fell into two more or less distinct classes. First, those connected with the feeling of sinfulness proper, which are negative and result in dejection and self-abnegation; and secondly, those which involve a struggle after larger life, and are largely positive, but often accompanied by uncertainity and distress. The general character of the separate groups is illustrated below.

1. *M.*, 19. "I mourned and wept and prayed, and stood trembling, with tears in my eyes." *M.*, 15. "Prayed earnestly for pardon; willing to do anything for Christ." *M.*, 16. "Felt the weight of sin as a burden on my mind." *M.*, 37. "Didn't care whether I lived or died." *F.*, 14. "Past life was source of great regret to me. Conviction came so strong at 14 that I thought I would die that very summer if I did not get relief; often worried and lost sleep; one evening after retiring a queer sensation came over me; it was very dark, as though passing through something and God was right over my head; I trembled intensely and became exhausted and helpless."

2. *M.*, 16. "Inexpressible joy sprang up in my soul." *M.*, 12. "Saw a flood of light, and faces in room seemed to reflect the bright light." *M.*, 15. "While praying I seemed caught up into the presence of Jesus." *M.*, 19. "Perceived a load go off." *F.*, 12. "I had a sudden transport of joy; wished I might die right then and go to God." *M.*, 17. "The emotion suddenly broke and I was convinced of the atonement of my sins."

3. *F.*, 15. "I prayed day after day, struggling for light." *F.*, 10. "The chief trouble was I did not feel myself as great a sinner as I ought." *F.*, 16. "Felt the need of a religion; read book and thought over it; was beginning to despair." *M.*, 23. "Prayed and cried to God for help; wandered four years seeking rest; went to many a priest for comfort."

4. *F.*, 15. "While struggling in prayer peace came to me through the darkness." *F.*, 10. "Came to have a feeling like I do now when a thing is right." *F.*, —. "New light seemed to dawn in me." *M.*, 23. "When all outward help failed a voice came which said: 'There is one, even Christ Jesus, can speak to thy condition'; and when I heard it my heart did leap for joy." *F.*, 13. "I could fairly see the gospel truths, which had always been misty."

Groups 2 and 4 are very similar; 1 and 3 show somewhat distinct mental states and processes. They may be characterized respectively as the *sense of sin* and the *feeling of incompleteness*. The sense of sin is attended by feelings of wretchedness, heaviness, helplessness, weariness, sensitiveness and resistance, separation from friends and God, fear, resentment, and so on, which are followed after the crisis by joy, peace, rest, lightness of heart, oneness with others and God, love, exuberance of spirits, sense of free activity, and the like. The feelings are reduced to the last degree of tension, and then recoil; are pent up, and suddenly burst; the life appears to force itself to the farthest extreme in a given direction and then to break into

free activity in another. The feeling of imperfection or incompleteness has slightly different accompaniments. There is uncertainty, unrest, mistiness, dazed feeling, distress, effort, struggle toward an indefinite something, longing for something out of reach, etc., which is followed by peace, happiness, a sense of harmony, a clearing away, a flash of light, freedom, entrance into new life, and so on. Something like what the cases show is represented graphically in Figure V.

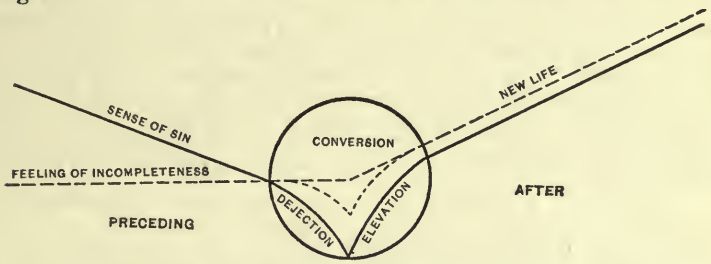

FIGURE V. *Illustrating roughly the mental processes at conversion as shown by the feeling accompaniments.*

The meaning of these phenomena can be discussed better later. Those attending the sense of sin are more characteristic of each of the cases above 27 years of age and of the younger subjects in which there has been definite waywardness. The feeling of imperfection and its accompaniments seems to be a normal adolescent experience. It is often attended, also, by mental depression, but not so frequently as is the sense of sin.

(*b*) *In what conversion consists.*

Just what happens at conversion is hinted by the surface phenomena which can be put into words by the subjects. Nearly all the persons answered questions IV of the syllabus completely enough to give some glimpse of the mental state at the time of conversion, and a few had a distinct feeling of something taking place in their natures. Two persons illustrated graphically what happened by drawing lines. In both, conversion was pictured by a rapidly ascending curve. When the states and processes thought to be central were collected, they formed seven classes, of which instances are given below. In order to see what peculiar conviction state the separate groups are most apt to follow, a record was kept of the frequency with which each followed one or all of these five conviction phenomena, — remorse (conviction, dejection, etc.), estrangement from God (and friends), resistance (to conviction), prayer (calling on God, etc.), and positive effort (in the direction of new insight).

1. Yielding, self-surrender, breaking pride, etc.: *M.*, 15. "I finally gave up trying to resist." *M.*, 18. "Wanted to be a lawyer; was not willing to do the work God called me to do; after much prayer I surrendered completely and had the assurance I was accepted." *F.*, 13. "I knew it would be best for me, but there were some things I could not give up; when relief came all pride was gone." *F.*, 17. "Had said I would not give up; when my will was broken it was all over." Self-surrender generally follows remorse, resistance and prayer, but seldom follows estrangement and positive effort.

2. Determination, making up mind, etc.: *M.*, 19. "Determined

to yield my heart and life to God's service." *F.*, 13. "One day made up my mind I would be for Christ always." *F.*, 18. "Made up my mind to be a Christian regardless of feeling." *M.*, 18. "It was deciding for the sake of doing right and for influencing others." Cases in this group rarely follow any of the above mentioned conviction states except positive effort and tendency to resist. The cases are interesting, in which there is a sense of expenditure of effort in the act of yielding.

3. Forgiveness: *F.*, 13. "Felt the wrath of God resting on me; called on Him for aid; felt my sins forgiven." *F.*, 16. "Felt God's forgiveness so distinctly." *M.*, 15. "Seemed to hear Jesus speak words of forgiveness (a purely mental experience)." *M.*, 15. "Gradually the sense came over me that I had done my part and God was willing to do His, and that He was not angry with me; I had sense of sins forgiven." Forgiveness generally follows remorse, less often estrangement, resistance and prayer, and seldom follows positive effort.

4. God's help, or presence of some outside power (generally not involving forgiveness): *M.*, 19. "By God's special grace and help I sought peace publicly and found it." *M.*, 27. "I saw the words, 'Without blood there is no remission,' and the Holy Spirit sealed them to my heart." *M.*, 15. "Felt sure I had received the Holy Spirit." Usually follows remorse; less frequently after the other symptoms.

5. Public confession: *M.*, 15. "Did feel that in taking this public step I had crossed the Rubicon." *M.*, 13. "Held up my hand in prayer meeting as a profession of faith in Christ." *F.*, —. "I rose for prayer and felt relieved." *F.*, 12. "At the call for those who wished prayer, I was immediately on my feet, and it seemed as if a great burden had been removed." Public confession seems often closely akin to forgiveness and the sense of harmony with God, the sanction of the church and approval of friends standing for the more abstract relation. It is also closely related to breaking pride and self-surrender. The conviction symptoms preceding it, except estrangement and prayer, are all present in about half the instances.

6. Sudden awakening: *M.*, 22. "Got to attending revivals and thought much over my condition and how to know I was saved; everything depended on 'Him that cometh unto me,' etc.; cometh was the pivotal word; one evening while walking along the road it came to me that it was all right now." *M.*, 11. "After failing of relief at revival, was singing songs by myself at home; after I got through singing I sat and thought, 'Why, God does forgive me and if I live right He will help me.'" *M.*, 37. "Had been a drunkard for years; struggled against my better sensibilities; attended city mission; read Bible and prayed far into night; went to sleep and during night the thing had cleared itself up in my mind, and I was ready to live or die by it." *F.*, 13. "For four years I had wanted to be a Christian but could not feel my sins forgiven; one morning sitting in my room reading, peace just seemed to come, and I was happy indeed." *F.*, 16. "The awful shock of mother's death seemed to awaken me from the state I was in and make me determined to do better." Such cases generally have some probable direct antecedent in thought or action which temporarily fades away and is revived as a finished result. They are preceded frequently by all the conviction symptoms, with remorse, prayer and positive effort in the predominance.

7. The sense of harmony (oneness with God, etc.): *F.*, 13. "Felt that God had sent peace to me." *F.*, 17. "Felt God had accepted

me." *F.*, 11. "Felt presence of God and found relief." *M.*, 17. "It was a sudden awakening, so I could say in my heart, 'Our Father in heaven.'" *M.*, 14. "I knelt and prayed; I seemed immersed for the moment in a larger being, as though it had closed about me; I felt sure I had received the Holy Spirit." The idea of oneness is also involved in forgiveness. The sense of harmony frequently follows remorse and prayer; less often estrangement, resistance and positive effort. There is evidence that mere imitation is a strong factor in conversion, and there is nothing new to be said of it here. The elements considered here only include those cases in which the subjective forces were strongly marked.

The relative frequency of the various elements thought to be central in the change are given in Table VI. The same person often mentioned facts which came under two or more of the seven headings. The per cents were distributed so that the sum of the columns gives a hundred per cent. The figures do not show, therefore, the per cent. of cases in which each element enters, but their relative prominence.

TABLE VI.

Showing the relative frequency of certain things regarded as central in conversion.

That in which Conversion Consists.	Males.		Females.		Total.	
	Revi'l. %	Non-R. %	Revi'l. %	Non-R. %	Male. %	Fem'e. %
Self-surrender	15	—	12	11	10	12
Determination	3	11	4	15	6	8
Forgiveness	28	11	19	8	22	14
Divine aid	5	18	6	6	10	6
Public confession	17	7	19	15	14	18
Sudden awakening (Spontaneous?)	17	32	27	28	21	27
Feeling of oneness (With God, friends, etc.)	15	21	13	18	16	15

The table shows that the order of prominence as shown by the frequency of the different factors is: spontaneous awakening, sense of forgiveness, finding oneness with God, public confession, self-surrender, an act performed by divine aid, and lastly the exercise of will by the subject.

Comparing the males and females, it is seen that, self-surrender, determination, sudden awakening and public confession are more frequent among females. This harmonizes with the previous comparisons. Their feeling and volitional powers seem to be more highly developed. Sensitiveness to surroundings also helps account for the prominence of public confession and self-surrender. Each of these often means the breaking of pride and falling in line

with the ensemble. Forgiveness and the recognition of external, supernatural aid is more common among males.

The revival cases show some marked contrasts with the others. Self-surrender, forgiveness and public confession are more common in the former, while the force of will, spontaneous awakening and the sense of harmony are more essential factors in the non-revival cases. Yielding is entirely absent in non-revival males. That it is so frequent among non-revival females is explainable by the fact that so many of them occur in regular church services. The same thing explains the variance of the numbers for public confession. In general those factors more prominent in revival cases are such as naturally follow external pressure, while the others are such as require the natural awakening and exercise of subjective forces.

These are the facts as given by the subjects. An attempt at the interpretation of the life forces at work which produce them will come later.

(c) *The conscious element involved in conversion.* The term conscious is used diversely. Its use here is very general. It stands for the undifferentiated centre at which intellection and volition separate. It represents an element of purpose, insight and choice as distinguished from mere response to environment, reaction to physiological stimuli and blind determination. This is the most uncertain division of the subject. It requires evaluation at every point, and so the chance for error is heightened.

An interesting feature of the foregoing facts is the apparent smallness of the intellectual factor among the conscious motives to conversion, and also of the volitional element at the time of the change. For example, during the conviction period, conscious following out of teaching was mentioned in only 7% of the cases, and a response to moral ideal in only 20% of them; while external forces were recognized in 40% of them. We have first seen that the conscious exercise of will was rarely mentioned as being central at the time of conversion. That an apparently spontaneous awakening is the most prominent factor in the change, increased the evidence that the process is automatic. Public confession may mean that the subject is driven by surroundings. The sense of forgiveness and oneness with God also generally indicate that the experience is worked out in the sphere of feeling. There are, however, many evidences of the presence of conscious purpose. It is often mentioned as a recognized factor. Besides, the cases show that public confession is often made in spite of adverse surroundings. Self-surrender generally means that the subject is drawn between two possible courses, and must decide between them. The persistent struggle often shown during conviction, sometimes toward a definite end and sometimes toward a dimly defined one, indicates the presence perhaps of incipient ideation and volition.

In order to arrive at an estimate of the conscious concomitant, the cases were studied through with that alone in view. They were separated into five classes, as determined by the prominence of the conscious element: First, where it is absent, or nearly so; these are largely cases of imitation, adolescent ferment, and the like; second, those in which it is small; third, those in which the conscious and automatic forces are about equally balanced; fourth, in which there was apparently a predominance of insight, and moving along a clearly marked course; and lastly, those in which the conscious element seems without much doubt to be the determining factor. The following instances of each class will give an idea of the standard of evaluation:

1. *M.*, 15. "Began largely as imitation; a friend told me I was not free from liability to divine displeasure." *F.*, 8. "At camp meeting I went to the altar with twenty others; in the uncertainty at the altar I repeated after the leader,' I believe Him;' I knew I was converted; afterward had great comfort in Bible reading and prayer, and in times of anxiety."

2. *F.*, 11. "From my earliest days I had wanted to be a Christian; I felt desire, unrest and fear; many were going forward at the revival; that made it easy for me; I made confession by speaking in meeting, and felt the peace of God." *M.*, 14. "I was influenced by example of father and mother; besides this I had a sense of duty; was afraid of being lost; felt I was not good enough to become a Christian; I broke my pride and made public confession."

3. *F.*, 16. "Deeply convicted of sin; for three weeks I spent much time in prayer; had awful feeling of helplessness; relief came during a revival; I made up my mind the Sunday before that I would rise for prayer; I think it came through my own thought and deliberate choice." *F.*, 14. "Thought a great deal about the after life, and knew I must decide; I had a sort of depressed feeling, and I engaged in prayer; three days after making up my mind relief came by feeling God's forgiveness."

4. *F.*, 14. "Had unsatisfied feeling and craving for a higher life; fought and struggled in prayer to get feeling that God was with me; with the greatest effort I endeavored to get some glimpses of light; while struggling for light peace came to me through the darkness, and I felt at rest." *M.*, 18. "Wanted to make the most possible out of life and to exert the right influence over my pupils and young people; it was also a divine instinct, gratitude for blessings received, that led me to make a personal choice; I decided the matter at home that I would not only be partly right, but wholly right."

5. *F.*, 18. "The change was purely in making up my mind I would live as Christ would have me, whether certain feelings came or not; felt happy and satisfied." *M.*, 12. "Seemed only deliberate choice gradually growing and reaching its climax at conversion; duty I owed to Christ, who had done so much for me, was the chief factor; my conversion was just a jump for the better in the direction of the gradual growth which had preceded."

According to the above standard of classification the cases resulted as shown in Table VII.

It is seen from the table that there are a few cases only in which the conscious element is either absent or apparently the principal determining factor in the change. Most of them fall in between these extremes where the conscious and unconscious forces act together and interact on each other. They arrange themselves in a series from the almost wholly externally determined conversions to those which come with clear insight and controlled largely by subjective forces. Age has much to do with the place in the series into which any case will fall. It will be noticed that in both males and females the average age increases gradually with the increase of the conscious concomitant. The males form a pretty regular series, there being about the same number in which the conscious element is present and absent, and great and small. The females fall more on to the side of the automatic. 19% of the females belong to the first class, as opposed to 2% of the males, and as against 3% at the other end of their own series. This harmonizes with the facts under the discussion of the motives and the conviction period. The

consciously self-directing forces are less in females. It is somewhat opposed to the facts in the present section in regard to the volition element in conversion. Determination was more frequent in females. That is not incongruous, since the organic push in females which results in determination is mainly volition, and is more akin to feeling than is intellection proper. The revival cases

TABLE VII.

Showing the result of an attempt to estimate the degree of the conscious element present in conversions.

Conscious Element.	Male.		Female.	
	% of whole Number.	Average Age.	% of whole Number.	Average Age.
Conscious element Absent	2	11	19	11.8
Less than unconscious	34	13.6	42	13.2
Equal to unconscious	36	16.2	19	14.6
Greater than unconscious	26	17.4	17	15.4
Entirely dominant (or nearly so)	2	18	3	17

form a different series from the others when taken separately. They throw the greater number into the first two classes, while the non-revival throw more into the last two. It is not the influence of the revivals, simply, that throws the greater number of females into the first two classes. In part it is due to the fact that adolescent ferment is more common and earlier among females. In general it appears that among males the conscious and automatic forces are pretty evenly balanced, and that in females the automatic are in predominance.

The importance of the conscious element is not simply in its presence immediately at conversion. Without exception, the cases studied, no matter how suddenly the new life bursts forth, have antecedents in thought or action that appear to lead up directly to the phenomenon of conversion. The picture seems to be a flow of unconscious life rising now and then into conscious will, which, in turn, sets going new forces which readjust the sum of the old thoughts and feelings and actions. Whether the flow of physiological processes first gives rise to the thought product, or whether the incipient conversion holds a causal relation to the flash of new life and activity, cannot be determined. So much is clear, that before and during conversion, the two things go together and interact upon each other. The whole conviction period seems to be a disturbance in the automatic, habitual processes caused by the presence of an awakening but still dim and confused idea. The life is continually prodded by forces from without. Reverses in life, deaths, the example of a beautiful personality, ideas from other

people, the demands of established institutions, and the like, are frequently mentioned as among the things which shake the life from its self-content, and lead it into a recognition of a larger world than its own. The way in which a thought or an experience leaves its impress and works itself out in the sphere of the semi-conscious is best shown by some typical cases. *F.*, ?. "A year before my conversion I had been to the altar, but felt no better; I wasn't ready to become a Christian; the following year, during revivals I felt more in earnest than ever before; went to the altar two nights in succession; I went in spite of my friends; a friend came and spoke to me, and it came over me like a flash of lightning that I was saved; I remember distinctly what different persons said to me afterward." Here is shown an effort by an unripe nature, a year of perseverance, and at last under favorable surroundings the thing sought for came like a flash. The high mental tension at the time of conversion is shown by permanence of the impressions made on the senses. One young woman writes: "The change came in the ordinary course; no one else had anything to do with it; I know no cause." But in describing the preconversion experiences she says: "The fears of being lost set me to thinking; I regretted my moral negligence; for six months nothing gave me any rest, and I engaged much in prayer." *M.*, 15. "Felt self-condemnation at having done wrong; at the end of ten days went into the bed-room and prayed; 'Jesus take me,' is all I said; as I rose and walked across the room it came to me that I was sincere and my prayer was real, and I believed my acceptance with God." Sometimes the experience which precedes the change is weeks and even months of intensest thought, struggle and prayer. Often the thought or act which sticks in the life and seems to prepare it for the awakening is very small. This may depend on the ripeness of the life for the new experience. *M.*, 19. "Knowledge of sin had ripened into the sense of sin; at church one sentence in the sermon caught my attention, though I was usually inattentive; the impression faded away immediately; two days later while in business, there was a sudden arrest of my thought without a consciously associated natural cause. My whole inner nature seemed summoned to a decision for or against God; and in five minutes was followed by a distinctively formed purpose to seek Him; it was followed immediately by a change, the principal manifestation of which was a willingness to make known my decision and hope of divine forgiveness." These antecedents to the change are numerous and various. They are determination to yield, longing, effort, performing some act, serious thought, and the like. That they should help work out a transformation of character seems to follow the physiological law stated by Dr. Carpenter, that the nervous system grows to the modes in which it has been exercised. When there is a longing or striving in a given direction, that very act predisposes the nervous system still farther to grow in the same direction. A certain teacher of music says to his pupils: "Just keep on trying and some day all of a sudden you will be surprised to find yourself playing." Other analogies will be given in the next division. Another principle which seems to be clearly involved in the sudden changes of this type is one of assimilation. When the mind is once disturbed, it cannot rest until harmony is restored. The necessity for mental and spiritual harmony when once a new and foreign element is introduced, is clearly the occasion of much of the disturbance during conviction. Conversion seems to be a feeling of ease, harmony and free activity after the last step of assimilation and readjustment has been made. There are many analogies to this in both physio-

logical and mental processes. In using the Ebbinghaus series in the study of memory, Dr. Theodate Smith finds that in using successive series, the forgotten members of a previously used series are more apt to come up in a later series than those which were remembered in the earlier series. The mind seems to have a way of working ahead at its difficulties unconsciously and even during sleep. In fact much of that which appears unaccountable in sudden religious awakenings is much in harmony with what is sometimes called "unconscious cerebration."

(*d*) *The unconscious or automatic element in conversion.* The conscious factor nearly always operates in connection with a large amount of the spontaneous. In many cases relief from the sense of sin persistently refuses to come until the person ceases to resist, or to make an effort in the direction he desires to go, and throws himself back on—what? Some instances of self-surrender have been given. A few others will help show the process. *F.*, 19. "I had two years of doubts and questionings. It was my disposition to look at everything intellectually; I found I must give myself up into Christ's hands; I stopped thinking about puzzling questions; I had faith in Him and found peace." *F.*, 13. "After seven days of anxious thought and meditation, I gave my heart to God, and He sent peace; the feeling came,—how, cannot tell." *M.*, 15. "After I had done everything in my power, it seemed that the change took place; I saw I had depended too much on my own power." *M.*, 45. "All at once it occurred to me that I might be saved, too, if I would stop trying to do it all myself and follow Jesus; I determined right then to test His power and love; while at the altar I determined I would live a Christian life the remainder of my days, whether I felt forgiven or not; somehow I lost my load." *M.*, 15. "I finally ceased to resist and gave myself up, though it was a hard struggle; gradually the feeling came over me that I had done my part and God was willing to do His." The physiological terminology for this so common occurrence, of processes working themselves out unconsciously is, "nervous functioning." The psychologist calls them automatisms. The philosophical designation of it is often "the universal working itself out through the individual." The theologian usually attributes the process to some personal agency outside the self—God, Holy Spirit, etc., and calls the act of yielding "self-surrender," the confidence that the new life will spring forth, "faith," and the assurance that the change has taken place, "salvation," "regeneration," etc. The likenesses to this so important element are numerous. A certain music teacher says to her pupils after the thing to be done is clearly pointed out and has been attempted unsuccessfully, "Stop trying and it will do itself." Holmes disavowed having written his best poems. They were written for him. Other analogies will be given later.

In the cases studied in which the various steps could be distinguished, the order seems to be: conviction, seeking, self-surrender, faith and assurance. The steps are often so completely mingled that no distinction can be made between them.

Post-Conversion Phenomena.

(*a*) *Feelings immediately following conversion.* The feelings which come directly after conversion are generally the opposite to those which come before. The most frequent are joy, happiness, peace, sense of relief, etc. Not infrequently do the feelings express themselves in physical terms, such as weeping, bodily lightness, improved health, and the like. The general nature of the feelings is

shown by the following: *F.*, 18. "Happiness intense; wanted to sing, but all the house was quiet." *M.*, 12. "Was very happy; sang all night and couldn't sleep." *M.*, 15. "Joy almost to weeping." *F.*, 16. "Wept and laughed alternately; was as light as if walking on air; felt as though I had gained greater peace and happiness than I had ever expected to experience." *F.*, 17. "A sudden peace and rest seemed to come over me; I felt completely, perfectly and quietly happy." *M.*, 15. "I felt my face must have shone like that of Moses; had a general feeling of buoyancy; greatest joy it was ever my lot to experience; felt as if I had been in the very presence of Deity." *M.*, 19. "I felt relieved and filled with fresh courage." *F.*, 14. "I felt as if a load were lifted from my body, and I was very happy."

A few of the cases vary somewhat from the above. Among the feelings mentioned, are zeal, earnestness, seriousness, hopefulness, subdued feeling, continued struggle, and anxiety about future conduct.

A record was made of the conviction phenomena and the experiences at conversion which had preceded the various kinds of feeling after conversion. Among the significant things in the tabulation are: Joy, happiness and peace are most apt to follow remorse, sudden awakening, public confession and sense of forgiveness. In their intenser forms they seldom follow imitation, determination, self-surrender and sense of oneness with God. Where there is positive effort preceding conversion, these feelings afterward are most frequently of the milder degree of intensity. The sense of relief follows remorse, resistance, prayer, sudden awakening, public confession and sense of forgiveness. It more frequently follows resistance than does any other feeling. It generally comes after those states which denote mental tension. The bodily affections also most often follow the more intense previous experiences.

(*b*) *The character of the new life.* The things most frequently mentioned as characteristic of the new life are: conformity with the conventional forms of religious observance, such as prayer, Bible reading, attendance at church, etc.; and various indications of the deepening of religious life: meditation, private prayer, positive religious effort, performance of duty, and acting from more ideal motives. In the tabulation the cases were kept separate, in which conformity to established usages involved personal insight and spontaneity. The non-revival cases fell mostly into this class; the revival cases for the most part seemed to conform uncritically to the conventional standard.

An important feature of conversion is that it brings the individual into closer relation with the objective world: persons, nature and God. The nature of this changed attitude is suggested in the following: (1) Relation to persons: *F.*, 13. "Began to work for others; immediately was anxious that all should experience the same." *F.*, 17. "Had more tender feeling toward family and friends." *F.*, 16. "Spoke at once to a person with whom I had been angry; felt for every one and loved friends better." *M.*, 19. "Felt everybody to be my friend." (2) Relation to nature: *M.*, 16. "Stars never have appeared so bright as that night going home." *M.*, 13. "Had special feeling of reverence toward nature." *F.*, 12. "Seemed to see God's greatness in nature." (3) Relation to God and Christ: *F.*, 11. "God was not afar off; He was my Father, and Christ my elder Brother." *F.*, 14. "Fear of God was gone; I saw He was the greatest Friend one can have." *M.*, 14. "Felt very near to my God." *M.*, 15. "Felt in harmony with everybody and all creation and its Creator."

The result of tabulating the cases in which the changed relations occur is shown in Table VIII.

TABLE VIII.

Showing the per cent. of cases in which a changed attitude toward persons, nature and God was mentioned as the result of conversion.

	MALE. In % of cases.	FEMALE. In % of cases.
Desire to help others	25	25
Love for others	43	42
Closer relation to nature	36	32
Closer relation to God	48	47
Closer relation to Christ	5	6

It should be noticed that in this table, as in all the preceding, the figures represent the lowest possible estimate, since they show the number of cases only in which the phenomenon was sufficiently prominent to receive explicit mention. It is clear, therefore, that in a large per cent. of the cases an immediate result of conversion is to call the person out from himself into active sympathy with a world outside him.

(*c*) *The permanence of conversion.* When there is sufficient maturity to enter conversion understandingly, relapses from the first experience are rare. It seems to be a natural entrance into a larger life, which easily becomes one's own. Where the subjects are hastened into the change, backsliding is frequent. An adequate discussion of relapses will come more properly in another paper. The central facts in regard to it will be seen in Table IX.

TABLE IX.

Showing the per cent. of cases in which the results of conversion were temporary or permanent.

PERMANENCY OF CONVERSION.	MALE.				FEMALE.			
	Revival.		Non-Rev.		Revival.		Non-Rev.	
	%	Age.	%	Age.	%	Age.	%	Age.
Relapsed	48	13.7	24	17.5	41	12	14	16
Permanent results	15	17	35	18.7	14	14.3	17	15.3
Uncertain	37		41		45		69	

The relapses include all cases in which there was a definite retrogression from the first experience, whether regained or not. A few were permanent relapses. It is seen that relapses after revival experiences are twice as frequent among males and three times among females as after the non-revival experiences. In the revival cases relapses are three times as frequent as permanent results, while in non-revival cases permanent results are more frequent than relapses. The relapses are generally among the younger persons.

Other Experiences Similar to those of Conversion.

For the purpose of finding whether the phenomena of conversion were unique or only in line with other normal experiences of common occurrence, the questions in group C of the syllabus were added. They brought in a large mass of valuable data. Space does not admit a complete organized presentation of the facts, but a few illustrations will be appended to show certain features in the other experiences which are analogous to conversion.

(*a*) *Conflicting tendencies:* The following facts illustrate the possibility of slipping into inharmonious relationship with environment. It is the pull between selfish inclination and the sense of ought. It leads into the condition represented by No. (1) of Figure VI. *F.*, 19. "My mother had positively forbidden me to visit one of my friends, and many times I willfully disobeyed her, because the attraction of my friend's society was stronger than my sense of right." *F.*, 17. "Used to be fond of jumping rope; mother forbade me; at school I disobeyed because I thought mother need never know of it; all the other girls jump ropes without falling dead, and I wouldn't meet with any accident either." *F.*, 9. "Refused to sing at a school entertainment because mamma would not let me wear a certain dress; I felt satisfied to think I got out of singing it, but felt an inward voice chiding me; on the whole I thought I was a very bad girl, and did not want to think of it."

(*b*) *Depression and joy:* The feelings of accompanying uncertainty in the presence of two or more alternatives and the final decision between them, illustrate the feelings during conviction and after the conversion crisis. *F.*, 20. "For a year or more I had something on my mind which I felt I ought to tell mother; at last I came to feel that I could not stand it any longer, and that I must do something to relieve me of this constant feeling that I ought; felt very nervous and worried; was determined to tell her, but felt afraid my courage would fail; with my heart beating very fast I followed her to her room; felt so relieved when it was over I hurried to my room and laughed and cried at intervals; still felt nervous, and trembled somewhat for a little while afterward; after that I seemed to forget everything connected with my old wrong, and I felt that I had gained a great victory over myself." *F.*, 18. "When 14 was undecided whether to go away from home to school or to public school at home; I used to think about it continually until I lost my appetite, and became so cross and fretful that my brothers told me that I had better go to T— away from home, as I was a little crank; I decided to go away, and after I once decided it seemed as if a great load had left me, and I was free again." *F.*, 17. "Uncertain about choosing profession; was in a state of perplexity and restlessness; could not lie down to restful sleep; felt to a certain degree depressed; was anxious for decision, because I knew it must come; when struggle was ended, feeling of relief and rest came; almost seemed as if I had entered new world." *F.*, 27. "Most difficult decision was choice

of profession; lasted for years; began with a vague desire, and became more and more definite and clear through successive periods of waiting and effort; first part of time had many tears; some feelings of anger and rebellion; many doubts; decision came gradually; seemed to grow; feeling of decision was that of lifted burden, and seemed to me like that of a person who has climbed a hill—notices he is breathless, but feels at liberty to sit for a moment for breath, while he looks backward and forward." *F.*, 19. "A year ago was uncertain whether to break friendship with girl; thought she exerted harmful influence, but I liked her very much; took over a week to make decision; all that time had fear and depression; could not sleep well, and lost appetite; one night as I lay in bed I felt I must decide; for a few moments there was a struggle in my mind that almost amounted to pain; then I resolved to break off friendship; after struggle felt sense of weariness as well as of peace; felt just as if I wanted to rest awhile and soon fell asleep." *F.*, 37. "Since conversion have had same feelings when trying to decide some important question; after making the decision, in trying to decide which way is best, there come the same peace and rest." It is seen that both the bodily and mental accompaniments in these instances of uncertainty and relief are the same as those preceding and after conversion.

(c) *Sudden awakenings:* These instances of sudden and apparently unaccountable awakenings of power and insight are analogous to the larger spiritual awakenings, and like them, are, so far as any adequate explanation goes, mysterious and "supernatural:" *M.*, 4. "Little boy 4 years old could not talk; made queer sounds for different objects; all at once he began to talk, and said his words plainly; could soon say everything he heard." "Little girl I knew well could not sing a note or carry a tune; suddenly one day she came in singing 'Sweet Marie' in sweet, clear voice." *F.*, ?. "I was very anxious to learn to play the piano, and would spend hours at the instrument; one day I suddenly found I could play a little waltz my sister had given me; this incited me to try another piece, and I found I could play that." *F.*, 19. "Tried to learn to mount and dismount a bicycle, until it seemed to me there was no use in trying any more; all at once one night I found I could do both easily." *F.*, 19. "Studied physics under good teacher, but could not see into it; went home feeling sick, discouraged one day with a problem: why do we see ourselves upside down in a spoon? Studied over it for an hour; it seemed dark; suddenly it seemed lighter; then I saw the reason as clearly as I ever did anything; I felt so glad, and the physics problem was solved forever in my mind; I liked the study, and could understand it; I cannot explain why it was." *F.*, 27. "At 14 studied etymology and mensuration; thought I could never understand them, and felt quite discouraged; after hearing pupil recite one day power to do them came like a flash, and they became favorite studies." *F.*, 19. "Could not understand subtraction in algebra; could not even do the examples mechanically; failed every day in it; suddenly one day, while working alone, it dawned on me, and since then I have had no trouble; it is the easiest thing in algebra now." *M.*, 27. "My students and I had worked several days on a problem in geometry; one night I went to bed after trying again and failing; the next morning on awakening the solution of the problem was so distinct before my mind I saw it in visual terms." *F.*, 22. "When grandmother died everything seemed so dull and dreary, as if a dark cloud hung over me; couldn't seem to get comfort from anyone or even prayer; when I prayed seemed as if words had no meaning at

all; was in this condition more than one month, when suddenly cloud broke away and I found comfort in my Bible." *F.*, 27. "With sudden flash I saw meaning of, 'And ye shall know the truth and truth shall make you free;' perception had almost character of physical thrill; power to perceive grew gradually in experience; the perception was sudden." *F.*, adult. "Had married; husband was jealous of my love for my invalid sister, who had lost her health for me; forced me to leave her; went back to her with my baby, and was able by teaching music to make scanty living for three; husband begged me to return west; I refused, though I was heavily burdened; my judgment told me to stay, but my heart yearned after him; I went to God and wrestled in prayer half the night; at 2 o'clock peace came; He took away my love for my husband; it left me in an instant, and has never returned; now I feel free." These changes are especially similar to the conversion experiences which follow what was called the sense of incompleteness.

(*d*) *Sudden changes:* The following illustrate the sudden break in character at conversion: "I disliked bananas very much; one day on tasting one I found I liked them very much, and since cannot get enough of them; it was just the same with cooked onions." *F.*, 9. "When about nine was very fond of bananas; cousin gave me all I could eat; became sick at stomach; after that had same sick feeling whenever I saw bananas." *F.*, 17. "Never could bear taste of turkey; two years ago was visiting and had to take it or be rude; have liked it ever since." *M.*, 21. "To one particular fellow in our club I took a great dislike; he never did anything to me; always treated me kindly; I never knew why I disliked him." *F.*, 18. "Knew girl whom I thought great deal of; one day I happened to think of her, and just then I felt that I didn't like her at all; seemed strange to me, and I thought I could not dislike her; but all her bad traits stood out before me, and I couldn't see anything in her to like at all." *F.*, 17. "I once had a teacher whom I simply detested; I detested her so much that I thought of her constantly; one day I happened to pass her in the hall; I do not know what she did, in fact I think she did nothing, but just as quickly as she passed me my hatred turned to love; I know it sounds foolish to speak of loving anyone like that, but I positively adored her." *M.*, —. "Little nephew played unceasingly with little niece; when she died, from being a gay little fellow he became sad, and has been of a sallow and cranky disposition ever since." *F.*, 18. "Was always being teased when I was small, so that small things made me very angry; when in an angry fit one day a little girl friend came in; I told her sharply to go home; she went and became very ill; I never got into such states any more." *M.*, 5. "When about five displayed violent temper; one day in unrestrained rage I chased next older brother around yard and into house, hurling things at him like a young gorilla; my mother was so concerned about me that she wept (she was not the sort of woman to 'cry') in genuine discouragement, and said she didn't know but I would have to go to the reform school; I truly repented; after a short nap I sought her good will, and ever afterward was noted for obedience and docility." "Uncle had horse which was great favorite and as gentle and docile as could be; was once frightened by a fire engine, and after that he became so vicious that it was not safe to drive him." "Knew of a horse which delighted in kicking, biting and running away; its owner was afraid even to feed it; he gave it away; the new owner geared the horse to drive it home; it tried to kick; he gave it a good beating; he never had any trouble

with it after that; he would let it stand without tieing." *M.*, 5. "The child of my friend was much spoiled; while I was with him the child became unmanageable; the father held him firmly several hours; at last the child stopped kicking and crying and said, 'Papa, I love you,' and was good after that." "Young man took school; boy nearly as old as he spit tobacco at him first day; teacher measured him, and decided he could shake him; almost an even match; succeeded in giving him sound thrashing; after that day boy was his admirer." *F.*, ?. "My music teacher asked why I hadn't practiced a certain thing; I said, 'Because I didn't want to;' she said, 'that is a very bad habit; do you always expect to do what you want to in this life?' No one can ever expect to; immediately made up my mind never to do things very agreeable to me; from that minute I was a different person; felt it was almost wicked to do things which I liked, and sought disagreeable things to do; did it just because I was convinced it was the right way to live." *F.*, ?. "When a child I got in the habit of putting my thumb in my mouth at night; my parents did everything they could to break the habit, but did not succeed; when about six I became ashamed of the habit, so one night I lay on my hand all night; I never put my thumb in my mouth again at night." *F.*, 17. "Broke slang habit; put papers over bureau, washstand and bed with words, 'Don't use slang;' took paper and wrote every word of slang that slipped; before I broke habit was discouraged, discontented, and in small way angry with myself; after I succeeded I was happy, and the words that came from my mouth seemed to please not only me, but my mother." *M.*, 20. "For years had indulged in habit of profanity; when 20 was elected teacher of country school; felt I ought to set good example to pupils; about same time the reading of the Chautauquan course set me to thinking, and led me to adopt a higher ideal; as soon as foolishness of habit was brought to my notice, I made one firm resolve and the battle was won." *F.*, 53. "When I was about 40 I tried to quit smoking, but the desire was on me and had me in its power; I cried and prayed and promised God to quit, but could not; I had smoked for fifteen years; when I was about 53 years, as I sat by the fire one day smoking, a voice came to me; I did not hear it with my ears, but more as a dream or sort of double think; it said, 'Louisa, lay down smoking;' at once I replied, 'Will you take the desire away?' But it only kept saying, 'Louisa, lay down smoking!' Then I got up, laid my pipe on the mantel shelf, and never smoked again, or had any desire to; the desire was gone, as though I never had known it or touched tobacco; the sight of others smoking and the smell of smoke never gave me the least wish to touch it again."

In these common experiences are shown all the steps of conversion, even the most unaccountable and mysterious. These facts do not explain conversion, but they do make intelligible the processes involved in the same way that all natural phenomena come to be understood. They help to make it clear that, however inexplicable, the facts of conversion are manifestations of natural processes. We accept them as mental laws because we see them working here and there and everywhere in the sphere of psychic life. Each of the above phenomena seems to be the special thing of which conversion is the general. To break a habit involves one small group of tastes, or desires and faculties, conversion takes the whole bundle of them. An awakening to one specific truth involves one faculty; the great awakening which we fitly call a second birth, is a similar awakening into larger spiritual insight. Each of the above experiences is the part of which conversion is the whole.

A General View of Conversion.

Such are the facts, as nearly completely objective as it was possible to give them. Their value is in the light they may throw on life forces and processes. It is each person's right to put his own construction on them. The following is a brief statement of the interpretation of them which has grown up during the study:

(1) *A sociological and biological view.* Conversion is primarily an unselfing. The first birth of the individual is into his own little world. He becomes conscious and self-conscious. The universe is organized about his own personality as a centre. His own will is law. His own individual insight is order. He soon finds there are other wills than his own. There is a complex, organized social will. A clash is apt to come between the self and whole. The social will is stronger, and the individual must adjust his will to it; then his sympathies follow the direction of his new insight, and he transfers his centre of life and activity from the part (himself) to the whole (society). When he attains the power to think in abstract terms, he becomes conscious of a world order outside himself. Then he begins to feel after the reality and worth of its spiritual content. He becomes dimly conscious of its unity and its authority. He must learn to submit himself to it and be guided by a larger life outside his own. With new insight comes new beauty. Beauty and worth awaken love—love for parents, kindred, kind, society, cosmic order, truth, spiritual life. The individual learns to transfer himself from a centre of self-activity into an organ of revelation of universal being.

The period of adolescence is naturally the time for the awakening into the larger life. It begins with puberty. Biologically that is the period when the person begins vitally and physiologically to reach out and find his life in another. The life of two united in love, each making demands on the other, and living for each other, becomes the centre of organized life, and comes, through the family, to reflect the entire social order. Thus the advent of puberty becomes a natural doorway for entrance into the larger life outside the self. Family life furnishes the opportunity for every kind of fresh exercise of power through the necessity for providing, for defense, for growth, and the like, and brings with it an increment in the development of all the powers of one's being. We have seen that the most rapid growth of the individual is at puberty, and that the greatest increase and readjustment is in the nervous system. This reorganization of nervous tissue furnishes the basis of new insight, the means of appreciation of the larger spiritual world.

(2) *The physiological view.* It is pretty well known that the quality of mind is much dependent on the fineness of nervous structure. The child has about as many nerve cells as the adult. They differ from those of the adult in form. Those of the child are mostly round, whereas those of the adult have often very many branches with which they connect with other cells. Nervous growth seems to consist largely in the formation of new nerve connections. The rapid growth at puberty probably means that at that time there is a great increase in nervous branching. The increased ramification of nervous tissue probably determines the ability for seeing in general terms, for intellectua grasp, and for spiritual insight. The rapid formation of new nerve connections in early adolescence may be the cause of the physiological unrest and mental distress that intensifies into what we have called the sense of incompleteness which precedes conversion. The mind becomes a ferment of half-formed ideas, as the

brain is a mesh of poorly organized parts. This creates uncertainty, unhappiness,dejection, and the like, because there is not the power of free mental activity. The person is restless to be born into a larger world that is dimly felt. Finally, through wholesome suggestions or normal development, order comes and the new world dawns. Often some emotional stress or shock strikes harmony into the struggling imperfection and truth comes like a flash.

(3) *The psychological view.* Seen from the standpoint of what was designated "consciousness" earlier in the paper, conversion becomes the sudden readjustment to a larger spiritual environment when once the norm has been lost, or when it is dimly felt, but not yet attained. In answer to the question, "What acts or faults have you committed which you knew at the time were wrong; why did you do them?" there were several replies. The wrong acts performed knowingly were of two classes: first, those in which some immediate desire was stronger than a remote truer one, and secondly, those in which associations and social complications led the person against his or her private judgment into a wrong course. The last class was strongly mixed with personal imperfections, such as natural willfulness, abnormal tastes, and native inertia. These, and perhaps other causes, tend to lead one away from the straight, middle way. When once one has gone wrong, the force of habit, pride in self-direction, etc., tend to make the life persist in its own course and to resist any forces which would throw it into a better way. The conflict between the accepted course and the truer one which is pressing for recognition through the dawning of fresh truth, or through the influence of organized social life, creates those disturbances in the individual which can only come to rest through a readjustment of his life, often sudden and eruptive, into harmony with the new demands or new truth. If the normal life were represented by a straight line, that actually chosen would be a line starting in the same direction, but swerving to one side. The individual pushes on in his own course until dissipation of power and physical and mental exhaustion make it necessary to surrender the old self for a larger one. If the straight line representing the norm were one side of a triangle, the way actually pursued would be represented by the other two sides.

Something like what seems to take place at conversion is shown in Figure VI. In No. (1) of the figure the lines going in the direction (*a*) represent the way old habits, associations, tastes and ideas

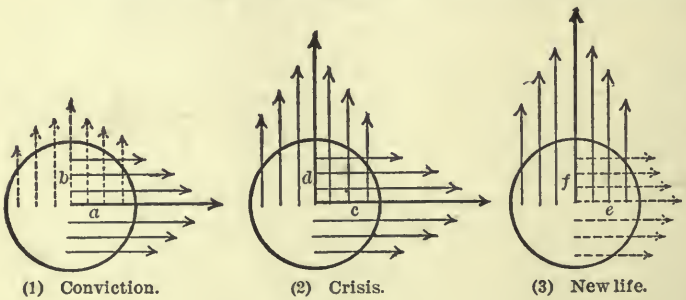

FIGURE VI.

tend to carry the current of life. Lines going in the direction (*b*) are the beginnings of a possible better life,—purer associations, coöperation with others, regard for future interests, ideals held up by the church, love of truth, a glimpse into a larger spiritual world beyond the self. Thus the even flow and harmony of life are destroyed. The person is pulled in two directions. This conflict between the old habitual self and a possible better one results in those conviction phenomena described as the sense of sin and the feeling of incompleteness. As the call toward the new life becomes more urgent, the situation is shown in No. (2) of the figure. (*c*) is the habitual self striving with all its might to preserve its self-consistency. (*d*) is the divine urging which has become imperative and irresistible. Here is the critical point, the tragic moment. The subject resorts to evasion of good influences, pointing out the perfection of the present self, the imperfections of others, and anything to preserve the old self intact. It is more often a distress, a deep undefinable feeling of reluctance, which is perhaps a complex of all the surface considerations which a thorough break in habits and associations would involve. He continues until complete exhaustion takes away the power of striving; he becomes nothing; his will is broken; he surrenders himself to the higher forces that are trying to claim him; he accepts the higher life as his own. The next stage is shown in No. (3). Only a vestige of the old life (*e*) is left. The new self (*f*) is now the real self. The conflict has ceased and there is relief. The depression has gone and gives place to joy. The pain from friction between contending forces becomes now the pleasure of free activity. Harmony is restored, and there is peace. The facts in the preceding study nearly all seem to fit into such a scheme. The phenomena up to the change itself have been sufficiently discussed. The various things given as essential in the change become more clear. "Self-surrender" and "new determination" seem at first entirely contradictory experiences, which often follow the same conviction states and precede similar post conversion phenomena. They are really the same thing. Self-surrender is seeing the change in terms of the old self; determination sees it in terms of the new. Each overlooks, for the time, one fact,—self-surrender, that the essential part of the old enters the new, and that really nothing is given up, and on the other hand determination does not stop to estimate the quality of its losses. The frequent phrase, "determined to yield," stands half way between and expresses, perhaps, more nearly the truth of the process. Where the change is attributed to "divine aid," the new forces which come to lead into a larger life are entirely objectified and become the influence of some outside personality or spirit. "Forgiveness" involves the same tendency to objectify the forces at work, and also the sense that the old life is no more—has been forgiven. "The feeling of oneness" (with God or Christ) is the experience in which the most prominent thing which presents itself at the time is the sense of freedom and harmony that follows the change, and the consciousness that the life is now the completer embodiment of the larger spiritual world. "Public confession" is much the same as oneness with God. To the nature which has not yet grown into the power of deeper intuitions, the sanction of friends, compliance with church rites, and the like, stand more distinctly for oneness with God. The same person more highly developed might have described the central thing in a similar experience as harmony with the will of God. The experiences immediately following conversion, called theologically "regeneration," are such as would naturally come after the steps described.

Psychologically they are in line with the phenomena of fatigue and rest, of repression and free activity.

(4) *Pedagogical view.* The differences between the male and female and revival and non-revival cases lead to some definite pedagogical inferences. In the first place, the custom of some religious bodies of working toward a distinct break in the life and a sudden awakening to a higher life is in line with something entirely normal in human nature, and which often comes spontaneously in the natural growth of the individual. Especially in the case of persons who have gone far astray, or who lack self-reliance and need the stimulus of outside influences to escape an imperfect way. For such instances, the methods conventionally used seem altogether wholesome. It is a matter for the most serious consideration, however, how the helpfulness of the revival service can be kept and its disadvantages avoided. It is significant that of the whole number of cases studied, only two or three of those who had been through revival experiences spoke in unqualified terms of approval of the usual methods employed. There were a few of the number who condemned them severely. There was a general deprecation of the emotional pressure usually exerted, and this coming from the converts themselves should be of value. We have seen that the average age of revival conversions is considerably less than the non-revival, which shows they have been hurried. There is every evidence that many of them have been hastened unduly. Many were left out of the study because they had clearly been forced into compliance with what they were not ready intelligently to accept. They were pulled green and withered. It was especially true in the case of sensitive girls who were carried away by the excitement, and afterward awakened to the fact that it was not a true experience. It is like pulling away the folds of a growing bud to disturb unduly the tender unfolding of religious nature. The greatest difficulty seems to be that the hardened natures who need the help of violent methods for restoration are the last to respond, and meanwhile much harm is done to those who are receptive and responsive to finer influences. Unless the person is ready for a change, the results of hastening conversion are apt to be temporary and soon followed by relapse. We have seen that "backsliding" much more often occurs after revival experiences than after the others. The question is, how can we preserve the essential things in revivals, and at the same time escape their evil effects? How can the uninterested be led to identify themselves with righteousness, and the wayward be reclaimed without harm to those who least need the influence of revival tactics? A few things are suggested by the study, which can only be most briefly hinted. People should be dealt with as individuals as far as possible instead of in masses. Still, the force of the ensemble should be preserved in furnishing the necessary stimulus to carry the "seeker" out of his slough. The higher motives should be appealed to more and the lower ones less. It is doubtless entirely out of proportion that one-third of the subjective forces present at conversion were self-regarding (mostly fears), while the number of distinctively altruistic motives were only one-third as frequent as the self-regarding. The lower ones should, of course, not be neglected. If a person has become an habitual transgressor of right, it is not only pedagogical, but true to the facts of life to bring him squarely to face the evil consequences of his ways, and to feel the awful authority of the moral and spiritual order. But conversion means unselfing, the entrance into a new life of insight and love, and the wise teacher will naturally hold up those incentives which

are in direct line with the new life. If men were reached more on their God side, the possibility of lifting them into a higher life would be greater and the results more permanent. The consciousness of the influence of wholesome teaching and high example is painfully absent in the cases studied. The love of God and Christ, which is supposed to be central in Christian theology, almost never appears. Exactly what the person needs who is struggling in haze and darkness and uncertainty is to have the mind clarified, to have the ragged bits of awakening consciousness struck so they may organize themselves in the direction of some high ideal, instead of in a chance or haphazard manner. It cannot be discussed here how these demands can be met practically, but they are of too great importance to be disregarded. It is necessary that we understand more fully the processes involved in conversion to adequately meet the needs of human nature. For example, it will appear from the preceding study that often when adolescents are in the throes of conviction, what is needed rather than excitement and emphasis of sin is treatment purely physiological and sanitary.

It must be evident that conversion is not a matter for the churches alone. It is under certain conditions a vital, normal step in individual growth. We have seen that all the phenomena of conversion show themselves everywhere in the psychic life. They should be accepted and utilized as belonging to growth. Each step is of frequent occurrence in common life. Sudden awakening to specific definite bits of truth are accepted as natural. We shall learn not only to anticipate, but to bring about such conditions as will foster an awakening of the whole being to larger insight. It is not a surprise that a habit should be broken and never return. It is perhaps even more natural and easy that the whole group of tastes, desires and habits which make up a character should be radically changed. It is easier to take the whole skein than to extricate one tangled thread. That conversion is deep and central in human nature we know, because it appeals, as we have seen, to the most primal instincts; we know, that its central laws are in accordance with well recognized biological principles, and that in its results it is an awakening to the highest ethics. It should be recognized as never before that a birth into new life is something that belongs to human nature. The old cult has been narrowed and abused. Consequently it has been dropped by many of our so-called liberal churches, and is willfully neglected in psychology and education. It needs to be saved from its narrow uses, and its truth refined, broadened, deepened and utilized. When restored it may have little likeness to its old forms, but will incorporate their essential truth and the wisdom which psychology and experience may be able to furnish.

The fuller discussion of the nature of conversion can be better presented after organizing the returns to section B of the syllabus in regard to gradual growth. It appears, so far, that the essential processes of conversion are quite in harmony with well recognized psychological laws, and that in its results it agrees with the truest ethics and with the tenets of the leading faiths of the world. It is the birth of the individual out of self into a larger spiritual world in which he finds his life. It is the individual will coming in harmony with the Divine Will.

The foregoing study is a modest beginning of what aspires to become a psychological study of the religious consciousness. In this time when the empirical methods of study are being so successfully applied to every department of research, and have at last reorgan-

ized our knowledge of the psychic life, it seems a most natural step that they should also help to increase our insight into the laws of the spiritual life. If the reader has found the preceding pages helpful, no farther explanation is necessary of the methods to be used, or the purpose in view. It is the intention to carry the same methods into the study of several other related topics. Before such an end can be successfully attained, it is necessary that sufficient raw material be accessible to make generalizations safe and illuminating. For the accumulation of such data the writer is almost entirely dependent on the coöperation of those who are sufficiently interested to take the time and pains to give their assistance. The facts for the foregoing study were collected by continued effort during three years. The energy that is used in getting together such material might be spent in the actual study if only it were more clearly seen that the motive behind the research is primarily in the interest of religion; for then all earnest people would be glad to coöperate. An urgent appeal is hereby made to any who are willing to assist farther in this or in the later topics by furnishing facts out of their own experience, or that have come under their own observation, to send in their names immediately to the writer, and questionnaires will be sent as the facts are wanted. His address for the present college year will be Clark University, Worcester, Mass. Many more answers are needed to section A of the present syllabus. There are many dark problems still that want farther discussion in regard to sudden conversion and confirmation. Especially are answers wanted to section B on gradual growth, the returns from which are now in process of organization. Perhaps it will be regarded as a slight compensation for their pains that copies of the results will be furnished to any who are willing to assist in getting together the facts. But the study is undertaken almost purely in the interest of both science and religion, and must depend on the unselfish help of those who are interested.

PSYCHOLOGICAL LITERATURE.

Elements of General Philosophy. By GEORGE CROOM ROBERTSON, late Grote Professor, University College, London. Edited from notes of lectures delivered at the college, 1870-1892, by C. A. Foley Rhys Davids, M. A. New York, 1896. Charles Scribner's Sons.

This work is a brief *résumé* of philosophical problems and philosophical theories, written with definite reference to psychology. The original lectures were designed to complete the author's course in psychology, published by the same editor as "Elements of Psychology." The work is divided into two parts. The first contains a very short and concise history of philosophy, with an incidental treatment of the main problems of the different periods. Of these the theory of knowledge receives by far the greatest attention. In this connection there is given a complete though brief statement of the theories of the different thinkers from Plato to Mill and Bain. In summary the subjective, idealistic factor is resolved into the inherited mechanism of the body; the Kantian *à priori* is replaced by the experience of the race. This is very similar to Spencer's doctrine, but is more carefully worked out and more clearly formulated.

Another peculiar theory or rather peculiar reversion to an ancient doctrine is given in the discussion of the question of perception of an external world to explain the concept of substance. Prof. Robertson cannot believe that substance is but the sum of its attributes. It must be something more. This something more must be something mental like ourselves, because, as Berkeley has shown, dead matter has no meaning for us. But we cannot say with Berkeley that its perception by us is a sufficient explanation of the mental element. The attributes must themselves be held together by a mental activity. Here we find a return to the monads of Leibniz, rendered all the more striking by the generally modern tone of the work. The first part closes with two more special chapters, one on the normative sciences, logic, ethics and æsthetics, and their relation to each other and to psychology; the other on ethics in general.

In the historical exposition of this part the chief emphasis is laid upon the English philosophers. The entire account of the English school is masterly, and much more sympathetic and painstaking than the treatment usually accorded in the German works now recognised as standard. The second part supplements the first by a series of lectures on Plato, Aristotle, and the modern philosophers from Descartes to Kant.

The work as a whole furnishes the lay reader with a valuable and very readable statement of philosophical doctrine, and will give new points of view to the philosophical thinker who is unacquainted with Prof. Robertson's system. It is too brief and not

consecutive enough to find a place as a text-book. Mrs. Rhys Davids deserves great credit for the skill with which she has pieced together the materials at her disposal. To an unsuspecting reader the book would not betray the fact that it was not written at first hand. We can safely predict that it will continue the influence which the author exerted while living, and which would have undoubtedly been increased except for his untimely death.

W. B. PILLSBURY.

Immanuel Kant's Critique of Pure Reason. Translated into English by F. MAX MÜLLER. The Macmillan Co., New York, 1896, pp. xxvi, 808. Price, $3.00.

Max Müller's translation of the Critique is too well known to need more than the mention of this new and cheaper edition. The back of the title page bears the legend, "First edition printed in 1881. Reprinted with alterations, 1896." The alterations from the two-volume edition of 1881 appear to be, as to matter, the omission of the translator's preface and the historical introduction by Noiré; and, as to form, the use of a smaller though very legible type and a slightly smaller page. These changes reduce the present volume to the text of Kant's first edition of the Critique and the supplements, which show the changes that were made in his second edition. Students of Kant will be grateful to the publishers for making this translation accessible at a reasonable price.

An Outline of Psychology. By EDWARD BRADFORD TITCHENER. The Macmillan Co., New York, 1896, pp. xiv, 352. Price, $1.50.

In this book Prof. Titchener gives the substance of his university lectures to Sophomores and Juniors at Cornell. The work is written from "the traditional English standpoint," but its purpose is a brief and simple exposition of the newer experimental psychology. For such a task Prof. Titchener is singularly well qualified, having added to an Oxford B. A. and Leipzig Ph. D. a number of years of independent teaching and research. The book presents methods and results without the scaffolding of tables and details which have often added to the obscurity of the larger works. Extended criticism of the psychology of the work is reserved for a later number.

Von Darwin bis Nietzsche. Von DR. ALEXANDER TILLE. Naumann, Leipzig, 1895, pp. 241.

An interesting little work and highly anathematized by the highly orthodox. Like young Germany, the author swears largely by Nietzsche. Nietzsche, the erratic, the eccentric, the aphoristic and the modern oracular Zarathustrian, is for him the high-water mark of the tide which has been rising so steadily since Darwin's days. Spencer, Leslie Stephen, Wundt, Huxley, Fiske, Williams, Bebel and others are shown to be so many landscapes on the road to Nietzsche. The trend of thought is, of course, biological and evolutionary. The *Abermensch*, the Beyond-Man, is the continued goal. A race of laughing lions is coming, strong men full of deeds and vigor. The cry is not Repent! but the true Metanoia, change of life and conduct; not so much humility and penance, as Grecian valor and Roman *virtus*. A high aristocratic *Herrenclasse*, the product of natural selection is his ideal. Consumptives must not marry. Only the fittest must survive. "*Nicht nur fort sollst du dich pflanzen, soudern hinauf!*"

The author's historical portrayal is good. In the development of thought here presented there are hints for certain methodological

considerations of great value. Ethics is becoming apparently a *science* in so far as it is portraying the history of ideals and their natural causes and consequences. The organisms that have the best ideals live, racially considered; there is a natural selection. Ethical progress is apparently as definite and certain as physical or organic evolution. Ethics is here a science. As an *art* it will have to do with present ideals, their practicability and the means for their attainment.

ARTHUR ALLIN.

De la Croyance. Par JULES PAYOT. Alcan, Paris, 1896, pp. 251.

The *question dominatrice* in psychology, morals and education is belief. The intellectualists are denounced for resolving everything into pure intellect. "We think and believe with all that we are, with our body as well as with our sensibility and our intelligence." Education of belief is possible. Certitude is nothing distinct in kind from belief. Epicurus and Hume wrongly held the type of all certitude to be in perception. Payot holds perception to be a very complex process of inductive reasoning, instantaneous and automatic. Hence there is room for error, and hence perception is not the highest type of certitude. Nor is certitude to be found in sensations, for they are wholly hypothetical. Nevertheless there are simple perceptions which we call sensations (light, sound, etc.); these possess irrefragible certitude.

What is objective reality? Not secondary qualities. There are, however, tactile sensations; these, though similar to secondary qualities, take on a character of solidity. These, along with the sensations of resistance, give us all the *permanent* qualities of objects. Space is the essential quality, and "space is constituted by our muscular presentations." The character which differentiates this "primary quality" from the secondary qualities is that of its *necessity*. The author also endeavors to show that "to believe is to restrain oneself from acting" (*croire c'est se retenir d'agir*). Belief and will are fundamentally the same, differing only in degree.

ARTHUR ALLIN.

NOTES AND NEWS.

THE LATE PROFESSOR DELBŒUF.

The last number of the JOURNAL chronicled the sudden death of its coöperative editor, Professor Delbœuf. The following details of his life and professional career may be of interest to psychological readers.

Joseph Remi Léopold Delbœuf was born at Liège in 1831, and spent the greater part of his working life as professor of classical philology in the university of his native town. He died at Bonn on August 14th of the present year, having been seized with illness as he was travelling to the third international congress of psychology held at Munich in the first week of that month. He carried his sixty-five years well; and no one who had seen him in 1895—still less one whose memory dates from the part he took in the London congress of 1892—would have anticipated his early death.

Professor Delbœuf was indefatigable as an author. He has made lasting contributions to philology, physiology, psychology and philosophy. Of his publications in the last two fields the most important are his *Prolégomènes philosophiques de la géometrie* (Liège, 1860); the *Essai de logique scientifique* (Liège, 1865); three volumes on 'questions in philosophy and science'; the *Examen critique de la loi psychophysique* and the *Éléments de psychophsique, générale et spéciale* (both Paris, 1883) and *Le sommeil et les rêves* (Paris, 1885); the *Étude psychophysique; recherches théoriques et expérimentales sur la mesure des sensations*, etc. (Brussels, 1873); *La psychologie comme science naturelle, son présent et son avenir* (Paris and Brussels, 1876); *Théorie générale de la sensibilité* (Brussels, 1876); *L'hypnotisme et la liberté des réprésentations publiques* (Liège, 1888); *L'hypnotisme appliée aux altérations de l'organe visuel* (Paris, 1890); *Magnétiseurs et médecins* (Paris, 1890); *Le magnétisme animal, àpropos d'une visite à l'école de Nancy* (Paris, 1889); *L'hypnotisme devant les chambres legislatives des Belges* (Paris, 1892); etc., etc.

Professor Delbœuf owed his first allegiance to the *Revue philosophique*, to which he had contributed since its foundation, and where he concluded in April of last year his series of articles on the "Old and New Geometries." But he took a lively interest in the affairs of the JOURNAL, and had promised one if not two papers for the coming year. In him the world loses one of the most original and at the same time one of the most erudite of modern psychologists.

CONGRESS NOTES.

The question as to the nature of feeling and emotion, though still a long way from final settlement, seems to have given place to a general interest in the more fundamental problem of the relation of mind and body. "Parallelism" and "interaction" were the

favorite topics of conversation, among normal pschologists at any rate, at the Munich Congress. The immediate impulse to this interest was imparted, no doubt, by the opening address of Professor Stumpf, who devoted the main body of his presidential speech to a polemic against parallelism. But recent psychological literature has been rife with discussions of the problem, and one of the features of the last meeting of the American Psychological Association was a debate on the place of consciousness in organic evolution,—a debate that has not yet been brought to a conclusion. At Munich the balance of professional opinion appeared to be on the side of parallelism; and it was noteworthy that the interactionists, following the presidential example, were content to support their own position by attacking that of their opponents. Positive arguments for interaction, on the lines of those urged, *e. g.*, by Professor James, were not forthcoming.

In his addresss of welcome the rector magnificus paid a special compliment to American psychology. The compliment was heartily applauded. Yet one could not fail to be struck with the ignorance of English-written literature displayed by German psychologists, and by the lack of it in German university libraries. This state of things is due, in part, no doubt, to the large attendance of English-speaking students at German seats of learning: if they are obliged to seek instruction in Germany, they cannot leave much that is worth knowing behind them. The German student himself very rarely travels outside of his own country for even a portion of his education. As the German Ph. D. becomes less a matter of course, and teachers get their training more in their home laboratories, it may be expected that Germany will come to hold foreign psychological literature in greater respect.

Herr Zimmermann had several new instruments or appliances on exhibition. Chief among them were the von Frey bristle-æsthesiometer, a novel and very convenient color-disc motor, the Marbe color-mixing apparatus, and some comparatively cheap drums for demonstration purposes. A new model time-sense machine was also shown in action; but the latest Meumann contacts were not displayed. Herr Zeiss had an interesting, if not particularly psychological, exhibit. Herr Appunn showed his steel wire forks for deep tones, along with other apparatus. Dr. Stern's arrangement for the obtaining of continuous tonal change by the rise of mercury in a blown bottle promises to be most useful, and should not be expensive, given the bellows. The other exhibits were, in the main, of 'technical' electrical instruments.

The Congress had one important reason for self-congratulation,—it attracted many eminent investigators in the fields of anatomy and physiology. Professor Flechsig gave what was, in some respects, *the* lecture of the whole meeting; Professor Exner read a paper; Professor Hering was present, though he took no part in the proceedings. All this is a new departure, and a very welcome one.

Books Received.

Bourneville. Discours prononcés les 7, 24, 25, et 28 juillet, 1896, aux distributions des prix des écoles municipales d'infirmières laiques. (Reprint, Laicisation de l'Assistance Publique Enseignement Professionnel des Infirmières. No. 19, pp. 733-792.)

Bourneville, *et al.* Recherches cliniques et thérapeutiques sur l'épilepsie, l'hystérie et l'idiotie. Compte-Rendu du service des enfants idiots, épileptiques et arriérés de Bicêtre pendant

l'année 1895. Volume XVI, avec 31 figures dans le texte et 8 planches. F. Alcan, Paris, 1896, pp. lxxi-254.

ELLIS AND SYMONDS. Das Konträre Geschlechtsgefühl. Deutsche Original-ausgabe besorgt unter mitwirkung von Dr. Hans Kurella. Pp. xvi, 308. Georg H. Wigand's Verlag, Leipzig, 1896.

MÜLLER. Kant's Critique of Pure Reason. Translated into English by F. Max Müller. Pp. xxvi-808. The Macmillan Co., N. Y., 1896. Price, $3.

STRATTON. Ueber die Wahrnehmung von Druckänderungen bei verschiedenen Geschwindigkeiten. Separat-Abdruck aus Wundt's Philosophische Studien, XII Band, 4 Heft. Leipzig 1896.

ADVERTISEMENT OF THE WELBY PRIZE.

A prize of £50, to be called the *Welby Prize*, is offered for the best treatise upon the following subject:

The causes of the present obscurity and confusion in psychological and philosophical terminology, and the directions in which we may hope for efficient practical remedy.

Competition is open to those who, previously to October 1st, 1896, have passed the examinations qualifying for a degree at some European or American university.

The donor of the prize desires that general regard be had to the classification of the various modes in which a word or other sign may be said to possess 'meaning,' and to corresponding differences of method in the conveyance or interpretation of 'meaning.' The Committee of Award will consider the practical utility of the work submitted to them as of primary importance.

The essays, which may be written in English, French or German, must be typewritten, and extend at least to 25,000 words. They should be headed by a motto, and accompanied by a sealed envelope containing the name of the writer. They may be sent to any member of the undersigned Committee of Award, and must reach their address not later than January 1st, 1898. The right of publication of the successful treatise is reserved.

Professor SULLY,
1 Portland Villas, East Heath Road, Hampstead, London, N.W.
G. F. STOUT,
University, Aberdeen, N.B.
Professor TITCHENER,
Cornell University, Ithaca, N.Y.
Professor KÜLPE,
Würzburg, Germany.
Professor E. BOIRAC,
Lycée Condorcet, Paris.

THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

VOL. VIII. APRIL, 1897. NO. 3.

A STUDY IN APPERCEPTION.

BY WALTER BOWERS PILLSBURY, A. B., PH. D.,
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INTRODUCTION.

In the past history of psychology, almost as far back as the beginnings of modern philosophy, there has been much controversy as to whether the immediate datum of sense or some more general factor of mind plays the greater part in determining the nature of conscious processes. One side holds, to state it baldly, that we have in consciousness nothing but sensations, and associations which are directly conditioned by the nature and previous connections of sensations; the other that there are further subjective or mental states which have no small share in shaping consciousness. The two views are the psychological echo of the old philosophical war cries of 'innate ideas' and 'the mind a *tabula rasa*': a legacy of Hume's impressionism and the Kantian *a priori*. In recent psychologies we find this antithesis represented by the associationists on the one hand, and the apperceptionists on the other: the former deny, the latter affirm, the existence in mind of elements other than sensations and their connections.

In spite of numerous and spirited debates on the question, there has been no attempt made, so far as we can learn, to employ experiment for its solution; and only too often observation has been used both scantily and carelessly. Our pur-

pose in this paper has been to state the results of experiments which bear directly on the point at issue, and give evidence that promises to be of value in its settlement. It was our intention in beginning the experiments to try and discover the relative importance of sensation, and the more general or remote factors—if such there were—which are at work in the very simple and familiar action of *reading a word*. Briefly stated, the method employed was the reduction of the intensity of objective factors to a minimum, and the examination of the subjective factors that remained. As the work progressed, we found that the relation between the directly given sensations and the more subjective factors as a whole was comparatively simple, and that the real complexity of the problem was bound up with the classical antithesis, within the subjective elements, between apperception and association. This has, therefore, received a very large share of our attention.

When we came to report the results, we found it very difficult to give accurate definitions of the terms that must be used to make clear the exact relations of the different concrete processes. The most convenient and the simplest way to do this, everything considered, was to follow some standard treatment of the subject, as a guide through the various complexes. We have, therefore, given a *résumé* of Wundt's theory of apperception and its relations to the other mental activities as an introduction to our own work. Wundt was chosen because he gives the most comprehensive and systematic discussion of the question, and is, moreover, one of the very few writers of scientific accuracy who have held the apperceptive view. It would, of course, be useless to discuss apperception upon the basis of a system which attained only negative results in this respect. We have constructed a connected exposition from the statements in the *Grundzüge der physiologischen Psychologie* (4th edn.), the "Lectures on Human and Animal Psychology," the *Logik* (2d edn.), the *Ethik* (2d edn.), the *System der Philosophie*, and the articles *Zur Lehre vom Willen* and *Bemerkungen zur Associationslehre*, published in the *Philosophische Studien*. We found that much has been made by critics of what seemed, on superficial examination, to be inconsistencies in Wundt's doctrine. Most of these disappear with a more complete knowledge of his works. Nevertheless, in one or two cases we believe that different conclusions can or must be drawn from the premisses which he has assumed. The theory as a whole is unaltered, and no material has been used in any part of the discussion except that furnished by Wundt himself. It is hoped that an impartial statement of Wundt's

attitude towards this question will be of some value to the English-speaking student of psychology, even apart from the use we have made of it in connection with our own investigation.

We have found no literature that bears exactly on our more special problem. It is, of course, impossible in a paper of this scope to examine even superficially the more general literature of the subjects involved. We have, therefore, trusted to our *résumé* of Wundt and the very widespread knowledge of the theories of association to furnish the discussion with a historical setting, and to give a clear statement of the problems involved. Credit for suggestion of experimental methods has been given, where due, in the main body of the article.

CHAPTER I.

The Psychology of Apperception.

SECTION 1. APPERCEPTION AS CONSCIOUS PROCESS.

In discussions of apperception we must distinguish three uses of the word. Apperception may be used (1) to designate certain phenomena actually given in consciousness. (2) A second very general use is to denote a certain activity, whose existence we infer from these conscious data. Both meanings are perfectly valid in psychology. The immediate datum of consciousness may be either an actual element of conscious contents, or a certain change in that contents. Sensations we know directly. We also know, *e. g.*, that under certain circumstances sensations which have previously been in the mind return accompanied by peculiar states of mind which indicate that they have been in consciousness before. This knowledge forms the immediate datum of memory. But, in addition to this, we conceptualise the fact, or infer from it a general tendency of sensations to recur in consciousness. This, too, we call memory,—and with equal right. The same distinction holds true of apperception. The concept 'apperception' is not directly given in mind, any more than the concept 'memory'; both are immediate inferences from the actually given contents.

There are certain given phenomena of consciousness, which may be explained by the assumption of an apperceptive activity; and we may use the concept to generalize the given, just as the physicist assumes ether to explain various phenomena of the physical universe. But further, in many cases, after the concept has been formed, it is used as if it stood for an immediately given, not an inferred process.

This use is legitimate as a short-hand expression for the whole procedure of observation and inference which led to the formation of the concept. But it cannot, of course, give any warrant for ascribing to apperception a substantial existence. It still remains a convenient category under which we may group a number of related phenomena, but which itself has no existence in the sense that the phenomena themselves are existent.

Besides these two legitimate psychological uses of the term apperception, there is (3) the varying and indefinite metaphysical use. This is in general related to the psychological uses from which it has developed. To trace the relation in detail would take us too far from the proper subject of this paper. It has, moreover, been thoroughly worked out by Dr. Staude.[1]

The first two uses of the word occur indiscriminately throughout Wundt's works. In nearly all cases the context gives a ready means of determining which of them is intended. In general, the concept apperception is meant in all passages except those concerned with an analysis of the immediately given. No confusion results if the distinction has once been noticed. On account of the great convenience of the double use, we shall follow Wundt in adopting it.

Wundt declares that his 'apperception' is not a metaphysical concept, not the addition of a new faculty to mind. Apperception stands simply for a certain group of conscious phenomena, which have such definite relations, and so many marks in common to distinguish them from the other mental contents, that they deserve a special name. In beginning a discussion of Wundt's doctrine, we must, therefore, determine exactly what processes he includes under the term.

As we observe our ideas, we find that some are distinct and clear, while others are vague and indefinite. In this difference in degree of clearness Wundt finds the first and most prominent of the facts to which he applies the name apperception, and about it he groups the other phenomena to be included under the term. This difference is not a difference in the ideas themselves, as contents, but a mere changing accident of their appearance in consciousness. The clearest ideas may become vague, while the vague ideas of the conscious background may grow clearer, and assume a prominent place. The change is best illustrated by Wundt's metaphor of *Blickpunkt* and *Blickfeld*. At any given moment we have certain portions of the 'field of consciousness' at the 'point of clearest vision.' From this clearest point, the

[1] *Phil. Studien*, I, pp. 149 ff.

ideas shade off in all degrees of clearness down to the greatest obscurity. But the relations of the ideas to each other in degree of clearness are not fixed. The point of clearest mental vision *(innerer Blickpunkt)* may move over the entire range of consciousness, just as we may move the *fovea* of the eye over the entire field of vision, and bring each point into the place most favorable for its seeing.

Difference in clearness is not the same with difference in the intensity of the idea or sensation, though it may in part be dependent upon intensity. This is best seen in the variations of very weak stimuli. Here we can easily distinguish a variation in the degree of subjective clearness from a change in the objective intensity of the sensation. A little care in observation, however, serves to make the difference apparent even in sensations of average intensity. In extreme cases, when the stimuli are very near the limen of sensitivity, we may have sensations which lie above the intensity limen, but below the limen of clearness or apperception. | Ideas may be below the apperception limen and still be in consciousness. The general relation of intensity to clearness seems to be reciprocal. Intensity favors clearness, clearness favors intensity. The increase of intensity accompanying or following increase in clearness is induced only indirectly by apperception. It depends directly upon the motor discharges called up by association during apperception.

That difference in clearness is not a function of single ideas and not occasioned by the external stimuli to ideas or sensations, is shown by the fact that degree of clearness varies with the number of ideas contained in the *Blickpunkt* at a given time. If one idea alone occupies the important place in consciousness, it is much clearer than if several others are equally prominent. In Wundt's terminology, the clearness of the apperceived ideas varies inversely with the number of ideas simultaneously apperceived. This interrelation between the number of ideas and their degree of clearness seems to indicate that we are dealing in apperception with a factor which is of wider influence than any single idea.

Preceding, accompanying and succeeding increase in the clearness of ideas there is a varying complex of sensational and affective phenomena which deserves very close description and analysis. It appears most simply in the processes accompanying the immediate arousal of a sensation through the sense organ. Here Wundt[1] makes it consist of four elements: (1) increase of clearness in the idea directly before the mind, accompanied by the immediate feeling of activity

[1] *Phys. Psy.*, II, pp. 274 f.

(Thätigkeitsgefühl); (2) inhibition of other ideas; (3) muscular strain sensations, with the feelings connected with them, intensifying the primary feeling of activity; and (4) the reflex effect of these strain sensations, intensifying the idea apperceived. Of these four elements which Wundt distinguishes we can regard only the increase of clearness (which we have discussed above), the feeling of activity, the strain sensations with the increase in the feeling of activity which accompanies them, and probably the increase in intensity succeeding the strain sensations, as directly given in consciousness. The immediately inferred constituents are the inhibition effects, and the dependence of the increase in intensity upon muscular excitations. The conscious facts in these two cases are that other ideas do not come to consciousness, or to the clearest consciousness, while we are attending to some given idea, and that the entering ideas grow in intensity after the strain sensations appear. We shall find it necessary later to question how far the feeling of activity is elementary, and how far analysable into simpler elements.

Besides the direct accompaniments of apperception in attention, there are others, more remotely related, which often precede and accompany them. These again always seem, when analysed, to consist of strain sensations, of more or less dark ideas, and of the affective tone which the process produces. They are very marked in expectation and the succeeding state of satisfaction or surprise.

In expectation Wundt distinguishes three important factors: oscillation between the ideas of the various objects expected; sensations of strain,—especially from the muscles of adaptation in the organ from which the sensation is expected; and feelings (for the most part, evidently, the sense feelings of pleasure-pain) which arise partly from the strain sensations, and partly from the unrest due to the vibrating memory images. With the entrance of the expected idea we have the state of satisfaction *(Erfüllung)*. Here we find a feeling of passivity, followed by a feeling of activity and the feeling connected with normal adaptation. Should an idea enter which was not expected, we have surprise. Here the feeling of passivity lasts for a longer time; the feeling of activity enters but slowly; and the accompanying feeling of disagreement with the expected idea gives the whole process an unpleasant affective tone. In both these complexes, therefore, Wundt sees, ultimately, nothing more than increase in clearness of sensation, a changing affective tone, various strain sensations, and ideas that come and go in the dark background of consciousness.

There are two strong pieces of evidence, he says, that the

phenomena of this group are causally related. (1) They always occur together in time. An idea never undergoes the peculiar increase in clearness when the accompanying phenomena mentioned are not present. This is definitely stated by Wundt[1] as follows: "Careful introspection seems to show that feelings of the same kind are never entirely absent, where ideas which were formerly obscure become clearer, although their intensity be much less and their quality exceedingly variable." (2) The feeling of activity and the sensations of strain are most intensive when the ideas are clearest. Increase in clearness of ideas and in intensity of strain sensations, etc., always go on side by side.—Thus two of Mill's canons of induction apply to the case under discussion, and the evidence that there is some fundamental relation between the two processes seems very strong, if it is not indeed conclusive.[2]

So far all has been plain sailing. We have discovered that sensations change in a way which seems to be independent of the individual sensation, and of the objective causes of sensation in general. We have three decisive bits of evidence that this change is peculiar, and only partially dependent upon the ordinary attributes of sensation. Unlike them, it is almost entirely independent of the objective conditions of sensation. (1) It is not like quality, or extent, and other attributes of sensation, dependent merely upon the character of the stimulus. Changes in clearness take place while all external conditions remain the same. Dark or confused sensations increase in clearness; the clearer sensations at one moment become the confused at the next, without reference to changes in the external world. (2) Although a reciprocal relation exists between clearness and intensity (the attribute to which it is most similar), the two are different and distinguishable. They are independent variables. A sensation of

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[1] "Lectures," p. 248.

[2] The word 'feeling' is used, here as elsewhere, by Wundt in a peculiar sense, which must be made plain if we are to understand much of his discussion. A 'feeling' is a reaction of the total organism upon any phenomenon. As a conscious process it is a characteristic mark of the presence of the phenomena which occasion it, and is usually regarded as simple and unanalysable. Nearly every feeling has its opposite: pleasure and pain are opposed, as are the feeling of activity and the feeling of passivity. But, as we shall see later, there are some feelings (*e. g.*, the conceptual feeling: *cf.* p. 337 f.) which do not stand in any such antithetical relation to others. It should be noticed, in particular, that 'feeling' *(Gefühl)* does not always refer to feelings of pleasantness and unpleasantness. We have sometimes used the word 'affection' or 'affective tone' in place of feeling in this restricted sense.

small intensity may be very clear, while a comparatively very intensive sensation may hardly affect consciousness at all, may remain dark and confused in the conscious background. (3) That clearness is not a function of any single sensation is apparent from the inverse ratio between degree of clearness and the number of clear ideas,—between the extent and intensity of the *Blickpunkt*. Were clearness a function of the individual sensation, it would not be affected by the variation of another sensation in the same respect. This very involved relation between the variations of different sensations under certain conditions seems to preclude the possibility that the attribute thus affected is dependent merely upon the sensation to which it attaches for the moment. The three sets of facts, then, seem to render it very improbable that we are dealing with a phenomenon of consciousness which is dependent upon a single sensation or upon external conditions.

If this phenomenon stood alone, it would of itself be sufficiently important to deserve notice. It becomes still more striking when we consider the importance of the phenomena which accompany it. The strain sensations, the affective processes, and the cloud of darker ideas scattered about the focus of consciousness, before and during its occurrence, constitute a group respecting which we cannot but be of Wundt's opinion, that it is worthy of special description and a special name.

The number and nature of the elements in the complex of concomitant processes are in general clear enough from the analysis of attention and expectation which has been summarised above. The complex consists of numerous strain sensations, and a general affective tone, which is excited partly by these strain sensations and partly by the sensations which take part in the process.

So much of the description is completely unambiguous. Here and there throughout the different discussions, however, we meet with a mention of a feeling of activity *(Thätigkeitsgefühl)*. It is not immediately evident whether by this is meant something ultimate and unanalysable, a direct consciousness of an element of mind different from sensation or pleasure-pain, of apperception in what we have called the concept sense of the word; or whether it is merely a convenient term used to designate a complex of affection and sensations from which we naturally and directly infer that an activity has been at work. We are told repeatedly that we can know apperception only by its effects upon sensation and feeling; but the implication of many of the discussions is that we know it immediately, in the *Thätigkeitsgefühl*. We must decide in favor of one view or the other from a careful

examination of the various passages in Wundt's works in which the question is discussed.

Two kinds of evidence are available in this connection. We can examine analyses of the apperceptive process, for evidence of identity or non-identity of the *Thätigkeitsgefühl* with the sensational and affective contents usually mentioned as present; and we may look for and evaluate passages that state explicitly that apperception appears in consciousness immediately. One of the passages which offers the most unequivocal evidence of the former kind is in the *Zur Lehre vom Willen*. After analysing the side-contents of consciousness during the apperception of an idea into feelings and innervation sensations, Wundt says: "In diesen Innervationsempfindungen liegt zugleich der nächste sinnliche Anlass dafür, dass wir die Apperception oder Aufmerksamkeit eine Thätigkeit nennen und sie als solche von dem völligen passiven Verhalten gegenüber äusseren Eindrücken oder in uns aufsteigenden Vorstellungen unterscheiden."[1] Lower down on the same page he gives an equally decisive analysis of will and apperception to prove that they are the same. "In der That sind bei derselben [die primitive Willenshandlung = die Apperception] die bei jeder Willensthätigkeit zu unterscheidenden Stadien auzutreffen: die Erregung des Bewusstseins durch ein Gefühlsmotiv, die daraus hervorgehende Richtung des Bewusstseins mit ihren psychischen und physischen Folgezuständen, und endlich die durch die letzteren herbeigeführte Lösung der Spannung."

Similarly the analysis of expectation,[2] which Wundt calls the apperception of a future, not a present idea, is reduced entirely to strain sensations, to affective states accompanying the strain sensations, and to the oscillation of the dark ideas in consciousness. So in the "Lectures"[3]: "The whole circle of subjective processes connected with apperception we call *attention*. Attention contains three essential constituents: an increased clearness of ideas; muscle sensations, which generally belong to the same modality as the ideas; and the feelings which precede and accompany the ideational change." Thus wherever Wundt gives an exact analysis of the processes which he includes under the *Thätigkeitsgefühl*, he seems to reduce it mainly to sensations of strain or (as in the older article cited) of innervation. The 'sensations of innervation' are, of course, equivalent to the 'strain sensation' of his modern work. This is evident from

[1] *Phil. Stud.*, I, p. 347.
[2] *Phys. Psy.*, II, p. 280.
[3] P. 249.

the general change of terms between older and newer editions. It is seen more particularly in the present connection from the fact that the sensations of innervation reflexly increase the intensity of the sensation, — a function which is ascribed in the fourth edition of the *Physiologische Psychologie*[1] to strain sensations.

The direct statements concerning the conscious phenomena of apperception or, as Wundt usually states the problem from the other point of view, of the way in which apperception comes to consciousness, seem just as definite in favor of the same interpretation. Thus in the *Physiologische Psychologie*, II, p. 279, after speaking of the relation of passive and active apperception to association, Wundt says, "In beiden Fällen kommt uns aber als ein von dem Verlauf der Vorstellungen verschiedener Vorgang die Apperception theils durch die sie begleitenden Gefühle, theils durch die begleitenden Spannungsempfindungen zum Bewusstsein, deren Intensität mit dem Grad der Aufmerksamkeit zunimmt."

Yet stronger are the statements in the fine print at the end of the same chapter,[2] in which he defends himself from the charge of introducing metaphysical concepts into psychology.

"Metaphysische Begriffe bezeichnen nicht Thatsachen sondern speculative Ergänzungen derselben. . . . . Dagegen verstehe ich hier wie überall unter Apperception lediglich die sämmtlichen oben geschilderten einfachen Phänomene selbst: die Veränderungen im Klarheitsgrad der Vorstellungen, die begleitenden Gefühle, die mir, je nachdem das Thätigkeitsgefühl das ursprüngliche ist oder das Gefühl des Erleidens ihm vorausgeht, zugleich das nächste Unterscheidungsmerkmal der activen und der passiven Apperception abgeben, endlich die begleitenden Spannungsempfindungen und, wo sie vorkommt, die an die letzeren gebundene schwache Verstärkung der in ihrem Klarheitsgrad gehobenen Empfindungen. Natürlich bin ich nicht der Meinung, jene Gefühle der Thätigkeit und des Erleidens enthielten an und für sich irgend etwas von den Vorstellungen oder gar den Begriffen, die wir mit diesen Ausdrücken verbinden; vielmehr liegt hier genau der nämliche Fall vor, wie bei den elementaren Empfindungen: ihre Namen müssen wir gewissen Vorstellungsbeziehungen derselben entnehmen, ohne dass damit jemals gemeint sein kann, diese Vorstellungen selbst seien in ihnen enthalten."

This passage appears to indicate not only that Apperception is primarily merely the name for a group of conscious phenomena, but that the peculiar *Thätigkeitsgefühl* is itself but a complex of other feelings, which we frequently meet, and that its peculiarity is due to peculiarity in the combination of familiar sensations and feelings rather than to any

[1] II, p. 274.
[2] *Ibid.*, II, p. 283.

new mental element. Still further support for the same view is given by a sentence at the bottom of the page quoted: "Ebenso scheint es mir, dass der Versuch die Vorgänge der Apperception und der Aufmerksamkeit in die Elemente zu zerlegen, die den überall sonst uns begegnenden Elementen des seelischen Geschehens entsprechen, das Gegentheil von dem ist was man die Construction eines neuen Seelenvermögens nennen könnte." This is the general tenor of all Wundt's statements which give us a direct account of the precise way in which we are conscious of apperception. It seems to reduce to a complex of changes which appear in consciousness when the favored idea increases in clearness. The feeling of activity covers the most striking part of this complex, the part which is most prominent in the 'spontaneous' acts of mind.

That an activity is to be inferred from certain states of consciousness is, then, the meaning of the passages so far. The phenomena from which activity is inferred are now grouped together under the name of *Thätigkeitsgefühl*, and under the conceptualising tendency to which we called attention at the beginning of the chapter, activity or spontaneity is referred to as if it were an element of which we were directly conscious. In the passages we have considered, Wundt is thus analysing and grouping the phenomena which permit the inference that there has been activity, and so justify him in giving these a distinct name. A passage in the same connection as those quoted above from the "Zur Lehre vom Willen"[1] seems to show that this procedure has been followed consciously.

"Ich gebe zu, dass in der hier gegebenen Schilderung gewisse Elemente mehr aus Folgeerscheinungen erschlossen als direct beobachtet sind. Immerhin wird der Versuch gemacht den in der gewöhnlichen Vorstellung völlig unbestimmt gelassenen Begriff der 'spontanen Thätigkeit' so viel als möglich in seine Elemente zu zerlegen und darüber Rechenschaft zu geben, warum wir gewisse Vorgänge auf eine innere Thätigkeit beziehen und andere nicht."

If we have correctly interpreted Wundt's statement of the conscious effects of apperception, it is nevertheless easy to see how he would speak of the immediate consciousness of a *Thätigkeitsgefühl* as he does, and assume that the reader would refer to the explanatory passages for the exact meaning of the term. The concept is used for convenience in place of naming the separate elements in each case. Our explanation is further supported by the fact that the passages which

[1] *Phil. Stud.*, I, p. 347.

can be interpreted to imply an immediate consciousness of a peculiar *Thätigkeitsgefühl* are either (1) introductory passages,[1] where it is particularly desirable to emphasise the distinctions between this complex and others more or less similar to it, or (2) passages in which the process is mentioned only incidentally. Still a third connection in which the word is used in the same general significance occurs in the *Ethik* (pp. 435 f., *e. g.*), where the point in contention is that voluntary action is conscious and is not merely inferred from the phenomena of external movement. Here, then, *Thätigkeitsgefühl* is a descriptive term, indicating that there are some conscious processes which accompany voluntary action, but not implying anything as to the nature of these processes.

SECTION 2. PASSIVE AND ACTIVE APPERCEPTION.

The group of processes which has for its core the increase in degree of clearness of some idea, seems to be of two general kinds, which Wundt denotes by the terms 'passive' and 'active' apperception. The ground of this classification is furnished mainly by the quality and intensity of the concomitant strain sensations and feelings. Active apperception is accompanied by the *Thätigkeitsgefühl*, which we have discussed at length in the preceding Section; passive apperception by a feeling of passivity. The difference is almost entirely one of intensity in the concomitant phenomena.

Passive apperception appears to have two forms, or, rather, to be present on two occasions, one of them independent of, the other closely connected with, active apperception. (1) At certain times when an idea enters consciousness under the most favorable conditions, we have only passive apperception; while (2) in other cases passive apperception takes place first, and is succeeded by active. In neither event is passive apperception so complete or full as direct active apperception. There is a feeling of being at a loss, of insufficiency—as in the emotion of surprise—which hinders the proper or usual increase in degree of clearness. The strain sensations are fewer in number and less intensive, and the idea does not become so clear. Or, as Wundt sums up the description himself[2]: "Demnach unterscheidet sich objectiv die passive von der activen Apperception lediglich durch den geringeren Klarheitsgrad der Vorstellungen, durch die völlig mangelnden oder nur spurweisen und rasch verge-

[1] *Phys. Psy.*, II, p. 266.
[2] *Phys. Psy.*, II, p. 277.

henden Symptome motorischer Innervation und der von dieser ausgehenden associativen Verstärkung der Empfindungen."

Another accurate and detailed analysis of this complex of sensations is given in the "Lectures" (p. 254). "Even passive apperception, therefore, has its attendant feelings[1]; only that these are associated to form a total feeling with a character of its own, either exclusively conditioned by the quality and intensity of the ideas that happen to be present in consciousness, or (and this is especially the case in apperception of very intensive external sense-impressions) consisting in a feeling of inhibition, which appears to arise from the sudden arrest of existing tendencies in the formation of ideas." Here we see that the feeling of passivity is not entirely unanalysable, any more than the feeling of activity. It seems also to be like the latter in its components, and is in the main but another species of the same genus.

A better distinction between passive and active apperception depends upon the cause in the two cases, or, to speak in concrete terms, upon the states of mind which precede the apperception. In the typically passive form, apperception is determined unequivocally and immediately. There is no choice between several possible ways in which an idea may come to consciousness, or hesitation as to which of several ideas shall predominate in mind. One idea is so strong in interest or intensity that it overcomes all other applicants for the chief place in consciousness. In active apperception the incentives are more numerous and more evenly balanced. The decision is equivocal, and often delayed. Some time ordinarily elapses before we know which of the ideas that offer themselves will be chosen. In this hesitant decision, this trend of the incentives now towards the choice of one idea, now towards that of another, we see the most striking effects of the 'feeling of activity,' or as Wundt somewhat conceptually calls it in the *System*,[2] the 'feeling of self-activity.' The course of apperception is mainly determined by subjective causes, the individual characteristics of the mind, and its previous history.[3] These tend partially to conceal if not to counteract the effects of the external physical and physiological conditions which are most prominent in passive apperception. It is in passive apperception that we can best observe the effects of association, of the intensity of ideas and of the other chance or extraneous factors which

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[1] For Wundt's general doctrine of feeling with particular reference to the *Totalgefühl*, see esp. "Lectures," p. 220.

[2] *System*, p. 567.

[3] *Phys. Psych.*, II, p. 576; *Logik*, I, p. 30.

have a determining influence upon the course of consciousness.

The distinction between passive and active apperception in terms of cause leads us to a discussion of the conditions and causes of apperception in general. The conditions of apperception fall into two classes, subjective and objective. The objective conditions are intensity[1] and frequency of occurrence.[2] The more often we have had a sensation, the more readily do we apperceive it. Moderate intensities favor apperception; weak sensations are not easily noticed, and the organism cannot adapt itself to very intensive stimulation.[3]

Subjective conditions may be best treated under two general heads: the conscious states immediately preceding apperception, and the entire disposition of the individual consciousness as determined by its previous history.[4] Of the first class the most important seem to be the memory images and externally aroused sensations which are present just before and during the total process of apperception. Apperception of any sensation is rendered easy by its separate and isolated appearance shortly before in consciousness. That it shall at some previous time have entered consciousness alone is a *conditio sine qua non* for apperception, when it appears in a complex of sensations, or at the same time with other sensations. This rule is illustrated by the ease with which we hear out an overtone, if we have heard its quality singly, just before the complex note has been struck.[5] In many cases a memory image does duty for the externally aroused sensation in facilitating apperception. This is strikingly illustrated by the ease and rapidity with which we apperceive an expected as compared with an unexpected idea. This difference really reduces mainly to the absence or presence of memory ideas.[6]

Of the less immediate conditions of apperception we have frequent discussion throughout Wundt's works. In considering them we have, of course, to deal less with what is immediately conscious at the moment of apperception, and more with the hypothetical and inferred. The general disposition of consciousness here plays the most important part. It finds a physiological explanation in the habits of the organism, which have been acquired partly during the history

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[1] Intensity of course is partly due to proper adaptation of the sense organ.

[2] *Phys. Psych.*, II, p. 270.

[3] *Ibid.*, II, p. 271.

[4] *Logik*, I, p. 31.

[5] *Phys. Psych.*, II, p. 270. *Ibid.*, II, p. 280.

of the race, and partly in the life of the individual.[1] Where the sensational and associative factors which tend to determine apperception are fairly evenly balanced, this disposition decides in favor of one idea or the other. Its power is by no means inconsiderable, as can be seen from its activity in directing the attention upon weak stimuli when much stronger are present.

SECTION 3. APPERCEPTION AND ASSOCIATION.

Another important point in Wundt's theory of apperception is the way in which he relates it to association. In the previous Sections it has been shown that no sensation comes to its full rights in consciousness unless apperceived. Apperception either operates *actively*, as an arbiter between various sensations which seek to enter; or must at least *passively* consent to the entrance of an idea which comes alone, or with strength or interest sufficient to win from its rivals without contest. 'Association' performs the same office for a recurrent sensation as the physical factors which first brought it to consciousness. Just as physical forces furnish us with original sensations, material for apperception, so the physiological factors which underlie association offer consciousness the crude material from which apperception must choose those elements which are to be worked up into the finished mental product.[2] Association, that is, gives the possible connections of ideas, from which apperception chooses those that are to become actual. Associatively, the idea *a* may at any time call up *b*, *c*, *d*, etc.,—but apperception decides that of these *c* alone shall actually arise.

So far as it is conscious, apperception consists here of the presence of one idea under conditions which have at other times given rise to other ideas. At times, again, we are conscious of dark, *i. e.*, only partially apperceived ideas, while a particular idea rises to clear consciousness, although all seem to owe their origin to their connection with one and the same primary idea. Successive apperception and rejection of ideas belonging to a single group furnish evidence of similar tenor. The choice is accompanied by the feelings and secondary sensations which we know in attention to external objects as the feeling of activity. The facts of choice, of the increase in clearness of one of several ideas, and of the familiar feeling of activity, are amply sufficient to mark off the apperceptive complex from the associative.

[1] *System*, p. 566; *Logik*, I, p. 30; "Lectures," p. 252; *Ethik*, p. 439; *Phys. Psych.*, II, p. 279.

[2] *Phys. Psych.*, II, p. 279; *Logik*, I, pp. 28, 31, 48 f.; *System*, pp. 565 f.

Here again we have to distinguish between the functions of passive and of active apperception. It is through passive apperception that we are able to recognise the effects of association. At this stage what we have termed the objective causes of apperception play the most important part. That is, the physiological processes which underlie association are unambiguous, and consequently give the selective agency no choice. There is but a single course for the train of ideas to take, and idea follows idea in the natural unrestrained order that physiological causes and earlier relations of sensible processes in the external world dictate. We are in presence of the true causality of associative laws.

In active apperception, on the other hand, the merely physiological causes, the external relations, take a subordinate place. The particular conditions of the moment are subordinated to the more general conditions of consciousness. The subjective causes of apperception are so strong that they conceal, to a greater or less degree, the more mechanical associations. Remote causes, that lie in the general nature and individual tendencies of consciousness, are predominant to determine which of the many possible ideas offered by association shall actually enter consciousness. Active and passive apperception thus designate the same processes as in the earlier case, where the raw material was furnished by external stimulus. In both instances, passive apperception is only the less prominent form of apperception: it is still apperception.

If this distinction is not carefully noted, the reader is liable to a misconception of Wundt's position in the first chapters of the *Logik*. There we often find associative connections opposed to apperceptive, and treated as if they were entirely distinct from the forms of apperception. It is not intended, however, to give the associative processes a concrete and independent existence in consciousness. The difference is one of degree, and of degree alone. In associative connections, the subjective causes of apperception play a much less important part than the objective; in apperceptive connections the reverse is true, — subjective causes play the important rôle; but in neither is one series of causes present alone.[1]

From this discussion it appears that the finished product, the concrete mental image, is always the apperceived idea. Association can be known only as we abstract from, or conceptualise, the process that goes on in our consciousness. We never know the *merely* associated material, any more

[1] *Logik*, I, pp. 28, 31, etc.; *System*, pp. 556 f.

than we know the immediate contribution of the senses. Both must be worked up by apperception before they become fully and clearly conscious. Neither pure sensation nor the product of mere association is directly given in consciousness. They must be inferred from the nature of the given, after it has been already apperceived. Conscious associative connections are, in other words, not merely associative connections, but connections with a minimal amount of apperception.[1]

The degree to which the subjective causes of apperception are effective in associative connections increases, in regular gradations, through associative synthesis, assimilation and successive association. The more detailed relations of these to each other and to the apperceptive connections, will be discussed in the next Chapter. It is sufficient in this context to call attention to the fact that the difference between all stages is one of degree alone, never of kind.[2]

The relation between apperception and association is reciprocal. Not only does association furnish apperception with the material upon which it acts, but the apperceived idea can reënter the associative train and become part of the material for a later apperception. After the idea has been apperceived, or several ideas have been united by apperception, the resultant idea enters into associative connections, and offers itself to apperception again in the natural course of mental phenomena.[3] Not only, then, are associated ideas apperceived, but apperceived ideas are associated. The two levels of consciousness are not distinct, but mutually interrelated.

CHAPTER II.

Associative and Apperceptive Connections.

SECTION 1. ASSOCIATIVE CONNECTIONS.

We have seen in the preceding Chapter that Wundt finds in consciousness two general classes of connection. One is present in passive, the other in active apperception. One is mainly determined by the external and physiological conditions of the moment, the other by the more general conditions of the entire conscious disposition. The former class is that

[1] This view is opposed to Külpe's statement that association is not influenced by apperception. (Cf. *Die Lehre vom Willen in der neueren Psychologie. Phil. Stud.*, V, pp. 434 f.) Wundt's position in the *Logik*, however, is quite clear; and Külpe himself, in one passage, seems to incline to the opinion represented in the text.

[2] *Logik*, I, p. 31.

[3] *Logik*, I, pp. 50, 66; *System*, p. 566.

of associative, the latter that of apperceptive connections.

Wundt departs from ordinary usage in calling both the connections between ideas which are present in consciousness at the same time and those between ideas which succeed one another in consciousness, 'associations.' Indeed the difference between simultaneity and succession of ideas serves as the basis of his classification. Under each main head we have further several sub-classes, distinguished by the nature of the elements connected or by the closeness of the connection itself.

Simultaneous association takes three forms. We may have associations between sensations that enter consciousness together within the same modality, 'associative synthesis'; we may have association of a newly entering sensation with ideas already present, 'assimilation'; and we may have associations between ideas from different modalities, 'complications.' The first and last of these are of no special interest for our immediate purpose. In associative synthesis the elements are closely knit together about some prominent member of the group, and their individuality is frequently lost in the whole. A musical clang affords the best instance of this kind of association. In the complication, the different elements may be completely distinct and individual. Here, too, the elements come from different modalities. Examples of such a union are the connection between the idea of a word and the movements of the larynx that accompany its utterance in speech, and the connection of visual and tactual elements in the formation of the idea of a thing.

Assimilation concerns us more directly. The term includes all the phenomena that accompany the entrance of a sensation into consciousness. It thus covers the process which Herbart termed 'apperception.' A sense impression does not enter the adult consciousness alone, but always in connection with other processes. The new element is connected with others, which have themselves previously been connected with elements similar to it; and the whole thus formed appears in consciousness as a unit. Striking examples of assimilation are the overlooking of misprints in proof-reading, and the subjective completion of the rough daubs of stage scenery to a landscape, etc. Equally good, though less striking instances, are found in nearly every form of perception. When the process is carried a step farther, *i. e.*, when the associated elements outweigh the original in number and importance, or when the conscious connections do not correspond to the connections of the moment in the external world, we have 'illusion' instead of perception.

Assimilation is found on analysis to consist of an 'associa-

tion of identity' between the entering element and some element or group of elements previously present in consciousness. There is further an association by contiguity, which completes or fills out gaps in the original idea. If, *e. g.*, I read 'shocolate' as 'chocolate,' I get first an association of identity between the last letters of the word given and the corresponding letters of the word-idea 'chocolate,' and these, by contiguity, give the 'c' immediately and simultaneously.

From assimilation to *successive* association the passage is easy. In memory, the recurring ideational elements (the 'centrally excited sensations,' to use Külpe's phrase) which are brought up by physiological connections, and which are primarily a result of earlier relations of stimulation in the physical universe, must be worked up, as in simultaneous association. A memory image never comes back to us,—is never identical as a whole with its original,—but is always simultaneously associated to other ideas. And here, as before, we have the effects of two kinds of association, association by identity and association by contiguity. The latter is in the present case partially successive, partially simultaneous. We have a series of elements, which come by contiguity one after another; but each is in turn simultaneously associated by contiguity to many new processes, and one of these outlasts the remainder and gathers yet others about it. It is the persistence of one element in every two succeeding ideas which constitutes association by identity; it is the fact that an element in one couple of ideas is associated by contiguity with an element which is identical in the preceding or succeeding couple that gives us association by contiguity.

The successive association is, then, always of the same class.[1] We have no degrees of closeness enabling us to distinguish different kinds of association. That the connection is close enough to produce the succession, to cause one idea to follow another, is all that is essential. It is evident, therefore, that we can classify only by the nature of the assimilations which group about the central element, *i. e.*, by the relations between the simultaneous associations which arise successively; unless, indeed, we adopt a classification in terms of the various sense modalities. But this seems undesirable, since the simultaneous associations have already been made, when the successively associated sensation enters; and the successive association itself is no more than a second-

[1] Wundt's classification by logical categories, *e. g.*, coördination, subordination, etc., is couched in terms of relations in the external world, and not of mental connections as such.

ary working over of the products of the first connection.

Prominent among the simultaneous associations of successive elements is the process of *recognition*. This takes three forms, dependent upon the order of apperception of the accessory elements in the simultaneous association. When the accessory ideas which give rise to recognition, with its characteristic feeling, are apperceived before the entering idea, we have *mediate* recognition; when they are not apperceived until later, we have *immediate* recognition; and there is a third, intermediate form, in which both are apperceived simultaneously.

SECTION 2. APPERCEPTIVE CONNECTIONS.

Apperceptive connections of ideas follow much the same course as associative. They, too, are classified as simultaneous and successive, according as the elements appear together or succeed one another in consciousness. They differ from associative connections chiefly in the more perfect unity of the resulting process, and in the predominance of active apperception, *i. e.*, of the subjective factors in the apperception.

Simultaneous apperceptive connections are divided into three classes: agglutinations, apperceptive fusions or syntheses, and concepts. (1) Agglutination covers all cases in which the single elements unite to form a new individual whole, but are not themselves lost in the complex. They still retain their distinct individuality, though they become members of a more complex individual unit. The best examples are found in the subjective arrangement of beats in a rhythm, and in the formation of compound words like 'windmill' in English or *Heer-führer* in German, which obtain a new meaning as a whole, without alteration of form or significance of the components.

(2) In apperceptive synthesis we have a closer connection. The elements are so fused that the individual members of the group are lost in the whole. This stage is shown in the amalgamation of tense forms and pronouns with the root of a verb.

(3) When the fusion has become complete enough, and a large number of elements have been united, one element comes to predominate, and in a way to represent the whole. We then have a concept.

The word (usually the predominant element) represents the mass because it can successively associate with many single ideas which are logically subordinate to it. Thus we can have the word 'triangle' associated successively to very

many different forms of three-sided figures. The word can 'dissolve' into any of them, without making us feel that the concept has suffered material change. The representative idea of the concept is the nearest approach that we have in the concrete consciousness to an 'abstract' idea.

Successive apperceptive connections are similar to the preceding, except that the elements follow one another in time. The dividing line between successive and simultaneous apperception is not clear cut and definite. The same mental process may belong first to the one, then to the other class. This is shown again in the development of language. The general tendency in the formation of the verb, *e. g.*, has been from many separate elements (root, pronoun, tense forms) to a single element, and then to a re-separation of the complex thus formed into its original elements. It is more than probable that the mental picture has in the same time undergone a change similar to that of the word. The stages which the idea passes through between the opposite forms of judgment in one word and in many, of simultaneous and successive apperceptive connection, are very gradual.

There are many degrees of complexity in the successive forms of apperceptive connection. The simplest is the *judgment.* This consists in the apperceptive connection of two processes, one or both of which may consist of elements which have already been simultaneously combined by apperception.[1] Several such connections are often connected into a whole of a higher order, in a train of thought.[2] There is theoretically no limit to the complexity of the various elements which unite to form any of the members of the train of thought, or the separate thought or judgment. But no matter how great the complexity, the persistent unity of apperception is seen in the fact that always and everywhere the connection is by couples. All the connections reduce on analysis to simple connections of two elements, of two couples of elements, of one element and a couple, or of complexes of couples. In the train of thought, *e. g.*, we always have connections by pairs, *i. e.*, by simple propositions. Only when the propositions have been established and their connections shown, it is possible for single elements to be picked out of different pairs and again connected. This is the basis of the syllogism.

Nor is this the only evidence of the unity of apperception to be found in apperceptive connections. As we have seen, trains of thought may arise not only from connections of ele-

[1] *Logik*, I, pp. 59 f.
[2] *Logik*, I, p. 67.

ments, but also from the division of a given whole. Judgments are subdivided into concepts as well as concepts united into judgments. In every case, the division is by dichotomy. It is this feature which most closely distinguishes successive apperceptive from successive associative connections. It is this fact, too, which renders consciousness a single line instead of a series of diverging lines, as it would be if, *e. g.*, every association were effective in calling up ideas.

SECTION 3. THE RELATION OF ASSOCIATIVE TO APPERCEPTIVE CONNECTIONS.

The question of the exact relation of associative to apperceptive connections is not an easy one. The line cannot always be sharply drawn, nor is there any intrinsic mark, any entirely new element of consciousness, which invariably distinguishes the one from the other. The most we can do is to note the general tendencies of the two forms, and so determine the approximate position of the dividing line.

We shall avoid a frequent source of misapprehension in Wundt's system if we begin the discussion with a statement of the striking similarity, rather than of the difference between the two types of connection. The fact is that there is no real fundamental difference in the nature of the elements concerned in them. Both alike consist of associative elements, which have been apperceived and brought into connection with the whole of consciousness. Both alike, *i. e.*, are partly determined by the objective, partly by the subjective conditions of consciousness. The whole question turns upon the *proportion* in which the two determinants enter, or, in other words, upon the relation between passive and active apperception.[1] The line can therefore be drawn no more closely here than it could in the earlier Section. (Ch. 1, § 2.) Indeed, it cannot be drawn *so* closely, because now we have to classify concrete objects, to recognize general distinctions in concrete experience, instead of merely to describe abstract relations in abstract terms.

Wundt's criteria of the two processes are as follows. (1) There is a feeling of passivity accompanying the associative connections, as opposed to a feeling of activity in apperceptive connections.[2] This gives us a distinct conscious characteristic for extreme cases; but, as we have seen, the line between a feeling of passivity and a feeling of activity is

[1] *Logik*, I, p. 31.
[2] "Lectures," p. 312; *Phys. Psych.*, II, p. 476; *Logik*, I, p. 30.

not very sharp, so that the range of ambiguous processes is very large. (2) A second peculiarity of apperceptive connection is the greater unitariness of the resultant complex. "Every part of the resulting compound [associated] process is still independent, so that if it becomes dissociated from its companions, it continues unimpaired in consciousness. But with concept ideas, as with all conscious contents which belong to a logically coherent thought process, the case is very different. The significance of the individual is now entirely dependent upon the whole of which it forms a part."[1] The apperceptively united whole is also more definite and compact. The limits of the complex are more sharply drawn. There is seldom a limit to the number of elements which may unite in an association, either successive or simultaneous; but the number of elements in apperceptive connection is always limited, and limited in terms of the unity of the whole.

A better idea of the relation between the two forms of connection may perhaps be obtained from an examination of the concrete processes included under the various heads. Apperceptive and associative synthesis, Wundt tells us,[2] are alike in the fact that the elements in both are lost in the unity of the whole. The alleged difference is that the apperceptive fusion develops from the agglutination. Now (1) the great dissimilarity in the nature of the instances cited renders it difficult for the reader to place the exact line of division between the total processes. A clang is given as an example of associative synthesis, and the formation of words from simpler forms is used as an instance of apperceptive synthesis. It is evident that the elements from which the two connections result are of an entirely disparate nature, and it might well be that the apparent differences in form of the resultant connection are mainly, if not entirely due, to the character of the components. Moreover, (2) the development from agglutination is a rather precarious criterion. The agglutination itself appears to be entirely distinct in its nature. The addition of the unity of rhythm to a series of separate sounds gives rise to a wholly new conscious fact. The compound word, however, does not offer so clear an instance of unity of whole as opposed to part. When, therefore, we ask for a direct means of tracing the agglutination to the synthesis, we receive no direct answer; nor do the instances given enable us to construct it for ourselves. (3) To the concept Wundt attributes another peculiar character-

[1] "Lectures," p. 311.
[2] *Logik*, I, pp. 13, 37.

istic, which distinguishes it from all other connections — from the earlier apperceptive as well as from the associative. This is the concept feeling, a feeling occasioned by the cloud of dark ideas which surround the central or representative idea.[1] The 'dark ideas' are, mainly, partial judgments into which the concept enters, and which in mass give a peculiar feeling to the whole contents, though themselves not distinctly present in the consciousness of the moment.

The result of a closer analysis, then, is to show that the differences between the two classes of connection are less striking than they at first appear. Aside from the concept feeling, which marks off one peculiar concrete form, but is not very closely related to apperception as such, we are left simply with the difference between passive and active apperception,—between the relative proportion of subjective and objective determinants of connection. As we have said before, it is, so far as classification in terms of apperception goes, a difference in degree and not in kind.

We believe that the above is an impartial and accurate statement of Wundt's doctrine of apperception in its latest form. Care has been taken to select the salient passages from his different expositions, and to work them up into a connected whole. It has seemed desirable to state the doctrine as clearly as possible, even at the expense of so much space and at the risk of occasional repetitions: (1) because the subject possesses great intrinsic difficulties, as is shown by the frequency with which the theory has been misunderstood; (2) because even the trained psychologist may be confused by the conflicting views of other apperceptionists (Kant, Herbart, etc.); and (3) because we have found it necessary to make numerous references to Wundt in the course of our own work which would not otherwise be intelligible, unless, of course, the text itself were familiar to the reader. We also hope that the account given will fulfill our original purpose, and be of independent value in itself. The special application of the apperception doctrine to the problems of attention, consciousness and voluntary action, that completes Wundt's system in this regard, follows directly from the essentials of the theory as here set forth: we have given only so much as is applicable to our subsequent investigation.

The preceding *résumé* of Wundt's doctrine was written before the appearance of his "Outlines of Psychology."[2] There is nothing in the treatment of apperception in the newer work, however, that

[1] "Lectures," p. 311; *Phys. Psych.*, II, p. 477.
[2] Leipzig, 1897. Trans. by C. H. Judd.

differs in any essential respect from that in the earlier treatises. Some parts of the older exposition are omitted and others condensed, to adapt them to an introductory work, while yet others are given a fuller and clearer statement (*e. g.*, the doctrine of the feeling of activity, p. 189); but the theory itself stands as it did before.

CHAPTER III.

EXPERIMENTS.

SECTION 1. THE PROBLEM AND THE METHOD.

The purpose of our investigation was to obtain definite and, if possible, quantitative results as regards one feature of the phenomena of association and apperception—to determine the amount of change which might be made in an object ordinarily perceived or assimilated in a certain way without change in the character of the resultant perception or assimilation. The original impetus to it was given by the observation of some peculiar mistakes occurring in the experiences of every-day life. One of the first instances, and one which was typical of several that fell into the same class, consisted in the interpretation of the letters M A I L, roughly printed by hand, as a *number*. I was trying to find by its number (1423) a house which I had visited once before, but which had been so far forgotten that I could no longer be sure of it from general appearance alone. I noticed a house similar in aspect and situation to that sought, and went up to it. As I approached, I read the number 1427 on the mail box. I studied this a moment, and was so fully satisfied that I had been deceived by the general appearance that I turned and went back from the door. As I reached the street, I looked again at the house, which seemed strangely familiar, and then noticed the proper number, 1423, over the entrance. On looking again, I saw that the mail box was marked M A I L in rough letters.

Other mistakes of the same kind were made in different fields. I had myself, as I suppose most have, several times mistaken one man for another whom I strongly expected to see. Instances of striking errors in determining the nature of odors, while the subject was under the influence of strong suggestion, had also come under my notice. Many cases of similar nature are recorded in the literature. Wundt, *e. g.*, gives an example of the kind in his reading of the word TUCHHALLE, printed in gilt letters on a black ground. He could read it either correctly or as a mere jumble of letters, according as he expected the lettering to be gilt on black or black on gilt.[1]

[1] *Phil. Studien*, VIII, p. 337.

It is evident that in all these instances there are two influences at work. A group of immediate, peripherally excited sensations is supplemented or changed by certain other, centrally excited sensations. In Herbart's language, the apperceiving mass works a certain alteration in the apperceived elements. In Wundt's terminology, the new elements call up and simultaneously associate with certain old elements to form a resultant new idea. On either description the facts are the same: that, under certain conditions, a stimulus gives rise to an idea in some respects different from that which it would, of itself, usually and normally arouse. Our first aim, therefore, was to find a means of measuring the *amount of change* producible by the central supplementing. This must be a function of two factors: the intensity of the external stimulus which is at work, and the disposition of the mind at the moment, the mental "trend" at the time of its presentation. The stimulus intensity can be approximately measured, and the change noted which the corresponding sensation undergoes with change of that intensity. The mental disposition, on the other hand, lies far remote from direct measurement, but can, under certain conditions, be artificially varied. We can then measure the increase or decrease in the amount and kind of alteration which the sensation undergoes with each variation.

Numerous preliminary experiments, extending over half a year, were made in order to decide upon a form of stimulus which would be easily 'supplemented,' and at the same time be capable of regular and measurable change. We first tried pictures, colors and geometrical outlines; but none of these gave satisfactory results. *Pictures* afford no adequate means of measuring the amount of the departure from the usual combinations; they can hardly be broken up into separate units. Moreover, the perception of a picture is normally, in a greater or less degree, a case of associative completion; so that it would be very difficult to ascertain the value of the difference between the amount of completion necessary when the part completed represented the object well or ill. *Colors*, on the other hand, are so simple that they cannot readily be 'completed;' unless form is included, they carry with them very few natural suggestions of objects which they might represent. *Geometrical forms* themselves are open to both the above objections.

We finally settled upon the use of *typewritten words*. Although it is not entirely satisfactory to regard the letter as the unit from which the word is constructed, that assumption was, on the whole, the most satisfactory that could be thought of or experimentally obtained. Besides the advan-

tage that a word may be roughly regarded as made up of letters as units, it carries with it as a whole a certain suggestion of what its parts shall be. The value of a letter may be expected to vary with its position in the word, with its form (long or short, round or square, usual or unusual), and with the smaller wholes (long between two shorts, etc.) of which it forms a part. All these variations, however, lend themselves to regulation, and in some degree to measurement.

At this point our problem divides, then, into two distinct problems. The first is to determine the variation in the value of the unit of stimulus under changing circumstances, *i. e.*, to determine the value of the *sensational* factors which are concerned in reading. The other, related to the former as end to means, is to test the conditions under which completion takes place; to learn the ways in which these conditions acted, and to discover, so far as possible, the relative value of each factor in the total experience.

I. The first part of the problem falls again into several minor problems. (1) The first which suggested itself was the determination of the value of each letter of the alphabet in calling up a word, and the opposition which its absence would offer to the proper completion of the whole. Some letters would have, presumably, more or stronger associations than others, and would consequently be more likely to reproduce the proper word, or to prevent its reproduction if they were misplaced or absent. Although our investigation extended over two full years, its results are too few to decide this point. They make it probable, however, that reproduction is very nearly a function of the ease with which we distinguish the various letters. The latter question has been carefully worked out by Professor Sanford.[1] The second part of Professor Sanford's problem, closely connected with the first,—the determination of the letters which are most easily confused with one another,—could also be solved in time by our method; but it was found more convenient for our immediate purpose to eliminate the errors resulting from these and similar factors by using the same words wherever the results of two series given under different conditions were compared.

(2) A second problem was to discover the value of the different positions of the letters in the word. It is evident at a glance that there will probably be some positions in a word where a change of the letters will be of more influence in preventing its correct completion than a change of the same letters in other positions. These have been worked out, and

[1] Am. Jour. Psy., I, p. 403.

the relative values of the more important positions determined.

(3) Thirdly, our results throw light on the relative values of the different kinds of changes to which the letter may be subjected. We made use of three sorts of changes in the letters. We omitted the letter, substituted another for it, or printed an "x" over it to give a shapeless blur in place of the original. Our problem here was to discover the relative effect produced by omitting, substituting and blurring a letter. The last two of these methods were comparatively pure, but the first is complicated by the fact that omission not only removes one of the units, but also shortens the whole word, and brings other differently shaped units into juxtaposition.

(4) In a more general way we gathered information as regards the value of the length of the word in determining the character of its completion. This came mainly from scattered observations in the detailed records. At the same time, though we thus have indications of the importance of length, we cannot offer definite numerical results on the subject.

(5) It would have been interesting, further, to note the importance of the relative positions of the mutilations, where more than one were made, in determining the completion of the word which was shown. But as no more than two were used by us, except in eight instances, this problem also went beyond the scope of our work.

All of the points quoted may be decided by comparing the percentage of right and wrong cases, *i. e.*, of cases in which the word is not completed with the cases in which it is completed. The percentages under two different conditions will give an approximate means of comparing the effects of those conditions.

II. Under the second general problem—the determination of the strength of the suggestion which causes us to overlook mistakes in the word—we again have several partial problems. (1) The first factor to measure is the effect of the word as a whole in suggesting what its parts shall be. We can here count the number of right and wrong cases which, under normal circumstances, appear with a given amount of change. Of course, we must take the length of the word into consideration, and ascertain how the strength of suggestion is related to it. In a first series of experiments, therefore, we must leave the other subjective or centrally excited conditions of perception entirely to chance, and make no attempt to learn the conscious disposition or trend,—only occasionally noting what the nature of these factors has been from the subject's report of his introspection. (2) In a second series

we varied, and in a measure regulated, the more remote factors by calling a word associated with that to be shown immediately before this was itself given. The procedure introduced a new factor, which tended in some degree to create an artificial mental disposition, and the effect of this could be measured in the change produced in the number of words completed. We owe this method of varying disposition to Professor Münsterberg.[1] (3) We obtained some light on other points by classifying the effects of certain other factors which were brought out unexpectedly in the course of the experiments. The results are naturally much scattered, but are nevertheless, in certain cases, of even greater importance than the main line of investigation in making clear the efficiency of the different kinds of suggestion, and the nature of suggestion in general.

Our apparatus was similar to that employed, for another purpose, by Dr. E. W. Scripture.[2] It consisted in general of a lantern so arranged as to project an image upon a ground glass screen, with a delicate photographic shutter fixed in front of the lens to control the length of exposure. All the pieces were set up on a long, black table in a dark room.

In more detail: The lantern was of the ordinary type, provided with two double convex lenses. This was enclosed in a wooden case, with the necessary doors for adjusting the lamp and inserting slides, and an opening in front through which the cylindrical lens holder projected and which it fitted tightly. Immediately before the lens tube was placed the shutter, a Bausch & Lomb pneumatic photographic shutter. This was fitted into the front of a wooden box, which in turn was placed over the lens tube of the lantern, and supported by a standard. When all was ready for the experiment, and the doors closed, no light at all escaped from the lantern. A ground glass screen was securely screwed to the table 1.25 metres in front of the forward lens, and the subject was seated 2.50 metres in front of the screen, in a smaller dark chamber within the dark room. The words used were typewritten with extreme care,[3] then photographed and printed on lantern slides. When thrown upon the screen the small letters had a height of approximately 2.3 centimetres. Constant illumination was obtained, during the course of the investigation, by keeping the height of flame of oil lamp constant. Later experiments have shown that the arc lamp could be used to advantage in place of the oil lamp, but as the investigation was already under way before the arc light was in working order, the latter was not used. The method gave a

[1] *Beiträge*, IV, pp. 20 ff. These experiments, undertaken to prove the similarity between centrally and peripherally excited sensations, were suggested in turn by some observations and experiments by R. Avenarius (*Kritik der reinen Erfahrung*, II, pp. 472, f.) in connection with the effects of disposition upon perception.

[2] *Phil. Stud.*, VII.

[3] Typewritten, in order to secure greater equality of size for letters of different complexity than is afforded by print.

clear and constant image of the words shown, and permitted us to make a (for the subject) noiseless exposure of the word from the centre outward.

The investigation has continued over the greater part of three years. The preliminary experiments, referred to above, to discover a method were begun in the year '93–'94, and occupied about half of that year. Systematic work was begun with the chosen method in the fall term of 1894, and lasted through the year for the five subjects whose records serve as material for this report. Further experiments were made with three of the subjects during the year 1895–96. Professor Titchener (*T.*), Professor Margaret Washburn (*W.*), Dr. Alice J. Hamlin (*H.*), and Messrs. Cogswell (*C.*) and McVannel (*M.*) acted as subjects during the investigation. All but *C.* had had a good deal of previous training in psychological work, and were thus trained in introspection. Of these four, *T.* and *W.* knew the object of the experiments and had given advice in the preparation of the apparatus, material, etc. The other three subjects were completely ignorant of the purpose of the investigation. They were asked to read the words thrown upon the screen, and no suggestion was offered that would lead them to believe that the words were incorrectly spelled. None of them seems to have formed any very definite opinion as to the nature of the problem under consideration, and certainly none betrayed any strong suspicion that imperfect words were being displayed at any time during the experiment. We have made use of this difference in the attitude of the subjects towards the experiments in a later Section.

A few seconds before each experiment, warning was given to the subject by calling 'Ready!' and a faint diffused light was thrown on the screen, by slightly opening the back door of the box which enclosed the lantern. This was necessary, to give the subject opportunity to accommodate for the screen; it did not disturb the work. The door was then closed, and immediately after 'Now!' called, the bulb which released the shutter pressed, and the word exposed. Each experiment was recorded at length. The subject was questioned as to the general clearness of the word, and any peculiarity in it that he might have noticed, and a careful note was made of each answer, including any chance observation that threw light on introspection, disposition, etc. We asked the subject just what he was sure he 'saw' in every case, and encouraged him to mention any doubts he might have as to the presence of single letters, or a general lack of clearness of parts of the word. The close questioning (in which suggestion had to be avoided) rendered progress very

slow, so that never more than twenty, and frequently not more than eight or ten words, could be shown in an hour. This fact accounts for the small number of experiments which are contained in the report, notwithstanding the long period over which the inquiry extended.

One of the first difficulties that arose was to obtain a length of exposure which would permit the subject to perceive the word without being unnecessarily long. It was found impossible to get any constant objective period of time which would be just long enough for the perception of the word and yet not long enough to allow the first perception to be corrected. The time lay somewhere in the neighborhood of .2 sec., but varied greatly with the mood of the subject and was influenced by other uncertain subjective conditions. The fluctuations were so numerous and so large that it was finally decided to give up constancy of the objective standard, and to assume as a criterion the subjective feeling of satisfaction that the word had been perceived. In accordance with this plan, if a word was not seen at the first exposure it was repeated, each time with a lengthened exposure, until recognition was certain. In the first experiments with each subject it was necessary to find empirically the limits of the time of easy recognition for the kind of words that was to be shown.

When the nature of our experiments is considered, it will be seen that this uncertainty of the time of exposure is not so grave a matter as might at first appear. Usually in psychological experimentation the object is to measure a psychical process in terms of physical units. Both psychical and physical conditions must therefore be considered, and as the physical values are more easily obtained and controlled, they are chosen to be kept constant. We, however, are concerned with psychical variations alone. It is a matter of indifference to us how the psychical condition is produced, provided that it is produced. We also had a direct and fairly accurate measure of the subjective state we desired. In this case, then, it is possible and more convenient to use the subjective standard and vary the objective conditions—the time of exposure—until they become satisfactory. The fact of perception is the subjective indication that the stimulus has reached a sufficient intensity. The chief source of error in this method is that the experimenter may easily go slightly beyond the point which corresponds to the minimal time necessary for completion. We could regulate accurately only the lower limen of perception, but the other was less accurately determinable. We had no strict measure of the point at which the original completion was overcome by the strength of the objective stimulus. The few changes of the first judgment, however, and the small number of cases of failure to complete that appear in the records of three of the subjects, indicate that the error was not very serious. And it was again possible to get a rough determination of the limit by the subject's 'feeling' that he had had more time than was needed. In that event the results were thrown out, whether good or bad. At most, then, our method introduces an error which is constant in direction, though, like all

subjective errors, variable in amount. We may consequently assume that on the average it will result in a time a certain amount greater than the minimum desired, which will remain constant in all the series performed under similar conditions. We should expect from this simply a constantly greater number of correct readings in each series. As our results are entirely given in relative terms, an error entering equally into both sides of the ratio will not influence the final outcome in any appreciable way. Moreover, this error proved, so far as we could judge from the experiments, to be very much less than the chance subjective errors which would have entered if we had endeavored to make the objective conditions constant, and permitted the subjective to vary. Theoretically and practically, subjective constancy of time was more satisfactory than objective constancy. A steady increase in the number of right cases also proved very desirable; since otherwise we should have had practically no means of making comparative studies. The failures to complete would have been very few (especially with *H.*, *M.* and *C.*), if we could have reached exactly the proper degree of perception each time.

The actual times used varied between .1 sec. and .5 sec., though the latter exposure is but rarely recorded. By far the greater number of exposures were within a small fraction of .2 sec. Of course, any results from these data will be complicated by the fact that the shorter exposures were often repeated three or four times before perception took place, and often when the word had been completed in a wrong way, it was exposed again and another chance given for the correct completion. In such cases, however, one exposure proved to give but little aid to the succeeding, even when known, so that a number of successive exposures are not at all directly comparable with a single exposure of greater length. The relation between a number of short exposures and length of corresponding single exposure is too complex to be easily made out. Quite frequently, in fact usually, the subject did not suspect that it was the same word that was given in the series of exposures, so that there was no suggestion at all from one to the other.

SECTION 2. PERIPHERAL FACTORS IN RECOGNITION.

(1) We shall begin with the first problem upon the list, and seek to determine the relative *values of the three different kinds of misprint* in opposing the recognition of a word. It will be seen from Tables I, II and III that the several kinds of change stand in ease of recognition in the order: omitted, substituted, blurred. An omitted letter, that is, is most often noticed, a changed letter next most often, while a blur is most easily overlooked. This relation is what one would expect *a priori*. A blurred letter gives us in every case a nearly characterless impression, which has only itself to be supplemented

or completed. It carries with it almost no meaning of its own to offer resistance to the idea suggested by the remainder of the word. It is then only necessary for suggestion to work upon the single letter affected. The appearance of the remainder of the word is not in the least altered.

The relation between a letter substituted and a letter blurred on the one hand, and a letter omitted on the other, is not so obvious. It might seem at first sight that a letter omitted should offer less resistance to the completion of the word than a letter substituted. The greater effect of the former, as actually found, however, depends upon two factors: the length of the entire word is changed; and, what is even more important, the position of the letters immediately surrounding the omission is changed in relation to the remainder of the word. In our experiments, that is, the letters on either side of the omitted letter were printed side by side without leaving an empty space. This, of course, altered the general appearance of the syllable in which the omission occurred, besides shortening the word as a whole. The substituted letter was on the same level as the blurred in this respect. It offered the outline of a letter, which had only to be changed under the influence of the suggestion from the remainder of the word. There is no alteration of the length or general form of the word, or of the relative position of the letters in the syllable immediately affected. At the same time the more definite outline of the letter which was substituted, as compared with the mere blurring of the letter, called up supplements of its own, which tended, in a certain measure, to inhibit the action of the suggestion. This effect is seen in the large increase in the number of changes recognized in the substituted as compared with the blurred letters.

We proceed to the discussion of the experimental results in detail:

TABLE I.

Effect of Different Kinds of Changes for Words with one Misprint.

Subjects.	T.			W.			H.			C.—			M.—		
Kind of Disfigurement.	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%
Blurred	22	25	47	23	44	34	8	49	14	3	23	14	1	20	5
Substituted	35	29	55	71	39	65	27	98	22	7	39	16	8	37	18
Omitted	16	5	76	28	9	76	18	32	36	8	12	40	7	18	28

TABLE II.

Effect of Different Kinds of Changes for Words with More than One Misprint, on the Basis of each *Misprint*.

Subjects.		T.			W.			H.			C.—			M.—		
Kind of Disfigurement.		R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%
Blurred	+	26	25	52	20	43	32	9	49	20	—	—	—	—	—	—
	—	47	16	74	24	43	36	12	65	14	—	67	0	2	53	4
Substituted	+	10	8	54	29	15	66	11	27	29	—	—	—	—	—	—
	—	—	—	—	20	9	69	12	37	23	12	14	45	12	10	55
Omitted		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE III.

Same as preceding Table, except that each *Word* counts for One.

Subjects.		T.			W.			H.			C.—			M.—		
Kind of Disfigurement.		R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%
Blurred	+	21	2	91	13	13	50	12	19	35	—	—	—	—	—	—
	—	29	2	93	22	15	60	8	28	22	0	32	0	2	23	8
Substituted	+	5	2	70	18	6	75	7	12	32	—	—	—	—	—	—
	—	—	—	—	12	4	75	8	15	35	7	11	39	7	7	50
Omitted		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

In the above Tables the results for each subject are found, in the three vertical columns, under the initial. The columns headed *R.* give the number of instances in which the misprint was noticed, those headed *W.* the number in which it was overlooked; while the last column shows the percentage of cases overlooked to cases recognised. The horizontal divisions correspond, as is clear from the Tables themselves, to the different kinds of changes. Since in Tables II and III experiments were lacking for *T.* under one head, none having been given him without association, it was necessary to keep the results under the two conditions separate. Consequently we have two horizontal columns for each kind of change. The upper one in every case is marked by a + sign to indicate that

an associated word was called before each experiment, the lower one by a — sign to indicate that this condition of supplementing was lacking.

It has been necessary to give three Tables to represent the results upon this first point. The reason is that in some of the words shown more than one letter was altered, and it is not plain *a priori* what effect each disfigurement would have upon the recognition of the others where more than one are present. Table I gives the proportion of changes overlooked to changes noticed for each kind of disfigurement in the words in which only one letter was misprinted. Tables II and III give the same relations for the words in which more than one letter was altered. In Table II, the numbers stand in every case for the entire number of disfigurements, without reference to the question whether the others in the same word were recognised or overlooked. The misprint alone is considered, that is, without regard to its setting. If, for instance, there were two letters changed in the word, and one was seen while the other passed unnoticed, we should add one to the *R.* and one to the *W.* column. In Table III, the *word* took the place of each disfigurement, and when *anything* was found to be wrong with the word it was put into the *R.* column, no matter whether the other misprints escaped notice or not. It is thus possible to decide whether each disfigurement is as likely to be recognised when others are present in the same word as when it stands alone, or whether something will be observed to be wrong with the word as often when one letter is changed as when more than one are changed, or whether the percentage of recognitions lies somewhere between these two possible extremes. The interpretation of these results forms a problem by itself, and will be treated later. (See p. 351.)

In all the Tables, the results of *C.* and *M.* with association—where an associated word was called before the exposure—have been omitted. This is because the number of cases in which the misprint was recognised under these conditions was so small that the ratios practically became infinite. For *C.* we had 8 *R.* out of a total of 123; for *M.* 6, out of a total of 130. The omission is indicated by the insertion of a — sign after their initials.

(2) The second variation of the value of a letter as the unit from which we construct the word was connected with its *position* in the word. We have grouped our results to show the relative values of three positions: "first," "last" and "intermediate." The intermediate positions were again subdivided into "first" and "last," and each subdivision included one-half of the remaining letters when the word had an even number of letters. In the words of five and seven letters, the second and third letters were considered respectively, as belonging to the first half of the word; all others were counted with the last half. These two uneven divisions—of two and one, and two and three—which gave one letter too many to the first group in the words of five letters, and one too many to the last group in the words of seven letters, may be expected to offset each other in the total.

It will be seen from Table IV that for every subject but *C.* and *M.* there is a striking decrease in the percentage of recognitions as we proceed from the first letter to the last

throughout the word. The difference is most obvious between the first letter and the others, and more between the last letter and the intermediate letters than between the two halves of the intermediate letters. And for *C.* and *M.* all these results hold except that for *C.* there is practically no difference between the divisions of the intermediate letters, and for *M.* no difference between the intermediate and the last letters. This seems to indicate a general tendency of the subject to *read through the word from left to right*, and thus to give the first letters of the word a more prominent part in the recognition of the word as a whole. Consequently a disfigurement of the first letter was easily recognised, since there was but slight expectation of the word that was to come. When, however, the disfigurements came later in the word the expectation was greater, and the error more likely to be overlooked. This, however, is not the only tendency which is active in recognition, as will be seen later. (See p. 352.)

Further evidence of the same tendency is offered by the fact that in the words with more than one letter changed, whenever one disfigurement was noticed, and the other left unnoticed, it was the first alteration that was noticed in the greater number of cases. See Table V. This would not be sufficient in itself to prove the point at issue, on account of the small number of cases; but it adds to the evidence of the preceding Table. No other attempt was made to classify by position the errors in these words with more than one changed letter, because there were too few instances of each kind to give any satisfactory results on the problem. Moreover, the problem would be very much complicated by the effect of the different positions of the disfigurements relatively to each other. So that the question would require an investigation by itself, with more experiments than we could allow to it.

TABLE IV.

Effect of the Position of the Letters in the Words with One Misprint.

Subjects.	T.			W.			H.			C.—			M—.		
Positions.	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%
First	19	9	71	32	11	75	18	31	37	6	10	38	6	9	40
First half of Inter.	32	23	58	41	32	56.2	22	53	28	6	21	23	5	21	12
Second half of Inter.	15	16	48	39	31	55.7	11	55	17	5	24	18	3	26	13
Last	7	11	39	20	18	55	2	40	5	1	16	6	3	19	14

TABLE V.

Effect of the Position of the Letters in Words of More than One Misprint.

Subjects.	T.			W.			H.			C.—			M.—		
	R. W.	W. R.	% R. W	R. W.	W. R.	% R. W.	R. W.	W. R.	% R. W.	R. W.	W. R.	%	R. W.	W. R.	%
	16	14	53	20	9	69	11	7	61	3	1	75	1	1	50

In Table IV the vertical columns show the absolute number of times in which the misprint was recognised *(R.)* and overlooked *(W.)*, and the percentage of recognitions. The horizontal columns give these values for each of the positions in the word, for which results were collected.

In Table V the first column gives the instances in which the first of two alterations in a word was correctly recognised, the second those in which the last was seen. The last column gives the percentage of the former kind to the whole.

(3) A third point of interest as regards the value of the unit relates to the effect of the *addition of misprints within the same word.* Do the misprints add themselves arithmetically, or does some other relation obtain? It will be seen, if we compare Tables I and II, after averaging the percentages with and without association in II, that there is about as much chance of recognising a misprint when it stands alone as when there are others in the same word. If there is any difference it is *in favor of recognising a change when others are present.* Thus for *W.* and *H.* there is practical equality between the conditions, while for *T.*, *C.* and *M.* the percentages are a little greater where more than one letter was altered in the same word.

Our investigation, however, as has been noted above, extends only to *two* misprints in a word. With more the number would soon reach a maximum, beyond which even a bare recognition of the word would no longer be possible, to say nothing of recognition with complete ignorance of the changes introduced. The other objects of our investigation would not permit us to experiment on this point. For to show any great number of words so completely transformed as to make nonsense syllables of them would betray the purpose of the inquiry to the subject, and disturb the expectation or disposition with which he began an experimental series.

These five Tables of results give us some idea of the conditions of recognition in general, and of the more important factors which determine that an impression shall be read as one

word rather than as another. Two factors in recognition are at once apparent from the results so far given: the *length* of the word, and the *position* and *character* of the separate letters. (1) That the length of the word is important is clearly shown by the frequency with which the *omission* of a letter was noticed. Further evidence on this point was given by such remarks of the subject during the experiment as that he saw only that it was a word of five letters, or that it would have been 'probable' if it were not too short, etc. (2) The effectiveness of the position of the separate letters is shown by the increase in the number of times the misprint is overlooked for each successive letter as the word is read through from left to right. (3) Still another factor which is at work is the general appearance of the word as determined by the relative position of the *high* and *low* letters. This inference again is supported by the statements of the subjects during the experiments. In cases where no recognition took place, but some letters were seen, the subjects would frequently say that there was 'a high letter near the first,' or that 'it would have been [some word], except that I didn't see the high letter towards the end,' etc.

All these factors are at work at the same time in the perception of any word, and reinforce one another in accomplishing the final result. It is especially interesting to note the part played by the separate letters in recognition, in view of the fact that the reaction experiments of Professor Cattell and others show that the word as a whole is a unit, and that separate letters require as much time for recognition as short words. This is a matter which must be discussed more fully in connection with the theoretical problems of a later Section. (See p. 373.)

SECTION 3. CENTRAL FACTORS IN RECOGNITION.

In the previous Section we have considered the value of the letters, under different circumstances, upon the recognition of the word. In this Section we have to investigate the *subjective* conditions of this recognition, and determine so far as is possible their variation under different external circumstances. We have been assuming that the changes in the letters of the word offer opposition to its completion or recognition. We must now turn our attention to the forces which we have assumed to be opposed by these changes. These forces fall naturally into two distinct but somewhat closely related classes. (1) The first comes from the *effects of the word itself*, as a whole, *upon each separate letter*. This is the first stage beyond what we have called in the first two

Chapters the merely objective elements in or conditions of apperception. (2) Another and a more subjective class of forces at work are those that affect the general *disposition* of the mind at the time, the conscious trend of the moment. The elements of this second group lend themselves much less readily to experiment than those of the first, and are exceedingly variable and complex. We have, however, as will be seen in the latter part of this Section, succeeded in varying two of them experimentally and showing the effect of this variation upon the recognition of the word. As will be pointed out in greater detail when we come to treat the matter theoretically, we cannot entirely separate the two classes of conditions in practice. They are both at work at one and the same time, and the result is in every case a summation effect, from which we are not as yet able to learn definitely the exact part which each plays. We do, however, hope to show that certain special elements enter into this complex, and in a few instances to discover the effects of variations in the conditions.

(1) The main question under the first head is that of the effect of the *length of the word* upon the *strength of its suggestion.*[1] Does a long word give a stronger suggestion than a short word? or is there any other definite change in the amount of suggestion with the length of the word? Our results prove conclusively that the strength of the suggestion which comes from the word itself is *entirely independent of the length of the word.* (See Table VI.) This result seems strange at first sight. One would certainly have expected *a priori* that an imperfection which affected one of five letters would be much more easily noticed than an imperfection of one letter in a word of eight. This apparent anomaly may be explained by assuming either that the strength of the suggestion afforded by a word is inversely proportional to the number of letters, or that the prominence of the misprint is, for some reason yet to be discovered, in no way increased by a decrease in the number of letters in the word. The former seems the more plausible explanation. It must be remembered that our results have shown that the *first letters* of the word are largely effective in determining the word which is suggested. We have also seen that the subject recognises the *approximate number* of

[1]The length of the word in this connection has a different function from what it had in the previous Section, because here we are dealing with the strength of the word suggested in determining the separate letters that come to consciousness,—there with the effectiveness of length and general form in deciding what word shall be originally suggested.

letters in the word before he makes out the word itself. It is evident, then, that if two or three letters are seen, their suggestion will be more definite for words of five letters than for words of eight. There will be fewer possible ways of completing the remaining three or two letters in the former case, than the remaining six or five letters in the latter. Consequently the strength of the suggestion will be greater. It must be admitted, however, that it is surprising that these two tendencies, apparently due to such different conditions, should balance each other so exactly as our results show that they do.

TABLE VI.

EFFECT OF THE LENGTH OF THE WORDS UPON COMPLETION.

SUBJECTS.	T.			H.			W.			C.—			M.—		
No. of Letters in Word.	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%
5	12	15	48	8	18	31	23	20	54	5	13	28	2	11	15
6	17	12	59	6	25	25	23	18	56	4	14	22	1	14	7
7	10	12	46	10	27	27	22	20	52	2	16	12	2	16	11
8	34	20	63	29	109	21	64	34	65[1]	7	28	20	11	25	28

In Table VI the figures in the first column indicate the number of letters in the words of the different groups; the figures in the column marked *R.* under the initial of each subject the number of times in which the misprint was noticed; those in the column marked *W.* the number of instances in which the misprint escaped notice, and those in the third column the percentage of *R.* to the entire number.

(2) Under the second class of influences, the more general factors which tend to produce completion and to direct its course, we shall probably find the effects of the entire conscious life of the individual. It is of course impossible to trace all the factors which are or have been at work in producing the general disposition of consciousness which determines how one shall read a word, or what effects the word shall produce, *i. e.*, what it shall mean for the subject. The more immediate influences are the *sensations* that come into play at the moment. These we endeavored to exclude as far as possible by experimenting in a dark room, where nothing could be distinguished except the light on the screen,

[1] The high value here is due to the fact that a larger percentage of the misprints were either of the first or last letter.

and that only during the experiment. It was, however, impracticable to avoid *questioning* and *directing* the subject during the investigation, and it was also necessary to use a faint light in *recording*, and in *adjusting* the shutter between the separate experiments. Another influence which it was also impossible to exclude was the effect of the *preceding words*. We shall be able to discover traces of all these effects in our experiments.

Besides the variable and uncontrolled factors, we were able to vary experimentally two conditions, and to study the effects of the variation in the increase or decrease of the percentage of errors recognised to errors overlooked. (*a*) The first of these artificial mental dispositions we obtained by Professor Münsterberg's method of calling out a word associated with the word to be shown immediately before the exposure was made. The subject then looked for the word under the suggestion of the associated word. This would evidently tend to alter the disposition of his mind for the moment. His knowledge that the word to be seen was associated with the word called would facilitate the entrance of the word suggested by the letters perceived. The striking effect of the association upon completion is shown in Table VII.

TABLE VII.

Comparative Results With and Without Association for Words with One Misprint.

	T.			W.			H.			C.			M.		
	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%	R	W.	%
Without Assoc.	48	34	58	72	30	71	39	102	28	18	71	20	16	75	18
With Assoc.	25	25	50	60	58	51	14	77	15	6	56	10	0	89	0

TABLE VIII.

Same for Words with more than One Misprint.

	T.			W.			H.			C.			M.		
	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%	R.	W.	%
Without A.	47	16	78	44	52	46	21	76	22	7	43	14	9	30	23
With A.	36	35	52	41	58	40	21	102	17	2	46	5	1	41	2

In Tables VII and VIII the first figure shows the results obtained when an associated word was *not* called before the word was shown, the second when such a word *was* called. The abbreviations are the same here as in the preceding Tables.

In Table VIII the results for *T.*, *W.*, and *H.* are given on the basis of the entire number of misprints, those for *C.* and *M.* on the basis of the number of words, as the two Tables practically coincided. (Cf. Tables II and III.)

For every subject, it will be seen, the proportion of misprints overlooked is greatly increased under the influence of the association. There is little or no indication in the experience of the subject at the moment as to what the detailed mechanics of this effect may be. In only a very few cases did the word called suggest the word to be shown before the latter was seen; and then the misprints were observed quite as frequently as at other times. In most cases the relation

TABLE IX.

	Word Shown.	Word Called.	Word Expected.	Word Suggested.	Letters Seen.
H	fathex	son	.....	weather	.....[1]
"	ovenage	mean	.....	coward	c.....[2]
"	xrixoner	prison	.....	dungeon	dungeon
	bauty	belle		buoy	b.....y[2]
T	xrexkfaxt	morning	afternoon	———	(1) afrikant
"	———	———	———	acrostic	(2) akrostik
"	———	———	———	aggregate	(3) addregate
M	fashxon	style		author	author
"	escoxt	beau	.....	arrow	.....[1]
"	favox	gratitude		harm	h(?)arm[4]
"	heavilo	lightly[5]		unlikely	..lk....ly
"	rtful	wily	.....	steals	st....ls
"	———	ingenious	.....	genius	g.....s[3]
"	———	coquettish	girl	girlish	girlish
"	———	wily	.....	sharp	sharp
"	———	ingenious	.....	artful	artful
"	bauty	belle		girl	g....l
"	verbati	word for word	exactly	overexact	overexact
"	exxloxivx	gunpowder		magazine	maga(z)[6]ine
"	ramrob	gun		rifle	r..f..e
"	teochor	pupil		scholar	scholar
"	tlumder	lightning		illumine	..llumi..
"	winxow	pane		ache	aiche[7]
"	xover	lid		stove	stove

[1] The word was read definitely, but the subject could not remember what letters were seen.

[2] "Sure of the letters given, but can't remember what others were seen in addition."

[3] Letters given are those which the subject saw most clearly. The others were seen, but not so distinctly.

[4] 'harm' was seen exactly, except that the bottom of the tall line of the 'h' was lacking.

[5] 'Lightly' was understood as 'likely.'

[6] "The 'z' may be a 'g,' but I am sure it was magazine."

[7] The subject reported that he thought for the moment that *ache* was spelled with an 'i.'

An 'x' in a word in this Table indicates a blur, *i. e.*, that an 'x' was printed over the original letter.

between the two words was noted after the printed word was seen. In such cases the association helped the entrance of the word. It seemed to confirm the results of the visual impression, and to give a feeling of confidence that the word seen was the word intended.

In a few cases, again, it was found that the suggestion from the association was stronger than the visual impression in determining the word read. In such instances some association other than the one intended would be given in place of the word shown. They are collected in Table IX and given in detail to show the nature of the changes.

This is as far as the experiment or the subject's introspection will take us in determining the effect of the association. That the latter is not entirely introspectively reliable is evident from several instances in which the reader was positive that the association was of no effect, and in which the nature of the completion nevertheless seemed entirely determined by the association. The theoretical interpretation must go over to a later Section (pp. 374f.). (*b*)A second and even more constantly present element in these subjective factors, which affected the results of the experiments in a way that could be measured, was the *knowledge* which the subject had as to the actual purpose of the experiment. As has been said above (p. 344), *T.* and *W.* were working throughout with entire knowledge of the problem under investigation, and of the fact that the words contained misprints. *H.*, *C.* and *M.* on the other hand knew nothing of the nature of the experiment, and every effort was made to lead them to suppose that they were merely to read a series of correctly printed words. Of course it was impossible to keep them in this state of ignorance throughout the entire two years during which the experiments lasted. No one of them, however, is definitely satisfied that he knows the exact purpose of the work; but all have had attacks of more or less severe scepticism as to the correctness of the words shown. Of course, too, the mental disposition could not be kept constant for different experimental hours, or even for different parts of the same hour. If an error was recognised in several words in succession, the subject's faith would be disturbed for the time being, and he would be on the lookout for mistakes. On the other hand, if the errors had escaped his notice for some time, his suspicions would be lessened, and he would be less likely to observe an error.

The results indicate that the subjects were arranged in order of accuracy in distinguishing the misprints as *W.*, *T.*, *H.*, *C.*, *M.* (See Table VII.) In general this is the order of frequency with which they worked. Thus *W.* worked more

frequently than *T.*, *H.* than *C.* *M.*, however, was experimented upon more often than *C.*, though for a shorter period of time. It is obviously impossible to compare *T.* and *W.* in this respect with the others, who were working without knowledge.

It is evident at a glance that the mental attitude of an observer who knows that there are imperfections in the words is entirely different from that of one who does not. In the former case the attitude of the subject reached the stage of looking for mistakes which he expected to find in the words. This is really a suggestion antagonistic to the natural effect of the completion, and has a negative influence upon the normal tendency, as is shown quite vividly by the fact that mistakes were noticed in some of the correct words given as puzzle experiments in the early part of the investigation. Thus, of four correct words which were shown *T.*, three were said to be incorrectly spelled, and *W.* either wrongly completed or made nonsense syllables of all that were shown. [1]

Here we see the nature of the suggestion entirely transformed, and intense enough to change the resulting perception against the natural tendency to completion. It is still a case of the effect of subjective factors, but of factors acting in a direction opposed to their ordinary course, as shown in the other subjects.

(3) Still other circumstances which were of influence upon the reading of the words entered almost as chance disturbances, regarded from the standpoint of the previous investigation, but nevertheless offer valuable evidence as to the influence of the more remote experiences in determining the nature and direction of the completion. While the two previous factors have shown themselves in an increase in the number of completions, these reveal themselves only in the nature of the completion. The former aided in seeing the word intended in spite of misprints and disfigurements; these become evident only in the appearance of a new word directly connected with a disturbance which has immediately preceded. Thus we find that many times a word is said to be read which is only slightly similar to the word intended, or is entirely different from it. Very often this misreading cannot be accounted for, and we must assume that its condition is to be found in some earlier event in the experience of the individual which has been overlooked by the experimenter, or is beyond the range of his observation. In some instances, however, these unusual

[1] For instance, *T.* read *FABRICATES* as without the *I*, *fraudulent* as lacking the *n* and *fictitious* as if it were *flictitious*. *W.* made FABRICATES *Sabrigates*, and *teachor* was said to be spelled *teader*.

changes could be traced to some incident in the immediate past.

(*a*) The first class to be noticed under this head is the effect of the preceding word. In our experiments we could not of course have each word stand alone; it must be in series with others; and one would expect, consequently, that the influence of the preceding words in the series would be shown in the nature of the completion. This was probably working at all times, but as we could not eliminate it experimentally and compare a series with preceding words with one without, we shall be confined to noting the influence (from the form of the misreading) in the few instances in which it became predominant and determining. That one single influence should ever have gained such an ascendency against so many powerful elements is an indication of its strength.

TABLE X.

Influence of the Preceding Word in the Series.

Subject.	Word Shown.	Preceding Word.	Word Read.	Letters Seen.
W.	fellw	Many adverbs in '-ly'[1]	folly	folly
H.	ecently	(1) monopolict[2]	(1) metropolitan	m.....
"	"	(2) "	(2) metropolitan	.....p.....
"	"	(3) "	(3) metropolitan	metro.....
"	whenevxr	whatevea	whatever	whatever
"	stryight	kommonly[1]	straightly	straightly
M.	downwark	oulright	downright	downright

In Table X are collected the instances which come under this head. Here are included also two words which show the influence not merely of the immediately preceding word, but of the general character of all the preceding words, in the tendency to add '-ly,' or to read words as if they ended in 'y,' a tendency which was due to the large number of adverbs that had been shown by accident in the same series. In all these cases the influence of the preceding word was not conscious. The subject did not expect the word which deter-

[1] The first series, one of the longest, was composed of adverbs, many of which ended in 'ly.'

[2] Monopolict had been read cosmopolitan in this experiment, but not metropolitan. The strong expectation of metropolitan must have been from some union of the sensation with this completion after the experiment was over. The subject did not report any unusual expectation of the word.

mined the reading, nor have it clearly in mind at the time the word to be read was thrown upon the screen.

(*b*) In Table XI we have tabulated instances of the similar effect of some reading which was suggested when the word was shown more than once in succession. They illustrate

TABLE XI.

Effect of Previous Readings.

Subject.	Word Shown.	First Reading.	Letters Seen.	Second Reading.	Letters Seen.
W.	shabbilw	———	pl.....y	shabbily	pshabbily
H.	recentlr	remember	re.....	remember[1]	rem.....
"	verbati	vorbald	vorbald	verbald	verbald
"	oulright	glacier	.....	(1) alright	?alright
"	———	———	———	(2)	calright
"	cottrn	cottage	cotters	cottage	cottage
"	favnr	fervor	.....	ferner	.....
"	reglnent	negligent	.....	.....	regligent
"	downwark	downright	downright	.....	downwirk
"	hixtoxy	beat		hiatory	

the gradual transformation of the first suggestion under the influence of the immediate visual sensations of the letters. At each successive reading some new element of the word on the screen usually asserts itself against the chance suggestion.

(*c*) A third influence, even more unexpected, was exerted by the word called aloud before the word to be read was shown. Although the subject knew that the word to be seen was to be associated with the word called, in five instances he saw the word itself, or parts of it, on the screen. That it should make itself felt against the positive knowledge that it was not to be present, and after long practice in experiments where it had been an association, serves as an excellent illustration of the effect of the preceding state of consciousness. Misreadings due to this influence have been brought together in Table XII.

(*d*) A fourth factor which appeared less frequently and was more remotely connected with the immediate experiments was shown by the influence of some word which the

[1] After re..... at first exposure had suggested remember from the fourth to the tenth exposures, parts of remember were seen which varied from rem to the entire word with the vague feeling that 'something was wrong somewhere.'

TABLE XII.

Direct Influence of the Word Called Aloud.

Subject.	Word Shown.	Word Called.	Word Read.	Letters Seen.
H.	greal	small	small	....mal....
"	aesidance	dwelling	dwelling	....welling
M.	hopoful	expectant	expectant	expe(c?)t..t
"	sihenca	quiet	obedient	obedien(t?)
"	sobsffance	accident	(1)————	auch
			(2)acquaintance	acqu.....[1]

subject found it necessary to use, or was on the point of using just before the word was shown. It was impossible to prevent some conversation between the subject and the operator in connection with the experiments. Several times a further observation would suggest itself to the subject after the report on the experiment had been completed and the operator had begun preparation for the next experiment. Such remarks, or preparation for such remarks, proved to be disturbing factors. In two cases a word about to be uttered, and once a word that had just been spoken, was seen on the screen in the place of the word shown. (α) Thus 'somewhat' was read distinctly as 'moment' when the word came, as *H.*, the subject, was on the point of saying, 'Wait a moment!' when the first signal was given, and changed her mind before the words were spoken. (β) Similarly the records of the same subject show that 'probabln' was read 'possibility' when the word was shown, just as the word 'possible' came into her mind in another connection, and (γ) that 'hopoful' was read 'because,' just after she had stopped talking in the midst of a sentence with the word 'because.'

The influences which have been indicated here are probably only a few of many which are constantly at work in determining the course of the completion and the word which is ultimately seen. Most of the others might have been found in the conditions of the subject's preceding experience. (ϵ) Two of these factors which come from an earlier time were occasionally shown in the effects which could be traced to the work of the preceding hour. When, for instance, *H.* came from a German recitation she would frequently give German words as readings of the word on the slide. *T.*, also, when called to the experiment from reading a French work,

[1] General appearance and length confirmed the impression.

would substitute French words, or words with a French ring, for the words actually seen.

A similar instance is offered by *H.*, who read 'onother' as 'oratorio' when she had attended a performance of 'Patience' the night before. Instances of this type are given in Table XIII.

TABLE XIII.

Misreadings Due to the Work of the Preceding Hour, etc.

Subject.	Word Shown.	Word Read.	Letters Seen.
H.	shredly	(1) sprach	sprach
"	"	(2) schrift	schrift
"	ouwards	(1) erwecken	.....cken
"	"	(2) ———	.....sching
"	shredly	wartete	wart.....
"	shredly	schrecklich	schrecklich
T.[1]	ovenage	souvenage	souvenage

In all these Tables it will be noted that the subject distinguishes between reading the entire word and seeing certain letters of the word. Usually the word as a whole is given as read definitely and distinctly as a whole, and then several letters are given as most definite, or as most certainly seen, while the others are not so clear, or the subject may be in doubt whether they were seen at all. In many cases it was noticed that the letters which were most certain and of whose presence the subject is most confident were not on the slide, but were added subjectively. Occasionally no word is seen, but only detached letters or a nonsense syllable, which is made up partly of the word on the slide and partly of letters from the word whose presence is due to the disturbing influence. These facts show that for the individual the centrally excited sensations are just as truly real parts of the word perceived as the peripherally excited.

These questions of the subjective certainty of the correctness of the words read can be used still further to confirm many of the preceding results. So far, that is, we have been treating all kinds of completions and failures to complete as on the same level; we have drawn no distinctions within the

[1] The instance mentioned in the text, in which the subject came directly from reading a work by MM. Binet and Féré. It shows the tendency to give a word similar to the French. Other instances of the same kind occurred during the same hours, but the records of them have unfortunately been lost.

two main classes. This was done for the sake of convenience, as they represent the general tendencies, and the great majority of the instances belong to one division under each, *i. e.*, the word is read as a word and errors noticed, or the word is read immediately and the errors are entirely overlooked.

Regarded from another standpoint nearly every word given was completed. A word was read which was recognised as the word intended, but it was seen further that something was wrong with some of the letters. Such readings are, of course, to be distinguished from the few instances in which the letters were seen, but no word formed. In the latter case we may say that no completion or assimilation took place. Between the lowest form of completion—in which no word is made—and the highest form—recognition of the word intended without noticing the changes—which we have given in the Tables under *W.*, there are all degrees of completion. Thus a subject may recognise a word and have a vague feeling that there is something wrong somewhere; he may recognise the word and know the general part of the word which is disfigured; he may be mistaken as to the letter changed, or be right about the letter changed and mistaken about the kind of change; and finally he may complete the word without noticing that anything is wrong. Intermediate between the last two groups there may be placed two more stages in which the misprint is seen but is not believed or is believed to be subjective. The two latter groups are placed under the general class of completed words, since the final judgment of the subject would have been that there were no errors in the word that was shown him. All others were put together in the class of words which were read as they stood.

The variations in the number of each degree under the different experimental conditions are of interest as confirming the previous results. It will be noticed in Table XIV that a greater number of words are not completed at all—that is, read as nonsense syllables,—without association than with, and more uncertain judgments are also given in the former case. The cases in which a change was seen but not believed to be real were somewhat greater in general when an associated word was called before the word was shown, though the difference is not so great or so constant as in the preceding cases. This seems to confirm the statement of the subject that one important influence of the association was to increase the strength of his belief that the word read was the word shown. The smaller difference where it was a question of believing what was seen, not of being certain

TABLE XIV.

DEGREE OF COMPLETION.[1]

	T.		W.		H.		C.		M.	
	N.	A.	N.	A.	N.	A.	N.	A.	N.	A.
Completed, but changes noticed	68	40	57	60	60	14	17	7	14	2
Not completed	6	—	8	1	2	2	4	1	7	3
Completed, but noticed something wrong	4	3	12	5	3	1	—	—	2	—
Completed, but something wrong in the syllable	1	—	6	6	7	1	—	—	—	—
Completed, but mistaken in letter changed	—	1	4	1	—	—	1	—	—	—
Completed, but mistaken in kind of change	1	6	7	7	4	2	—	—	2	—
Completed, change not noticed	39	25	50	76	124	123	106	90	106	85
Completed, change noticed, but not believed	—	—	—	2	6	3	2	3	8	6
Completed, change noticed, but regarded as illusory	—	—	—	—	6	1	6	7	2	—
Partly completed	12	14	10	23	10	13	2	—	—	—

about it, was probably due to the fact that when the word seen was in the proper class, *i. e.*, an association, one would be more likely to doubt the letter demanded by the sensation as against the letter reqnired by the word read as a whole. Another striking fact in this respect is the difference between the subjects working with knowledge and those working without. Subjects with knowledge, it will be seen, were very much more likely to give a statement that 'something was wrong, they didn't know exactly what,' or that 'something was wrong in a given syllable,' and also to make more frequent mistakes as to the nature of the change, than subjects without knowledge. On the other hand, subjects without knowledge were much more likely to believe that the misprints were subjective, or that some mistake was made about them than subjects with knowledge. This illustrates and confirms our statements about the general disposition of the subjects working under the two conditions. One who is working with knowledge is practically looking for errors, and

[1]In Table XIV, the N. and A. at the heads of the alternate columns indicate the results obtained without and with association respectively. The other symbols are familiar from the other tables and the text.

consequently is prone to believe in the reality of every misprint, and to expect some to be present that are not seen, while one working without knowledge expects the word to be correct, and so is inclined to disbelieve that the errors seen are real, and also to banish any indefinite doubts about the correctness of single letters.

SECTION 3. THEORETICAL INTERPRETATION OF RESULTS.

We have been assuming that there are two distinct kinds of factors which influence the reading of the words shown upon the screen, and which go to determine the nature of the perceptions to which they give rise. The first class includes the letters actually seen upon the screen, the external visual sensation of light and dark. This we have called the class of *objective* factors. Those of the second class are due to the effects of previous experience, and also play an important part in the perception. These we have designated the *subjective* factors, and have analysed out some seven or eight of them from the entire complex. We have, now, (1) to explain and justify this classification of factors, (2) to learn their nature, and (3) to determine more nearly the part they play in the formation of the resultant perception, with special reference to the forms of connection between them. We must, that is, describe and synthetise the factors which we have previously discovered by analysis.

It is, of course, a matter of some difficulty to make out just what happens when the word is perceived. Introspection at the time of reading seems to be the only method which can give us an accurate account of the process. Our subjects were encouraged, during the whole series of experiments, to tell exactly what occurred in the perception, and were questioned on the general nature of the phenomena of reading, so far as this could be done without invalidating the results through suggestion. The subjects were again asked, in a general way, to give a description of the phenomena after the experiments were finished. By this method we obtained a large number of coincident results from experienced observers under different conditions. The subjects all agreed in the following general description of the processes. At first, for a moment, nothing was seen but the light space which surrounded the word, and a few indefinite letters scattered over it. Suddenly these letters assumed the form of a word and took on meaning. This flash of recognition was quite marked in all the observers, and was frequently made manifest to the experimenter by a period of expectant silence,

followed by an exclamation before the report was made. The word seen seemed to the person introspecting to be accompanied by a rush of associations and connections, which aided in giving it a place in the whole of mental experience. Our present problem is to trace more definitely the different factors in this process, which we may call apperception, in the current use of the word, and to give its effects, conditions and degrees.

(1) Our classification of factors into *subjective* and *objective* was intended to set off, roughly, the *external* forces which are actively at work at the moment in producing the perception from the more truly *physiological* forces which are acting independently of any event in the outside world that is affecting the subject during the instant of perception, though for the purpose of our experiment they may be regarded as the stored-up results of preceding stimulations. From this point of view, the distinction may be regarded as merely relative. The ultimate source of both sets of factors is some event in the external world. They differ only as past differs from present experience. There is no absolute and ultimate difference in kind. All the subjective factors were once objective, and the objective in one experiment may become the subjective in the next. At the same time the distinction is real for psychology, because (*a*) at the moment the one is of a purely internal or physiological origin, while the other is produced by physiological *plus* physical conditions, and (*b*) the two give rise to definite psychological processes, which, as we shall see below, show characteristic differences which serve to indicate their separate origin. (*c*) Still another difference is that of the degree to which they may become conscious. The objective factors are most easily noticed when the perception takes place; while the subjective factors vary in this respect between the conscious experience which immediately precedes the perception, and which may return at the following instant, to the ingrained tendencies due to events so remote in time that they are now mere physiological capabilities, and could not possibly be remembered in their individuality; or, again, may be a part of the inherited nervous mechanism, and never have been in the consciousness of the individual. None of them need be in the consciousness of the individual at the time the word is read.[1]

The different subjective elements have been analysed out to a certain extent in the preceding discussion. We have been able to note the effects upon perception of the different

[1] *Cf.* Titchener's "Outline of Psychology," pp. 109 ff.

events which occur during the experimental hour, in the nature of the work just preceding, in the current affairs of life at the time, in the general directions given for the investigation and the knowledge of its purpose, and in other elements, which go to make up the individual character, but are too remote to admit of ready analysis or accurate reference to their source. As will be seen later, these influences do not all seem to be upon the same level, but are arranged in an ascending series, in which the higher controls and directs those below. While we have been using the event itself as the factor, we have done so only for convenience, and because that was the one concrete fact with which we could deal at first hand. Of course it is effective simply in so far as this previous experience has left behind it some permanent change in the nervous structure which is the immediate occasion of the phenomenon under consideration. The two classes of factors are the immediate conditions of the two forms of sensations or ideational elements of which all the more complex ideational processes are composed. These we may call with Külpe the peripherally and centrally excited sensations. They are the only conscious representatives of the two kinds of factors: one, the presentation, is due to the sense-stimulation of the moment; the other is the effect of the physiological conditions, which are in turn derived from events in the past experience of the individual. They are both definite psychological processes, correlated on the physical side with certain physiological processes. The distinction between subjective or objective factors and peripherally or centrally excited sensations should be carefully noted. The latter are something definite physiologically and psychologically, and originate from definite causes. The factors include all the causes of the perception, and very frequently can be known only by inference. In nearly every perception we find both subjective and objective sensations that owe their origin to the two most divergent classes of forces. The simple subjective sensation may also be derived from a number of subjective influences which are at work at the same time. The perception, then, is a very complex process, that can be regarded as the resultant of the stimulation of the moment and of all past experience; as the product of the reaction of character upon the present external forces.

(2) The centrally and peripherally excited sensations differ not only in the nature of the factors that produce them, but also very often show distinct attributive differences. Letters wrongly completed were said, *e. g.*, to be of a different color from those which were actually present upon the screen; were less definite in outline; and were less stable, *i. e.*, seemed to

be in motion over the word. The particular differences are shown in the accompanying Table (Table XV).

The relative fewness of these instances is to be explained from the fact that the subject is interested in the word as a whole, not in the details of the letters. We are dealing with a case of overlooking the letters under the influence of the meaning, as on p. 000 below.

TABLE XV.

A. Centrally Excited Sensation Faint.

Subj.	Word Shown.	Association.	Word Read.	Remarks.
W.	danxe	———	danger	" 'r' seemed faint."
H.	ramp	tetanus	cramp	" 'c' seemed faint."
"	dangwr	———	danger	" 'e' was dim or blotted."
"	verbati	———	verbatim	"Last two letters seemed a little dim."
M.	feathr	———	feather	' 'e' not distinct, but there was some small letter where it belonged."

B. Centrally Excited Sensation of Peculiar Form.

Subj.	Word Shown.	Association.	Word Read.	Remarks.
H.	hopefxl	despondent	"officion"	"Saw nothing until after the word was gone. Then seemed to see 'offi-cion' in script of light letters against a dark background. Probably connected with after-image phenomena."
C.	shredly	cunningly	shewdly	" 'w' seemed to be only a blurred mark."
"	somemhat	slightly	somewhat	" 'w' seemed a little scratched."
"	quaintlo	picturesquely	quaintly	"Last letters seemed to be something inverted. The 'y' was not plain."
M.	ctaze	fad	crank	"Saw 'crank' spelled backwards."

C. Color of Centrally Excited Sensations.

Subj.	Word Shown.	Association.	Word Read.	Remarks.
H.	remotelk	distantly	faraway	"Expected 'far away,' and seemed to see it in dim reddish letters. The first letter was script."
"	camponiov	———	campnella	The letters seemed to stand out in terms of black and gray. Some of the gray letters were just as distinct as the black, but seemed less certain because not so black."

Besides the differences noted in the Tables there were two more general statements which relate to the nature of the characteristics that enable one to distinguish between the centrally and peripherally excited sensations, and which go to show that there is some noticeable difference between the two, but do not indicate definitely what the difference is. At one time *H.* was shown *January*, inverted by mistake, after *February* was called. The word was read *March* at once, and without hesitation. Immediately after, however, the subject added: "It was a dreary sort of thing, of whose existence I am uncertain." Again, the same subject read *recentlr* as *remember*, with the reservation that "something was wrong somewhere." Here the description was that "there were wheels of blackness going round." These come under very nearly the same class as the two instances in which the completed letters were seen to be in motion. These, too, both come from the records of *H.*; *gossi* was read *go . . . nt* with an *s o* which seemed to be dancing about in front of the glass. A more definite case of the same kind is found in the reading of the letters *chwter*, intended for *chapter*. The report in this case was that the letters *ca ? ter* were seen, and the doubtful letter seemed to be an *m* which moved about.

Few and scattered as these results are, they seem to show that the centrally excited sensation, no matter how certain of its existence we may be, possesses certain characteristic differences that distinguish it from the peripherally excited. It might be suspected that these phenomena were of *objective* origin, due to phosphenes, to eye movements, to imperfections in apparatus, etc. None of these explanations is probable, however. (1) The phenomena were of too infrequent occurrence, and (2) affected only the letters that were wrongly printed or were not printed at all. If they had been of objective origin, they would have been noticed much oftener, and would also have accompanied letters which were objectively correct. Nor (3) can the apparent motion of the letters be due to eye movements, since only a *part* of the letters were in motion, while the others remained fixed. Eye movements would have affected the whole word.

Professor Münsterberg[1] has argued from the fact that letters which are not in the word shown were mentioned by the subject as among those which were the most distinct in the word, that the centrally and peripherally excited sensations are identical in nature. This does not necessarily follow.

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[1] Beiträge, IV, pp. 17 ff. Cf. Külpe, "Outlines of Psychology," pp. 183 ff.

The natural expectation of the subject is that any letter which is seen at all, has as distinct an outline as every other, and the ordinary quality; and this expectation is strengthened by the fact that it is realized in a long series of experiments. Then, too, with the exception of the first one, the letters are of comparatively slight value in reading the word. The word itself is the thing of chief interest, while the letters pass comparatively unnoticed. It might very well be that the letters reported as present were those central excitations that had attention called to them by some peculiarity which escaped notice later when the report was made. There is, at least, no connection between mentioning a letter as present and carefully noticing its appearance as compared with the others in presentation.

If it were possible to call the subject's attention to the letters without destroying the centrally excited sensation entirely by removing the suggestion that produced it, this method would, perhaps, furnish a means of making a comparison between the two kinds of sensations. They are brought under observation side by side, and the subject is almost entirely free from any errors of expectation. The great disadvantage is that which we have mentioned so frequently,—that the attention cannot be directed definitely to this point without betraying the nature of the investigation, and that the differences are consequently very likely to be wrongly reported or to escape observation. For this reason, among others, the method cannot be applied to make quantitative determinations.

(3) We have now to determine the way in which these different elements unite or work together to form the whole, the given unit of our experience,—in this case, the word. The concrete facts are that when a word is shown, it is either read correctly or some other word, more or less like that intended, is substituted for the presentation and given as if it were read. We have to explain why and how these letters or words are substituted. The first explanation that would have suggested itself to an old-school psychologist would have been that the substitution takes place by means of 'association by contiguity' between the *letters* that constitute the word. His explanation would have been in detail that certain letters on the screen are seen distinctly, and these call up and unite with themselves other letters that have previously been together with them in the same mental group. When the other letters that are on the screen, but not seen, are excited by this process, the word is read correctly; if the associations take a different course, another word is substituted for it. Now the tendency covered by this phrase is

certainly at work —no letters come up in mind that have not been 'contiguous' with the presented letters at some time— and is effective by itself in a certain number of cases. But it is no by means an adequate motive to the entire process. There is much that lies behind.

Each letter that is seen has a more or less stable connection with a number of other letters, possibly as many as twenty-five. The question immediately arises why one should be chosen in preference to all the rest. The answer that would have been given is that *frequency of connection* is the main determining factor. That it is one of the factors there can be no doubt. Our experiments furnish abundant evidence of the fact. In Table XVI are collected the instances in which the appearance of single letters in peculiar places within a word admits of no other explanation. The frequency of the instances in which the *th* combination is effective in this way is very striking. It will be noticed that *hereupon* is nearly always read *thereupon*, and *hereunto thereunto*, though there

TABLE XVI.

INFLUENCE OF ASSOCIATION BETWEEN LETTERS.

Subj.	Word Shown.	Association.	Word Read.	Remarks.
W.	hreunto	———	thereunto	
"	hreupon	———	thereupon	
"	erridateon	instruction	irridation	
"	horeunto	thereunto	whereunto	
"	hreupon	thereupon	thereupon	
"	ctaze	fad	staze	"It was for craze."
H.	remotelk	———	reac..tation	
"	henius	———	when?	
"	"	———	———	"There's a 'th,' somewhere."
"	"	———	....ture	
"	cottrn	———	cottra	
T.	remotelk	———	remotall	
"	mutright	———	intrident	
"	"	———	intrigant	
"	"	———	astright	
"	youthiul	———	pettijoy	youthful was reversed on the slide so that oy came last.
"	"	———	frittioy	
"	bxnker	———	walker	
"	henius	———	thebiles	
"	"	———	femulus	
"	"	———	Sphencius	"Sure of 'S.'"
"	"	———	...henius	"Something before the 'h.'"
"	cottrn	———	cottra	
"	gossi	———	gossal	
"	hreupon	———	threupon	"First 'e' gone."
C.	hreupon	———	thereupon	
M.	horeunto	———	thereunto	
"	shredly	———	shriedly	
"	sufdenly	———	suffently	
"	cottrn	———	cottra	
"	rtful	———	... th .. l	
"	disal	———	disable	
"	xeduxla	———	aedulla	
"	uvermore	———	evermore	"Seems to be an 'm' before it."

is no other reason, apparently, why one should be chosen rather than the other. But it is not always this most usual connection which is effective in producing the result. It is again evident *a priori* that in many cases the frequency of connection would favor several letters equally; whereas we find that even then there is a definite choice made. Often the influences that control this choice not only decide between two 'associations' of equal strength, but overcome a stronger in favor of a weaker 'association' between the elements of the perception, and may actually replace a peripherally by a centrally excited sensation. These cases are much more frequent in our records than those which are due to association of elements by contiguity, induced by mere frequency of connection.

We have now to investigate these more subjective factors in an attempt to discover what the mechanism is that lies behind the selection. We find that it consists of an ascending series of tendencies that work down through each other until their effect is finally noticed in the control of the 'associations' between the letters. (1) The tendency that is most immediately effective comes from the word as a whole. If *h* is seen as the second letter in a word, it is associable with *s* or *t*, among others, for the first letter. If the form of the word and some other letter suggest that the word, as a whole, is 'should' rather than 'though,' the *sh* connection will be effective, although the bond of union between *t* and *h* is stronger in itself than that between *s* and *h*. In this way the word has a retroactive effect upon the letters which might be supposed to arouse it. It can replace certain presented letters by others that agree with the word, though they are not on the screen, and place the latter on practically the same plane for perception as the former. That the word is a real factor is evidenced by the experience of the subject. No matter how vague and fleeting the impression, numerous words were read with more or less confidence in the accuracy of the reading. The natural impulse was to find a word for *every* group of letters, however indistinct it was. That is, there was always a tendency to connect the separate impressions into something with a definite meaning for consciousness. We might offer further evidence for this influence of the word in a fact noticed in the preceding Section, but there not fully explained: the fact that the ease with which mistakes were recognized was practically independent of the length of the word. We found, in that Section, two influences of the length of the word which are incompatible on the ordinary theory of perception. (*a*) The length is a very important element in determining what *word* shall be

read; so that a word would be rejected if its length did not agree with the length of the impression. But (*b*) the length had no influence at all upon the number of times misprints were overlooked, *i. e.*, upon reading the *letters*. These two different effects of the same attribute would be inconceivable if they were both directed upon the same part process. The contradiction disappears if we assume that the length in the first instance aids in calling up the word, while in the second we are dealing with the effect of the word as it works back upon the separate letters. This theory, too, admits the explanation there offered, viz., that the fact that ease of recognizing the misprints does not vary for words of different lengths is due to the opposed action of two factors, the increased prominence of the misprints in the short words and the greater strength of association between the word and the form and first letters in the shorter word. While the shortness of the word, that is, makes the fault more prominent, it at the same time strengthens the factors that tend to override and destroy it.

This fact will also remove another difficulty in the same Section. We found that the position of misprints had a marked influence upon the number of times they were noticed; a disfigurement of the first letter was seen much more frequently than when it affected a letter that stood farther on in the word. This result seems to indicate that the word was read through to a certain extent letter by letter. At the same time investigations in reaction times have shown that a short word is read as quickly as a single letter. It is at once apparent, on our view, that the reaction time covers only the time required for the general form and length to arouse the word as a whole, and the misprints are overlooked or recognized during a more or less conscious reading—usually in memory—of the separate letters under the retroactive influence of the word.

Here the further question arises how we can explain this peculiar phenomenon that the word comes to consciousness before the separate letters, and is able to work upon them while they are being read. We have seen that the length and general appearance of the word played an important rôle in reading, while but a very few of the letters themselves were read at the first glance. This gives a clue to the puzzle. There is an association between the general form of the word and the word as a complex of motor, auditory and visual sensations in connection with other objects of perception. When the word is exposed, this association is effective at once and calls up a word without the least reference to the tendencies at work between the letters. It is the word that results from

this process which exercises supervision over the connection between the letters. There can be no doubt that the word comes up as the result of the general impression from the screen; though it is again a fact that the bare association has not such an important part to play as this bald statement would imply. For we have the old difficulty once more. The small part of the word really seen is associable with numerous complete words. The principle of association is too general: it would explain too much. We must look to more definite conditions to explain why one word has the preference over numerous others that are on exactly the same footing so far as this one factor is concerned in the determination. Here again, of course, the old-school psychologist would have adduced mere frequency of repetition as the all-sufficient explanation. And it would have validity as a statement of one of the conditions, but one of the less important. Certain repeated mistakes that were made in reading the same word show that it is effective in some cases. A few words were misread once when shown on the screen, and the same misreading was made one or more times in succeeding experiments, separated by intervals of several days. It is evidently an instance of association by frequency of connection between certain letters which were seen and the word as a whole. Practically the same sensation was received in each case from the word shown, and the choice between the numerous possible words was determined by previous experience. In at least one case there were other factors, extraneous to the form, which united with it. *E. g.*, the letters *ordnary* were mounted in such a way that they appeared in one corner of the oblong of light on the screen. They were read *orchard* several times at long intervals. (See Table XVII.) When part of the opening on the slide was covered in such a way as to bring the letters into the centre of the lighted space on the screen, the usual position, the word was not recognized during three exposures, and the subject seemed much confused. But at the fourth trial it was misread in the same way, with the remark that it had appeared in a different part of the illuminated opening. The instances of this kind are collected in Table XVII.

(2) But besides the influence of the association, and of even greater effectiveness than it, are certain more general factors which decide between the various most-frequently-connected words that might be called up simply by virtue of previous connections. (*a*) First in this group stands the associated word that was called before the exposure was made. This was active in two ways. It gave greater certainty that the word suggested should be the correct word, and thus

TABLE XVII.

REPEATED MISREADINGS.

Subj.	Word Shown.	Word Read.	Association.	Date.	Remarks.
W.	shredly	assuredly	——	Oct. 29, '94	
	"	"	——	Nov. 5, "	
H.	imrovement	internal	——	Oct. 23, "	
	"	"	——	Nov. 2, "	
"	ordnary	orchard	——	Oct. 27, "	Mounted in one corner of the space.
	"	"	——	Oct. 30, "	Mounted in one corner of the space.
	"	"	——	Nov. 7, "	Mounted in one corner of the space.
	"	"	——	Nov. 10, "	Mounted in one corner of the space.
	"	"	——	Dec. 15 "	Mounted in the centre, as were the others.
"	ordnary	ordinary	common	Feb. 23, '95	Mounted in the centre, as were the others.
"	verbati	vorbald	——	Nov. 8, '94	
	"	"	——	Dec. 1, "	Remembered it had been given before.
"	monopolict	cosmopolitan	——	Oct. 23, "	
	"	"	——	Dec. 15, "	

strengthened the effect of the word suggested upon the separate letters so that the misprints were overlooked more frequently, and it was also at times strong enough to supplant the word that would have been suggested by the general outline. (*b*) Other influences that acted in the same manner were derived from the preceding word, an earlier suggestion, and words that were called up in other connections. These have been fully described and discussed above in connection with the factors that aided in recognition (see pp. 358 ff.), and we need devote no more attention to them here. They all work upon the second association, that between the impression and the word, just as the word works upon the association between the letters, and it is only secondarily, through the mediation of the word, that their influence extends to the letters themselves.

(3) Nor is even this the end of our regress. The factors which determine what word shall be chosen may in turn be controlled by still more remote influences. These, of course,

may lie in circumstances remote enough to have lost their individuality in the general effect which we call 'character,' or they may be effective in producing a more transient tendency. Perhaps the best instance of the former case is seen in the different reading of the word *escoxt* with the association *beau* (bow) by a man and a woman. The woman read *escort* immediately, while the man read it *arrow* just as definitely. An example of the second kind is afforded by the tendency to read the words as French or German immediately after reading one of those languages. This is not as good a case as the former, because it is impossible to say whether the disposition acted upon the association between the mere letters, or upon that between general impression and word, or upon the highest level of all. The three lowest stages are inevitable, and it is quite possible that in certain special cases others of the same kind could be distinguished. We could find, that is, many more degrees in the increasing generality and abstractness of the factors which determine the association that finally result in the complete perception.

Yet another factor whose position in the scheme is not quite clear is the knowledge that the subjects possessed of the nature of the experiments. Its effect was probably due to greater attention to the letters after the word had been suggested. It thus seems to belong outside of our general scheme, and to be upon the same level as the word. It works, *i. e.*, directly upon the letters, and opposes the influence of the other more general factors which act upon these only through the word.

In what precedes we have made the *word* the unit, the element of the whole perceptive process. Everything less general leads up to the word, everything more general leads down to it; and it is itself the subjective factor which is of immediate influence in determining what letters shall be seen. There are now one or two other considerations which serve more fully to justify and explain the important function which we have attributed to it.

We have already proven that the word influences the individual letters, and is simultaneously effective with them in producing the perception. But that is not all: for the word has an effect on consciousness peculiar to itself and not due to the individual letters of which it is composed. As soon as the word is presented the group seems to be known; *i. e.*, in general, definite images tend to arise in the mind and form a unitary complex within it. The subject is reminded of something connected with the object which the word recalls, etc. A group of related ideas is immediately aroused, and gives the

perception a setting in mind. By it we pass from the letters, the single impressions, to something with a meaning for consciousness. That it is the union with some other ideas, and not the mere pronunciation of the word, or translation from visual to tactual or auditory elements that is mainly effective in recognition, is indicated by the fact that several times the subjects would say, "I know what that is, but can't think of it;" they would have a 'feeling' that the word was known before they knew what it was. The subject *T.* gave an excellent case of this kind,—which, however, started from the spoken word called as an association,—together with a complete analysis. The word *fireplace* was exposed under the suggestion of *andiron*. The word *andiron* was supplemented immediately by the visual picture of a fireplace, but no word came to mind. The letters *ace* were seen, and actually suggested *furnace* before the rest of the word was seen to be 'fireplace.' Here we see that the word was recognized, and gave rise to associations before it was itself perceived. Other in-

TABLE XVIII.

INSTANCES OF THE VANISHING OF LETTERS WHEN NOT APPERCEIVED.

	Word Shown.	Association.	Word Read.	Remarks.
W.	disal	———	deal	"There may be something between 'e' and 'a,' but I am not sure."
"	braft	trade	art	"There seemed to be a queer letter before it."
"	hxstoxy	English	atom	"'Atom' was in the middle; I could remember nothing else."
"	camponiov	———	campaniny	First statement was that the first was 'cam,' but after company had suggested itself, said it was 'com.'
H.	brnefit	———	———	"All is confusion. Remember nothing."
"	foyever	———	forever	"There is a hair across the 'r.'"
T.	chimnxy	———	chimney	"There are some crosses, but I can't remember where they are."[1]
M.	nxious	———	———	"Letters were 'n l g g ful.' Can't remember the order."
"	inectirity	———	———[2]	

[1] The subject made the further remark that he frequently caught himself making judgments in words to avoid trusting to memory.

[2] From the third to the seventh exposure vague letters were seen, but could not be remembered. At the seventh he said that he saw all the letters, but they disappeared before he could connect them.

The instances given in this Table are some of the more striking examples of this tendency for the letters to vanish. It was noticed very frequently, besides, when words were not completed, but it seems unnecessary and undesirable to multiply instances.

stances were given in which the letters were all seen accurately, but it was not until some minutes afterwards that the word was read, *i. e.*, aroused other associations which allotted it a place in the experience or knowledge of the individual. There is other evidence that this process of recognition, which we have analyzed into the origination of other associations, is an important if not an essential element in perception or assimilation. (*a*) Numerous instances show that unless the letters seen are fitted into some word, they almost invariably vanish. They cannot be remembered long enough to be repeated to the investigator a few moments after the experiment has been performed. That is to say, unless the individual letters give rise to a word, enter into connection with the rest of our experience, it is practically impossible to remember them. Instances of this kind are tabulated in Table XVIII. (*b*) Again, when the letters are recognized, the rush of recognition may be so violent that the letters themselves are entirely neglected,—forgotten, or not seen at all. We are interested only in the word which is the unit of experience, the smallest bit that can ordinarily find a place in our knowledge. When we get this we are so little concerned with the particular sensations that give rise to it that we pay no attention to them. They are not remembered as individuals. It is an association in which the original excitatory cause is not retained in consciousness, because it never really became a part of attentive consciousness. One link in the process of acquisition is simply omitted, so far as after-knowledge is concerned, or so far as knowledge is concerned at all, in the true sense of the word. The instances of this kind are tabulated in Table XIX. One of the best illustrations there is the overlooking of words printed in capitals. In the three instances mentioned it was known that the form of the letters was not seen at first, from the fact that it was seen later. Of the other eight times in which words printed in capitals were shown, only twice was it definitely stated that the word was printed in capitals. The inference is that the letters were unnoticed in the other six times.

This is essentially the same phenomena that Helmholtz[1] called 'unconscious inference.' We cannot agree that it is inference; it is mere perception; and it also seems to be rather a perception based upon or originating from an unconscious, *i. e.*, physiological source than an unconscious perception. It is evidently a process of the same nature as our space perception, as when, *e. g.*, we get only visual images from tactual stimuli, and when the very complex per-

[1] *Physiologische Optik*, 2d ed., pp. 582 f.

TABLE XIX.

INSTANCES OF THE VANISHING OF LETTERS WITH APPERCEPTION.

Subjects.	Word Shown.	Association.	Word Read.	Letters Seen.
W.	biagust	abhorrence	disgust	.....st[1]
"	whenewer	———	axiom	axiom[2]
"	henius	———	when	none
"	fathex	———	weather	"
T.	xnimate	———	animate	"
"	eaxth	———	earth	"
"	climxte	———	climate	"
"	forengn	———	foreign	"
"	Xebxary	———	Xebxary	"[3]
"	biagust	———	bicentiate	"
"	aprxcxt	———	apricot	———[4]
H.	iprecaton	vengeance	———	orence[5]
M.	aredibly	———	admiraty	ad(m?)iralty[6]
"	eaxth	heaven	earth	none
"	shabbilw	genteelly	shabbily	shabbily[7]
H.	ABOLITION	———	audition	———[8]
"	greal	———	greek	———[9]
"	FORESIGHT	———	foresight	———[10]

ception of distance is called up by retinal disparity or sensations from the ciliary muscle without any conscious sensation of what is known to be its occasion. It seems, then,

[1] . . . . st was seen at the first exposure, and nothing else, not even the general form of the word. The same reading was repeated four times in succession, and no more than one or two letters was seen at any time. It is given as a striking representative of the numerous times in which only a few letters were said to be seen, although the word was read as a whole. It is, of course, impossible to say how far the place of the letters was taken by the form of the word in these cases, and how far the letters seen were forgotten after they were seen, although probably both influences were at work.

[2] Whenever was also in mind after the reading.

[3] The word was seen some time before the crosses were noticed.

[4] This word was seen as a nonsense syllable at the first exposure; was correctly read at the second. The subject remarked that the letters were much clearer the first time than the second.

[5] *Revenge* was expected from the association, and the subject was so much surprised that it was not *revenge*, that she did not fit it into anything, and forgot what it was.

[6] First statement was that the word was admiralty without the "m," but before the report was finished "m" was said to have been seen. This is negative evidence that the subject is very uncertain about the separate letters that are seen.

[7] "Had a vague idea what word it was, and that it was the right word, some time before the word itself came."

[8] It was not noticed that the word was printed in capitals until the third reading, and then only the initial letter seemed to be capitalised.

[9] It began with a small capital.

[10] The capitals were not noticed until some moments after the word was read.

that we can have a sensation of so little interest in itself, and with associations of such great interest, that it comes to consciousness only in and through the complex process that it excites. (*c*) A third peculiar phenomenon in this connection was the tendency to recognize words falsely. Combinations of letters which contained centrally excited sensations were read off and pronounced as if the word really existed and was entirely familiar to the subject. Sometimes the recognition was complete and permanent, sometimes it was only a 'feeling' that the word was familiar; sometimes, again, it extended to whole words, and sometimes only to certain letters or peculiar spellings of words. That is, two of the subjects would give nonsense syllables as good words, though they did not give any evidence that they knew what the word meant, or anything else in connection with it. The suggestion that real words were to be given was so strong that unfamiliar and impossible words were 'recognized' as real and familiar. It is hardly safe to draw any inferences from this bare fact, though it would seem to indicate that recognition was a definite process which could be set up by a habit, in this case the habit of reading words which

TABLE XX.

FALSE RECOGNITIONS.

Subject.	Word Shown.	Word Seen.	Remarks.
C.	caffea	caffea	"Is there such a word?" the subject said, and remarked a moment later, "Yes, I remember it now."
"	fellw	felly (felloe)	A moment later the subject remarked that felloe wasn't spelled with a 'y.'
"	kommonly	kommonly	It seemed all right at first, but later it struck him as queer that it should be spelled with 'k.'
M.	verbati	verbati	"I thought, at first, it was verbatum, then saw it was the plural."
"	kommonly	kommonly	Same phenomenon as with *C* above.
"	xexter	rexter	"I don't seem to be familar with that word."
"	window	aiche	"I thought for a moment that *ache* was spelled with an 'i.'" (Read under association of pane. See Table IX.)
"	painxer	paintker (painter)	The first remark was that 't' and 'k' 'seemed a little run together,' and then it was added, "I thought for the moment that *painter* was spelled *paintker*."

could be recognized.[1] Instances of this kind are given in Table XX.

Besides this complicated web of subjective forces which mutually affect each other and show their influence in the final perception, we must also consider the effect of the objective factors, the letters shown upon the screen, some of which have served as a starting point or foundation for this elaborate superstructure. They are directly opposed to the former, and the result of the opposition is at times apparent in the perception. We find in nearly every word that the correct reading of some letter is directly opposed to many, if not all, the subjective influences which are at work in perception. Here, as in those cases in which continuous physical forces are opposed, we should expect that one would win, or that both would be evenly balanced, or that their resultant would be some effect related to both, but different from either. We find the two former cases, not the last. It will be seen in Table XXI that in some cases the doubtful letter is entirely unseen, while in nearly all other cases it is read correctly, or its place taken by a letter in agreement with the remainder of the letters in the word.

We also find results which could hardly proceed from continuous forces. In some cases the two letters would alternate in consciousness. First one would appear, and then the other,—as one force increased or diminished in strength. Again, in some cases both letters would be seen continuously; so that the word contained an extra letter. All these cases are taken from Table XXI, which summarizes the peculiarities due to this opposition.

TABLE XXI.

A. Both Centrally and Peripherally Excited Sensation Retained.

Subject.	Word Shown.	Association.	Word Read.	Remarks.
M.	painxer	.....	paintker	See Table XX.
"	dangwr	fear	dangewr	
"	fxotbxll	baseball	football	There is also a "g" somewhere.
H.	fxotbxll	baseball	football	There is "z" extra somewhere.
"	kommonly	.....	kcom....	
C.	quaintlo	.....	quaintley	
"	besidn	.....	besiden	

[1] *Cf.* Titchener, "An Outline of Psychology," §§ 70-72.

B. Alternation Between Central and Peripheral Sensation.

Subject.	Word Shown.	Association.	Word Read.	Remarks.
M.	hixtoxy	.....	history	"The third letter alternated between 'a' and 's.'"
H.	dulpably	.....	culpably	"The first letter alternated between 'd' and 'c.' Don't know which it was."
"	xexter	.....	dexter	"The first letter seemed to be 'd,' 't,' 'i' and 'k,' one after the other. One letter seemed to be over the other and change into it."
"	redluze	.....	recluse	"Seemed to be redluze at first, but when the word recluse came, the 'd' seemed to melt into 'c.' Probably 'c' and 'l' made the 'd.'"

C. Balance Between Centrally and Peripherally Excited Sensations.

Subject.	Word Shown.	Association.	Word Read.	Remarks.
M.	kommonly	ordinarily	commonly	"But I can't make out the first letter."
"	fashxon	.....	fashion	"Didn't see the 'i.'"
"	dulpably	guiltly	culpably	"'c' was not clear."
C.	soldoer	civillian	soldier	"The 'i' is not clear."

We must remember that in the greater number of cases in actual experience, all of these factors, which are present, are working together, coöperating to produce the general result. Thus in ordinary reading the words are *correctly* spelled, so that word idea and letters are at one, and associations with the preceding contents, together with the general trend of the meaning, both aid the visual form in calling up the proper words, and secondarily the proper letters.

We may now ask how the perception of the word is related to perception in general, *e. g.*, to the perception of a definite visual object. It seems quite easy to pass from one case to the other on *a priori* grounds, though we have not subjected the question to special investigation. In an object we have the general form, and a few details, in place of the outline of the word and certain of the letters. The total object takes the place of the word, and the other processes are the same as before. We have associations between the *separate parts*, under the domination of the unity of the object, which is itself determined by general experience. There is one function which the word still retains in perceiving a simple object; it gives *definiteness* to the perception, and connects with the remainder of consciousness.[1] What we have said previously of this function in the recognition of words is also true of it here for the finality of the verbal associate.

[1] *Cf.* Titchener, "Outline of Psychology," pp. 198 f.

SECTION 4. GENERAL THEORY AND RETROSPECT.

We may now turn back to consider how our own formulation of this perceptive process differs from that given by Wundt and summarized in the first two Chapters. The concrete process which most nearly resembles that investigated by us is *assimilation*, the second form of simultaneous association. In the external description of the process we are in complete accord with Wundt[1]; but in the analysis of what lies behind the phenomena we differ from him very considerably. Wundt reduces the process to an associative part-process of *identity* between the parts first seen and letters of the correct word, and an associative part-process of *contiguity* between these letters of the correct word and those usually combined with them to form the entire word.[2] Apperception is present only in the passive form in which the objective or mechanical factors are alone determinant. We, on the contrary, have reduced association to a very subordinate place, and find active apperception to be the truly controlling factor.

The first point to be justified is the omission of association by identity. We are unable to ascribe to identity any conscious place in simultaneous association. In successive association, as we have seen,[3] the identical element is the elementary process which acts as the hinge, the bond of union, between two total processes. It is the unit that persists from one state of mind, and gathers about itself the new elements for another state of mind. But we have in simultaneous association only what corresponds to a detached link from this chain. How the element that forms the centre or core of this process comes into consciousness upon the reproductive side lies beyond the reach of introspection, so far as we have been able to apply it. The part-process of identity may serve as a mental translation of cerebral mechanics; but it is not itself—at any rate, in the case of so habitual an assimilation as the reading of words—a conscious process. Moreover, the identity process, whatever else it may be, is not of the same kind as the association by identity in the successive association.

Further: we have found in regard to association in general that it is but one of many factors in determining the word to be read. Reduced to the mere contiguity of letter to letter within the word, to which Wundt ascribes such an important place, association is actually unimportant, though

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[1] See pp. 332 f.

[2] *Bemerkungen zur Associationslehre*, *Phil. Stud.*, VII, pp. 340 f.

[3] See p. 333.

potentially all-important. It has been shown that only in a very few cases has this association been strong enough alone to determine what sensation shall appear, while usually it merely coöperates with other factors which tend in the same direction, and very often a strong association is overcome by a weaker, with which the other more general factors are in coöperation.

Far more important than the difference in regard to association, however, is that between the presence and absence of active apperception. We have but to compare our results with Wundt's description of the complex he designates 'apperception' to see how fully and completely they agree. (1) We noticed that the letters only become clear and distinct when the word comes, when they are read; previously they are vague, indefinite and uncertain. (2) At the same time the sense of relief is strongly apparent on reading. This is substantial evidence for the presence of previous strain sensations with their affective tone. And remarks of the subjects made during the experiments were in themselves sufficient evidence for the presence of both. (3) More generally, we have found that each perception or reading is conditioned in its nature by very much of the preceding experience of the subject; so that the process partakes of the very general character of apperception, that it tends to form a unit of the entering sensation and the remainder of our experience. Besides these most important attributes we have almost the complete list of minor accompanying phenomena. The word is preceded and accompanied by numerous more or less dark ideas, and the completion of the process is necessary for the words to be retained in memory. All the characteristics of apperception in its most developed form are present in the simple act of reading a word. There can, then, be no doubt of the essential identity between the group of phenomena we have been investigating and those to which Wundt gives the name of active apperception.

If, now, assimilation, the most important of the associative connections, is under the immediate control of active apperception, it is necessary to examine the other forms of associative and apperceptive connection with a view to determining the differences between them. This can best be accomplished by considering the concrete instances in the different classes. As instances of associative connection we have the fusion of tones in a clang, 'associative synthesis'; the reading of a word, 'assimilation'; and a space perception, the union of elements from different sense modalities, 'complication'. Subjective rhythm, the different stages in the formation of a compound word, and the concept, are given

as instances of apperceptive connection.[1] It is at once apparent that these two classes do not differ in any of the attributes characteristic of apperception. One is not necessarily, or even usually, clearer, accompanied by more intense strain sensations, more easily retained in memory or more unitary in character than the other. This first impression is confirmed by closer analysis.

For purposes of discussion all the forms can be reduced to two general classes. (1) Complications are practically assimilations in which the supplements come from a sense modality other than that which furnished the original peripherally excited sensations, as when a visual impression is supplemented by a tactual, to give the idea of an object. This sort of supplementing happens in practically every instance of perception. In our own experiments we saw that the word was frequently a tactual idea, called up by and associated to a visual impression. Assimilation and complication, then, can be considered as one, so far as apperception is concerned. (2) We have already[2] ruled out the combination and transformation of words ('agglutination') on the ground of the complete dissimilarity of the material worked upon from that ordinarily present in the other groups. The process, too, is entirely different. The changes in language are due to slow growth during the history of the race, and only slightly, if at all, the work of any individual consciousness. It does not seem safe to reason from these very general products of the mind to special processes, unless we can follow the connection in much greater detail than is possible at present. So far as we can see, however, 'assimilation' would cover these cases also.—We have left, therefore, the clang as opposed to rhythm, and assimilation as opposed to the concept. Now (3) clang and rhythm ('associative' and 'apperceptive synthesis') are evidently not on the same level. A clang is a mere abstraction, an element out of its setting. We never find it in the concrete except as part of an assimilation, and it is only as the basis for the higher and more complete process that it has any real existence. The union between the tones themselves, is, probably, as entirely physical as that between the letters in the words that were used in our investigation. They never come to consciousness without being supplemented and united with other elements; they lie below the level upon which apperception is effective. The connection, of course, can be regarded as 'associative,' but it never comes to consciousness until it

[1] Cf. Chapter II, §§ 1 and 2.
[2] P. 337.

reaches the higher stage. That it is, then, subject to apperception is shown by the facts connected with the hearing out of overtones, etc. Rhythm, on the contrary, stands on the higher level. It is a concrete process. Previous experience has usually given us successive sounds and their concomitant movements in varying intensities. Consequently we tend to hear all successions of sounds in some pattern, just as we tend to see all groups of letters as words. And the nature of the rhythm changes with the circumstances of the moment and the previous history of the individual, just as the changes in the letters are subject to these more general conditions. Wundt in this case, then, has been opposing an abstraction to a concrete process, or a subordinate constituent of a conscious fact to a conscious fact itself. (4) The concept and the assimilation are identical for psychology. We have in the concept, according to Wundt, a definite idea, which can change into and so represent any one of several ideas.[1] The same is true of the word that was read from the screen. We found numerous instances of the manner in which more or less definite images grouped themselves about the word when it was apperceived, and formed part of the whole of which it was the core. That several different ideas in varied settings could and did come up is sufficient to characterize the combination as a concept. The logical concept, *i. e.*, differs from the simple perception only in the fact that in the former case emphasis is laid upon its value as a representative of different objects rather than upon its psychological nature. Nor can the often raised objection that the concept is more general than the percept serve psychologically to differentiate them in kind. When, for instance, the word 'horse' is read and the reading is accompanied by ideas of horses at different times and places, it is just as much a concept as if the word is seen so imperfectly that no such associations are found, and the general term 'word' comes with the idea of various more or less definite words in other settings. Both are apperceptions; it is only that the control exerted by the general elements is more adequate in the former case than in the latter.

Of concrete simultaneous connections we have now left but one form, which includes all the others. And this is in every case the effect of an external stimulus which arouses numerous associates under the influence of external and internal conditions effective at the moment, and which may be traced to past and present experience. The differences that have given rise to Wundt's classification are not due in any

[1] Pp. 334 f.

degree to apperception, and several of them are foreign to the nature of the mental process as such.

The question of the relation between *successive* association and apperception is beyond the range of our experiments; but analogy and the experience of every-day life show that here, too, the differences either do not exist, or are not correlated with any differences in the amount or kind of apperception. It was pointed out in the course of our earlier discussion (Ch. II, § 1) that successive associations were but series of assimilations acting upon a central core retained from the preceding mental state. It is altogether probable, then, that apperception enters here as strongly as where the original impetus is given by an external stimulus, though the problem at present lies beyond the realm of experiment. We should expect that when the whole process is due to what we have called the subjective factors, the more general elements are more effectually operative than in perceptions of an external object: and introspection confirms this inference. It is also very evident that the course of connection between the different assimilations is controlled by the more general factors. This is confirmed by every-day observations. The course of a man's thought under given circumstances varies with his experience, recent and remote, his education and his character. Even in reveries and dreams we can trace the effects of surroundings and disposition.— Successive 'associative' connections, that is, almost certainly involve apperception.

The first of what are called the successive apperceptive connections is judgment. We must, however, agree with certain modern logicians that many of what are usually termed judgments are, psychologically, simultaneous, not successive processes.[1] It is fundamentally a mere concept. The exigencies of language alone are responsible for its apparent successiveness. When, *e. g.*, I see from the window a man walking in a certain direction, the image of the man, together with the direction he is taking and the whole setting of the picture, brings up the idea of the University buildings. The process is as much one, psychologically, as the idea of a stable when the word horse is read. In order to convey this picture to others I must break up the whole in the statement, "That man is going toward the University." It is necessary to give each of the parts a separate word; and the fact that sounds must be successive is the only reason for separating the unitary complex in this way. To argue from this to the conclusion that the judg-

[1] Cf. B. Bosanquet, "Logic," I, pp. 80 f.; F. H. Bradley, "The Principles of Logic," p. 12; H. Lotze, "Logic," I, pp. 59 f.

ment is always a peculiar process, is to raise a defect of language to the plane of a psychological law. It would be going beyond our brief, and also far beyond our powers, to develop a complete and detailed psychology of logic. But the above would indicate that the solution of the question lies in great part in the necessities and limitations of expression, and in the objective reference which logic must see in all mental processes. For psychology proper these differences do not hold.

While by far the greater number of our daily judgments are *not* judgments at all, in any peculiar sense, but mere assimilations or concepts, which take the form of judgment, there are at rare intervals processes in which active apperception is again at work upon the developed concept, and forms from it a *successive* process under the influence of the most general factors. This may be regarded as the prototype of the abridged judgment we have been discussing. As applied to *real* judgment, the previous description is, therefore, not quite correct. True, the succession does not lie where the older psychologists and grammatical logicians put it,—between subject and predicate; but the process is none the less a process which is consummated in stages by succession. Cf. Wundt's *Logik*, II, pp. 155 f.; Titchener's "Outline of Psychology," pp. 205 ff.

We are now in a position to formulate a scheme of psychology upon the side of intellect. (1) As the element of all cognitive states stands the *sensation;* admittedly an abstraction from concrete reality. (2) Next in order comes the *idea*, a compound or complex of sensations: this is also an abstraction. (3) The simplest form of connection between ideas is that of the *association*, which is, again, in no sense concrete. (4) Above association stands *apperception* ;—yet another abstraction representing the influence of general experience in consciousness, just as association represents the influence of particular idea upon particular idea. (5) The first concrete conscious process, and the process from which all these forms have been abstracted, is the *assimilation* or *perception*. This includes Wundt's associative synthesis, assimilation and complication, *i. e.*, all of his associative connections, as well as the apperceptive connections of apperceptive synthesis, the concept, the greater part of what are known as judgments, and probably agglutination also. (6) Beyond these simultaneous processes we have the successive chain of assimilations, and (7), at the highest stage of all, the true judgment.

All the concrete processes may be regarded as made up of sensations and ideas connected and unified under the influence of the very complicated interaction between association and apperception. Our answer to the problem of the relation between association and apperception, set in the introduction, is that both processes are artifacts, fictions, intro-

duced to explain the course of consciousness in the concrete; that both are the results of inference; and that association, in our sense of the term, is subordinate to apperception, and of far less importance than apperception for the production of any mental state. Although we have thus rejected for psychology many of the distinctions usually drawn between various forms of connection on the intellectual side of mind, we do not mean, however, thereby to recommend any change of the terms in current use. For pedagogical purposes, and to answer the needs of every-day life, distinctions within what we have called the assimilation or perception are very necessary. A perfectly good theory of the intellectual processes can be built up with association alone as *terminus technicus*, or with association and apperception together, provided only that the words are correctly interpreted. Our purpose is simply to insist on the one hand that conscious processes and their connections are not so simple as is usually supposed, and on the other that what are ordinarily known as the 'higher' and 'lower' processes are not different in psychological structure and mode of composition. Wundt's classification 'works,' and serves a useful end; our one serious criticism upon it under this head, is that it is not intrinsically psychological, and that its logical basis ought therefore to be made explicit.

In the preceding discussion we have intentionally avoided the introduction of any controversial use of the 'unconscious,'[1] and of Meinong's doctrine of '*fundierte Inhälte*.'[2] It would be well worth while to work over the results of our inquiry from other standpoints than that actually adopted; but the investigation would require far more space than is now at our disposal.

Mr. Stout's doctrine of apperception[3] is in many respects very like our own, and it may be well to indicate briefly the points of similarity and difference. Perception for Mr. Stout consists in the reception of a sensation into a 'system,' and apperception is the general term that covers the interaction between system and presentation or between two or more systems. The system, so far as it is conscious, is a unified group of sensations, and corresponds essentially to our 'perception' or 'assimilation.' We have no criticism to offer on the description of the effects and conditions of this complex process. The term 'system,' however, is also used by Mr. Stout to cover the *forces* which control the formation of the unitary group. The double use corresponds to the two meanings of apperception which we noted in the first Chapter of the present paper. The word is first applied to the force that directs perception, and then to the conscious product of this direction. 'Systems'

[1] Cf., *e. g.*, Külpe, "Outlines of Psychology," p. 291; Lipps, *Grundtatsachen des Seelenlebens*, pp. 125 ff.

[2] *Zeit. f. Psych. u. Physiol. d. Sinn.*, Bd. VI, pp. 340 ff. and 417 ff.

[3] "Analytic Psychology," Book II, Chaps. V-VIII.

are said to lie unconscious in the mind, and to receive and modify the presentation that finally enters into the 'system.' This apparent identification of result and condition seems to give rise to confusion in terminology, and tends to obscure the mechanism of the total process. It affords us no adequate idea of the play of forces involved. A second term could easily be found for the underlying dispositions which govern the formation of the conscious 'system' that would not carry with it any such doubtful implications. The remainder of the scheme of the intellectual processes is practically the same as our own so far as we can learn from a cursory examination, though the details are worked out much more fully.

There were a large number of misreadings of words during the experiments which could not be classified in any of the usual ways, and for which we could give no explanation. They must be regarded as due to events in the life of the subject that lay beyond the observation of the experimenter. It is, of course, not surprising that we were unable to trace *all* the forces at work, when we consider the comparatively short time that the subject was under observation, and how much of character is due to the experience in the remoter part. These cases are collected in Table XXII. They number (167) almost half of the entire number of misreadings. It may be well to compare them with the total number of experiments. We used 155 different words altogether, and made with these over 3,000 experiments. Not all, of course, gave definite results. Of the whole 3,000, 1,570 were either read as intended, or read correctly, so that they could be considered in the numerical Tables; and in 330 instances another word than that intended was substituted for the word shown. About eight per cent. of the entire number of readings, that is, were due to causes not given in the experiment itself, and to conditions that could not be traced by the experimenter.

The reader will doubtless find words in this Table which admit of an explanation that has escaped our own notice. We have thought it best to err, if at all, on the side of conservatism.

Summary.

Our problem was to investigate the nature of certain compound processes which Wundt has classed under the two heads of *associative* and *apperceptive connections*. We analysed experimentally the psychological processes involved in the *reading of a word*, an *assimilation;* and compared the factors which we found operative in it with those that are present in the other forms of connection.

Our experimental method consisted in the presentation of words containing misprinted letters. The factors concerned in reading fall into two great groups, *subjective* and *objective*.

TABLE XXII.

Unclassified Misreadings.

Word Shown.	Association.	Word Read.
	W.	
gossi	telltale	goose
mcroscope	telescope	horoscope
eanth	sky	zenith
	H.	
rtful	ingenious	truthful
manscript	book	narcotic
forxibly	*vi et armis*	furiously
aredibly	truthfully	reliably
uvermore	eternity	unnecessary
———	———	emerging
———	———	———
———	forever	everlasting
chxmnxy	house	opening
———	———	awning
reglnent	company	restaurant
Jxnxary	November	February
Sextexbex	August	October
	T.	
bossom	flower	bloom
latferly	lately	carefully
appxe	pear	spike
	C.	
pxinter	artist	thinker
aemotely	distantly	velocity
lrustily	trustworthily	faithfully

Word Shown.	Association.	Word Read.
	M.	
favox	grattitude	harm
onother	the same	probable
diapram	sketch	disprove
disase	illness	death
fellw	companion	friendship
gossi	telltale	gross
ovenage	mean	evening
biagust	loathing	bigamist
foyever	eternal	evermore
hasitation	doubt	habitation
cxmmonly	usually	casually
forxibly	vigorously	formally
somewhat	slightly	seemingly
regether	connected	regulated
lrustily	confidently	restfully
urgemtly	strongly	arrogantly
downwark	upward	earthward
xebxuary	January	Kalendar
rxtixa	eye	spectacle
———	cornea	catina
xeduxla	spinal cord	neurility
xexter	paper	heresy
hxsbxnd	father	bankrupt
chxmnxy	stone	church

W.

Word Shown.	Word Read.
inxpedient	incandescent
imrovement	increment
ecently	elegantly
cxmmonly	uncommonly
aredibly	incredibly
forxibly	foreignly
latferly	jaggedly
eath	sixth
evory	sorry
heroditary	hcterodoxy
xouxe	mouse
ramrob	raggot
hixtoxy	hickory
quxntxty	humflity
appxe	people
campaniov	astronomy
greal	real
M.	
aemotely	anomaly
inwrdly	warily
sidexise	sideways
whenevxr	whereupon
whatevea	whatsoever
regether	regular
kommonly	heavenly
oulright	allright
ordnary	scenery
xover	never
bxnker	barrier
clexer	clear
dexence	defiance
favox	fever
ctaze	assize
cottrn	custard
heavilo	danville
rtful	restful
disal	disable
eath	earthen
grade	degrade
fellw	awfully
ovenage	outrage
foyever	whenever
feathr	feature
xouxe	azure
xebxuary	auxlliary
Sextexbex	Shakespeare
sendeuse	condense
teachor	anchor

C.

Word Shown.	Word Read.
clexer	clover
dexence	safe....
onother	mother
chwter	shutter
evory	envoy
———	ivory
diapram	decorum
cottrn	cottage
besidn	lesson
nxious	noxious
disase	dissect
cutom	outlook
cotlego	cottage
wxnxer	tinker
FABRICATE	refrigerator
pertrtor	praetor
redluze	realize
infxnitx	intermit
ztubent	resident
fellw	folly
———	jelly
lrustily	density
mutright	sunlight
oulright	sunlight
vautious	various
remotelk	remodeling
bxnker	buckler
downwxrd	downright
T.	
monopolict	surplice
forxibly	forkily
downwark	dominant
shabbilw	ablish
mutright	intrigant
somewhat	semblance
gratefal	accidental
ramp	camp
grade	degraded
appxe	spoke
hopoful	chrystal
thoxsxnd	inkstand
clixate	eliminate
heavilo	heavilie

H.

Word Shown.	Word Read.
monopolict	osmopolitan
inwrdly	intensity
cxmmonly	seasonly
imrovement	informerly
ovtright	overhanging
kommonly	homology
nowadxys	hereunto
———	merchant
———	towards
lrustily	legislative
uvermore	overseer
vautious	virtual
wellnich	wellright
mutright	nutrition
neligence	intelligence
immensx	tincture
chwter	charter
clixate	nitrite
braft	trait
immensx	locomotive
ctaze	stagg
evory	syrup
favnr	fervor
heavilo	silver
eath	satin
disal	dread
besidn	beautiful
reglnent	treatment
———	negligent
soldoer	sudden
tomblo	trouble
xover	rover
eath	bath
biagust	bigamist
henius	helpful

The former make for completion of the letters seen, in accordance with the usual connection obtaining between letters, the nature of the word, and certain more general conditions of consciousness; the latter are derived from the letters themselves, and make for a literal reading. The following points were investigated:

I. Value of objective factors.

(1) The value of the letters as opposing or aiding the completion of the word varied:

(*a*) with their *position* in the word;

(*b*) with the *character* of the letter.

(2) The effectiveness of the different kinds of change in a letter to prevent the completion of the word stood in the order: omitted, substituted, blurred.

(3) The length and form of the word tended to call up a word directly.

II. Analysis of subjective factors.—The subjective factors form an ascending series, from least to greatest generality, in which the higher work upon those next beneath.

We have:

(1) the association between letters in the word;

(2) the word as a whole, derived by association from the fleeting general impression of length, form and the first letter, under the control of

(3) the more remote factors:

(*a*) an associated word called just before the word to be read was shown;

(*b*) the preceding word in the series;

(*c*) an earlier suggestion (this is valid only when several successive exposures were made);

(*d*) a word the subject had spoken or intended to speak immediately before the exposure;

(*e*) interesting events of the preceding day;

(*f*) the work of the preceding hour;

(*g*) the general disposition of the subject, which determined the way in which a called word of ambiguous meaning was understood, and so its effect upon the reading of the word shown; and

(*h*) the subject's knowledge that the words contained misprints.

III. Evidence of struggle between the two sets of factors was found:

(1) in the mutual cancellation of the different letters demanded by opposed factors;

(2) in the alternation between two letters; and

(3) in the persistence of both.

IV. Subjective and objective factors were found to possess characteristic attributive differences.

V. The word gave rise to certain peculiar effects upon consciousness.

(1) It fixed and made definite the letters, and seemed to connect them with the whole of consciousness;

(2) unless the letters were formed into a word, they could not be remembered; and

(3) in some cases, when the word was read, the letters were not perceived.

VI. Our general theoretical conclusion is that the same factors are involved in a great many of the forms of intellectual connection usually distinguished by psychologists; and that if the classificatory schemes in current use are to be retained, their retention must be justified on other than psychological grounds.[1]

[1] We are now engaged upon an analysis of the psychology involved in the modern logic from the standpoint of this investigation.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF LELAND STANFORD, JUNIOR, UNIVERSITY.

COMMUNICATED BY F. ANGELL.

COMPARTIVE OBSERVATIONS ON THE INVOLUNTARY MOVEMENTS OF ADULTS AND CHILDREN.

BY MILO ASEM TUCKER.

There is but little available literature upon involuntary movements. Stricker, Lehmann, Féré and Jastrow give some facts bearing either directly or indirectly upon the subject.

Stricker's observations, in general, are too well known to need citing here. He calls attention to the influence of the representation of moving objects. By remaining quiet and imagining that he moved, he experienced a sensation in those muscles involved in the actual movement.[1]

A further statement of Stricker's is that his remembrance of motion of inanimate objects is mostly associated with feelings in the muscles of the eyes.[2]

After describing many experiments, Stricker says that he cannot picture to himself any motion without calling into play, by that means, through the centrifugal impulse, the actual muscular feeling.[3]

Lehmann says: "The execution of a certain motion requires a comparatively strong concentration of attention on the idea of the motion and suggested motions take place only in the deeper stages of hypnosis."[4] He then draws a distinction between concentration of attention on the perception of motion and kinesthetic ideas. He says, "So long as I perceive and desire to perceive sharply, my attention is directed to the sensory apparatus. . . . If, on the other hand,

[1] Stricker, "*Bewegungsvorstellungen*," p. 12 ff.
[2] *Ibid.*, p. 17.
[3] *Ibid.*, p. 27.
[4] Lehmann, "*Die Hypnose*," p. 166.

I desire to execute a motion, then my attention must be turned from the sensory apparatus to that part of the sensorium where ideas of motion arise.[1]

Féré, on the other hand, experimented with a dynamometer. He says that the mass of his observations indicates that each time the cerebral centre enters into action, it starts the excitation of the whole organism, by a process still undetermined; and when we say the brain thinks, it is the whole body which enters into activity.[2]

Jastrow, using his automatograph,[3] found the following results: First, a general tendency for the hands involuntarily to follow, sympathetically, the movements of the eyes in glancing along rows of colors or points.[4] Second, a movement of the hands toward stationary objects to which the attention was directed.[5] Third, the movements toward the front and toward the body were more favored than toward the rear and away from the body.[6] Fourth, a tendency for the hands to move sympathetically with rhythmic motions.[7] Fifth, a variation in results with the individuals and the sense organ engaged.[8]

The apparatus with which the present investigations were made, is practically Jastrow's automatograph, with a slate substituted for the upper glass plate. The balls on which the upper plate rested were balls used for bicycle bearings.

The number of reagents tried by Jastrow and the proportion of cases which he called "typical" are not stated in his investigation. A more serious criticism is that any spontaneous tendency the hand might have to move in a given direction, was not previously determined. Before one can predicate anything in regard to the influence of representations of motion, it is first necessary to ascertain whether the muscles have a tendency toward motion in any given direction. For the purpose of determining and estimating this last point as well as for marking the general tendencies of motion, what may be called the field of movements, for the hands may be considered as a circle. The horizontal and vertical diameters were used as dividing lines. The semicircles above and below the horizontal diameter may be designated the positive and negative field respectively, and the

[1] *Ibid.*, p. 170.
[2] Féré, "*Sensation et Mouvement*," p. 25.
[3] Jastrow, AMERICAN JOURNAL OF PSYCHOLOGY, IV, p. 398 ff; V. 223 ff.
[4] *Ibid.*, IV, pp. 400-1.
[5] *Ibid.*, IV, pp. 400, 404.
[6] *Ibid.*, p. 407; V, p. 427.
[7] *Ibid.*, IV, pp, 402-3.
[8] *Ibid.*, p. 405, V, p. 230.

semi-circles to the right and left of the vertical diameter, the right and left field respectively. A record of angular degrees of movements was also kept.

Practically, like directions were given to all reagents. A seat was taken at the table upon which the apparatus was placed. The finger-tips of the extended hand were placed lightly upon the upper surface, at a convenient distance from the body, that is, at a distance where the reagent was not conscious of any muscular strain. The arm was not per-

TABLE I.

ATTENTION DIRECTED TO SOME STATIONARY OBJECT.

Number of reagents: Adults, 18; children, 13. Number of cases: Adults, 367; children, 164.

Position of Object.	Hands Used.	ADULTS.				CHILDREN.			
		Positive Field.	Negative Field.	Left Field.	Right Field.	Positive Field.	Negative Field.	Left Field.	Right Field.
Front	Both	35	19	18	36	11	14	12	13
	Right	26	28	39	15	10	11	13	8
	Left	24	26	12	38	4	20	7	17
Totals		85	73	69	89	25	45	32	38
Left	Both	20	14	16	18	5	11	11	5
	Right	19	17	21	15	2	14	10	6
	Left	16	17	18	15	4	12	7	9
Totals		55	48	55	48	11	37	28	20
Right	Both	15	18	10	23	5	10	5	10
	Right	15	21	18	18	1	14	11	4
	Left	19	18	10	27	2	14	2	14
Totals		49	57	38	68	8	38	18	28

mitted to touch at any point, but to remain in a comfortable, forward position. No attention was to be given to the hand, apparatus or other objects about the room, except to such as were especially named as objects of attention. The reagents were always ignorant of the purpose of the experimentation. Each reagent was questioned afterwards regarding the work. The movements were generally unconscious, and only those that could fairly be called involuntary were counted.

TABLE II.

CONSTANTS: ATTENTION NOT DIRECTED TO ANY EXTERNAL OBJECT.

Number of reagents: Adults, 18; children, 25. Number of cases: Adults, 314; children, 209.

Position of Hands.*	Hands Used.	Adults.				Children.			
		Positive Field.	Negative Field.	Left Field.	Right Field.	Positive Field.	Negative Field.	Left Field.	Right Field.
I	Both	21	10	14	17	8	14	16	6
	Right	23	15	25	13	4	19	18	5
	Left	17	22	12	27	7	18	12	13
Totals		61	47	51	57	19	51	46	24
II	Both	21	10	19	12	7	15	14	8
	Right	20	17	25	12	8	14	18	4
	Left	17	18	13	22	4	21	8	17
Totals		58	45	57	46	19	50	40	29
III	Both	15	14	15	14	8	15	15	8
	Right	20	19	19	20	8	17	16	9
	Left	15	20	11	24	4	18	7	15
Totals		50	53	45	58	20	50	38	32

*Arms forward; I, near body; II, moderately extended; III, full length.

In determining the physiological tendencies of the hands toward motion in any direction, the thoughts of the reagents were necessarily turned towards things that had no connection with ideas of motion of the hands or body. Accordingly, in getting at these "*constants*," as we may term them, the reagent conjugated French verbs, recited the multiplication table, hummed songs, or in the case of children, counted aloud. During this time the hands were held in the three positions indicated in Table I, to see what the difference would be, if any, in the results.

From Table I, it may be estimated that for adults there were 51.5% of the movements in the positive or forward field, while 48.5% were in the negative field. For children, the entire movements in the positive field were only 26.9%, while those in the negative field were 73.1%.

From Table II, representing constants, that is, spontaneous movements of the hands, we see that the total movements for adults in the positive field were 53.8%, while those in the negative were 46.2%. For children the corresponding movements were 27.8% and 72.2% respectively. The similarity in the movements between the times when the attention was directed and when it was what may be called distracted, is very striking. See Tables I and II, also Figure 1 of the Plates at the end of the article.

TABLE III.

TABLES I AND II COMBINED AND CONDENSED.

Number of reagents: Adults, 36; children, 38. Number of cases: Adults, 681; children, 373.

Hands Used.	ADULTS.				CHILDREN.			
	Positive Field.	Negative Field.	Left Field.	Right Field.	Positive Field.	Negative Field.	Left Field.	Right Field.
Both	127	85	92	120	44	79	73	50
Right	123	117	147	93	33	89	86	36
Left	108	121	76	153	25	103	43	85
Totals	358	323	315	366	102	271	202	171

In Table III, the results of the preceding series have been combined and condensed. The movements, though more in

number, remain practically the same. For adults, the movements in the positive field are 52.5%, and in the negative field 47.5%, while for children in the same respective fields the movements are 27.3% and 72.7%.

On examining these tables, one is impressed with the similarity of the movements in the right and left fields. Nearly the same results are to be seen in Tables I, II and III, but in Table IV the comparisons are more plainly shown. It is to be seen that when both hands are placed together the percents of movements are not far apart. An interesting fact is to be observed in the move-

TABLE IV.

COMPARISON OF MOVEMENTS IN THE LEFT AND RIGHT FIELDS.

Total number of reagents—74. Total number of cases—1,054.

HANDS USED.	ADULTS.				CHILDREN.				ADULTS AND CHILDREN.			
	Left Field.		Right Field.		Left Field.		Right Field.		Left Field.		Right Field.	
	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.	No. Cases.	Per cent.
Both	92	43	120	57	73	59	50	41	165	49	170	51
Right	147	61	93	39	86	70	36	30	233	64	129	36
Left	76	33	153	67	43	33	85	67	119	34	238	66

ments of the right and left hands. For adults and children, taken separately, the results are very nearly alike. For both together, the right hand moves in the left field 64% versus 36% in the right, while the left hand moves in the right field 66% versus 34% in the left. This means, of course, that normally both the hands and the arms move inwardly toward the median plane of the body.

These results are, therefore, contrary to those of Jastrow, from the best that we can judge from his work, since no tables are given. As was previously stated, Jastrow failed to determine any spontaneous tendency of the hands to move in a given direction. The movements here were not toward the stationary object of attention, unless the object was upon the side toward which the muscles normally contracted.

On examining Table V, some interesting facts are to be seen. Adults are much more direct in their movements than children. Of the adult movements, 71% are fairly direct, and

TABLE V.

RELATIVE DIRECTNESS OF MOVEMENTS.

Number of reagents: Adults, 36; children, 38. Number of cases: Adults, 668; children, 474.

HANDS USED.	ADULTS.				CHILDREN.			
	I*	II	III	IV	I	II	III	IV
Both	154	43	4	45	38	32	87	122
Right	164	74	4	58	37	28	92	127
Left	157	57	11	73	28	26	106	138
Totals	475	174	19	176	103	86	285	387
Totals in percent.	71	27	2	32	21	13	66	68

2% are very irregular, while 21% of children's movements are fairly direct, and 66% are very irregular. The changes of the original direction with adults are 32%, while with children they are 68%, as compared with adults.

An effort was made to see which hand, if either, influenced the motion more when both hands were placed together. The number of reagents for adults were 28, with 200 cases. Of the right-handed persons, 75 movements were to the left and 100 to the right. Of the left-handed persons, 10 movements were to the left and 15 to the right. With children, the number of reagents were 38, with 151 cases. The children were all right-handed. There were 85 movements to the left and 66 to the right.

The question now arises, can involuntary muscular movements of the hands and arms be influenced or controlled by visible motion? For testing this, inanimate moving objects were introduced. A small can or bottle was drawn along by a string, while the reagent watched it. The results are shown in Table VI, and also in Figures 2, 3, 4 and 5.

From the results in Table VI, it may be estimated that 87.9% of adult movements imitate the direction of the moving object, while 12.1% do not. Of the children 81% imitate, while 19% do not. If we consider the entire number of

*I,—Fairly direct; II,—Moderately direct; III,—Very irregular, and IV,—Original direction changed.

TABLE VI.

CONTROL OF INVOLUNTARY MUSCULAR MOVEMENTS BY THE INFLUENCE OF MOVING OBJECTS.

Number of reagents: Adults, 24; children, 24. Number of cases: Adults, 332; children, 170.

DIRECTION OF MOVING OBJECT.	HANDS USED.	ADULTS.		CHILDREN.	
		Following.	Not Following.	Following.	Not Following.
In front from side to side.	Right	100	14	65	16
	Left	88	16	61	16
To and from the body vertically and diagonally.	Right	30	3		
	Left	30	4		
Moving around a parallelogram or around the room in a circle: the number of reagents was 8 adults, 4 children.	Both	5		4	
	Right	20	1	4	
	Left	19	2	4	
Totals		292	40	138	32

the movements of adults and children, amounting to 502 cases, we find 85.6% are in imitation of the direction of the moving object, while only 14.4% are not.

In Figure 6 one sees how marked the imitation is when the object viewed was passed around the room. Not all adults imitate so readily, and the results of the children are often very irregular, but the general direction is marked. In some cases the hand nearly flew around in imitation of a rapidly rotating object.

There is another marked phase of the investigation. The reagent, after seeing the moving object, was asked to close the eyes and think of the object moving. The number of reagents was 13, and the number of cases was 56. Of these 55, or 98.2%, were in the direction of the motion thought of, and only 1.8% failed to imitate the direction. See illustration in Figure 5.

In certain individuals, the idea thought was strong enough

to call the body into corresponding action. The reagent was asked to think of playing a chord upon the piano. At once the hand moved to the right in a fairly direct way. On thinking of playing downward, the hand slowly moved to the left. The same individual was asked to read columns and rows of figures in various directions. The hand moved in imitation of the direction of the thought, but to a less extent than before. See Figures 7 and 8. Often there was, with other reagents, a slight imitative movement, but frequently the result was a straight line. The person who gave the most marked results said the idea of direction was the "most important feature" in the reading of the numbers, though "the shape of the figures impressed themselves."

In the case of a person who was successful in working the "Ouija" board or planchette, the answers to different questions were written out. The reagent, on being questioned, said the words written were "whatever came into the mind, and that the hand involuntarily wrote the thing which happened to be thought of at the time." See Figure 9.

Another variation is thinking of hidden objects. The reagent was told to hide a knife or a bunch of keys in some part of the room. On returning, the hands were placed as in the other experiments, and the person was to think of the hidden objects. With 4 reagents and 13 cases, there were 8 movements in the direction of the hidden object and 5 which were not. The most "successful" reagent said: "I did not think *so much* of the *place* of hiding, but of the *direction* I took to hide them." It will be seen that these various facts bear out Lehmann's views.

The cumulative force of a series of kinæsthetic ideas was shown in the following trials. The repetition of the sight of moving objects increased the susceptibility of the person towards imitation. From 22 reagents, 12 adults and 10 children, the following results were obtained: In 13 cases the direction was imitated after 1 repetition; in 9 cases after 2 repetitions; in 1 case after 3, and in 1 after 6 repetitions. With 2 adults the direction was not followed, in 2 cases after 2 repetitions; and in 2 cases after 3 repetitions; and with 4 children, in 4 cases after 2 repetitions. This, in part, probably substantiates Féré's statement that increased attention increases the force of the movement,[1] and that the energy of the movement is in proportion to the intensity of the mental representation of the same movement.[2] The sight of motion invites the reproduction of the movement, and the motion

[1] "*Sensation et Mouvement*," p. 18.

[2] *Ibid.*, pp. 44-5.

In the following figures B = both hands, R = right hand, L = left hand. The arrow, which indicates the direction of the object, either stationary or moving, as well as the letters are placed at the point of beginning.

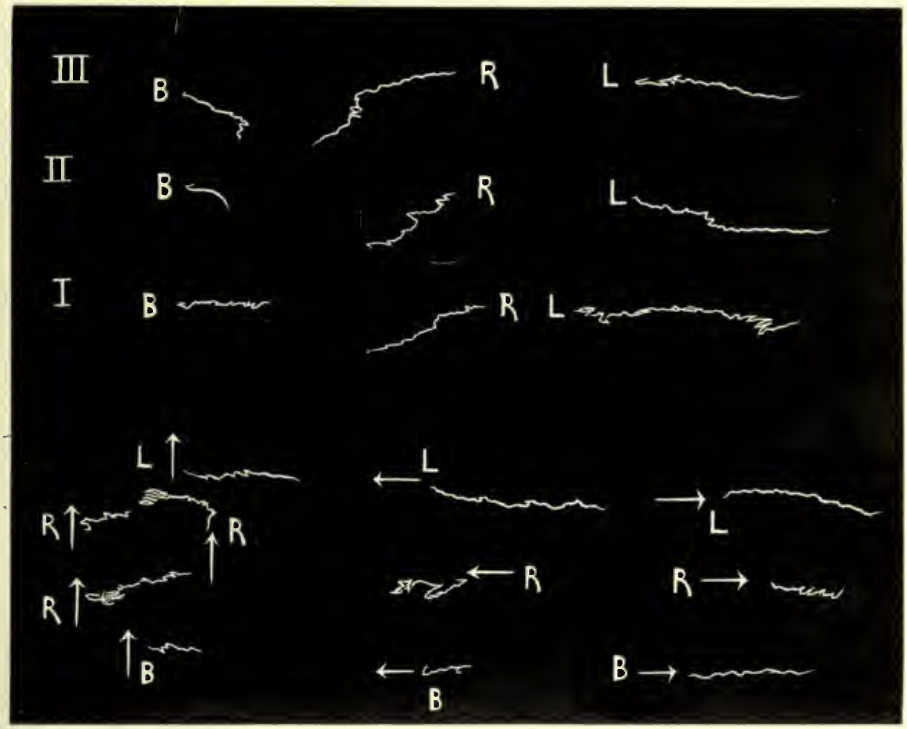

FIG. 1.

In the lower half, the reagent fixed the eyes and thoughts on a stationary object. In the upper half, the reagent closed the eyes and repeated the multiplication table. I = arms forward near body; II, moderately extended; III, full length.

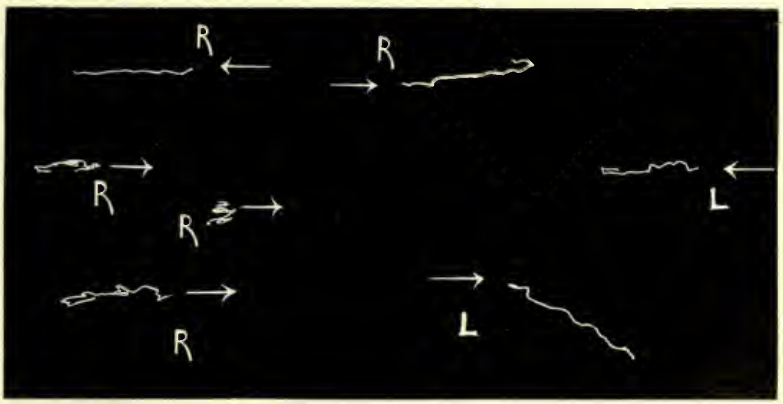

FIG. 2.

Reagent watching an object move in front. Failed to imitate the direction in the three trials in the lower left-hand side.

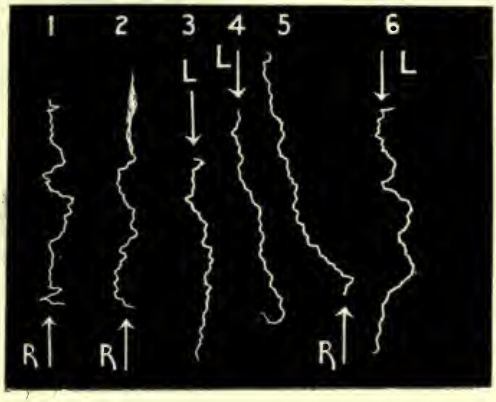

FIG. 3.

Reagent saw object moving in 1, 2. 3 and 4. In 5 and 6 the eyes closed and thought of object moving.

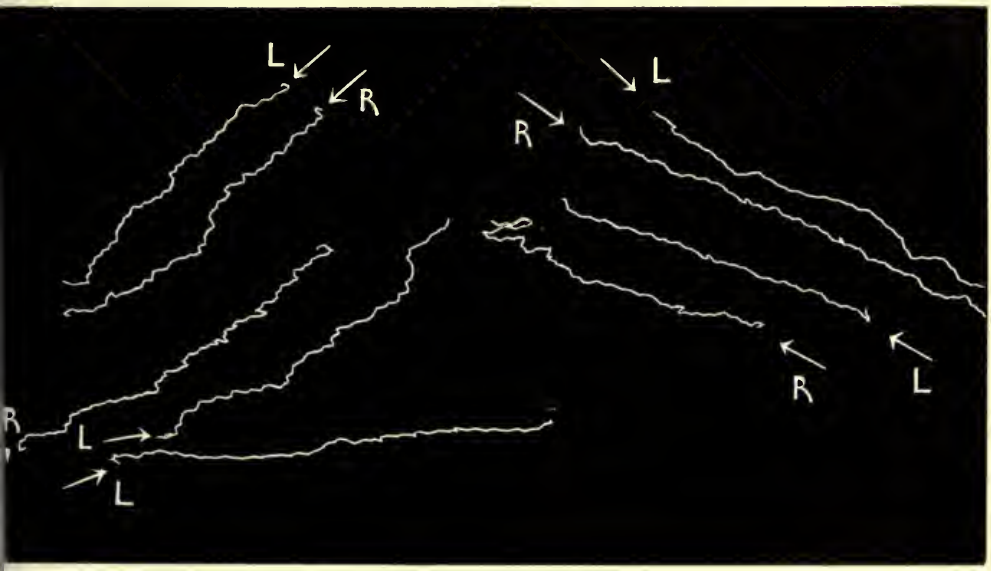

FIG. 4.

Reagent saw object moving at different times in various directions.

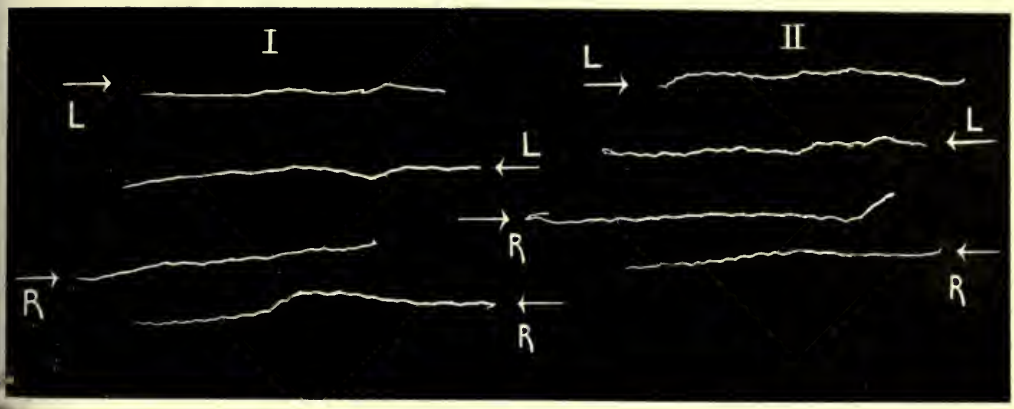

FIG. 5.

I. Reagent saw object moving.
II. Reagent closed eyes and thought of object moving.

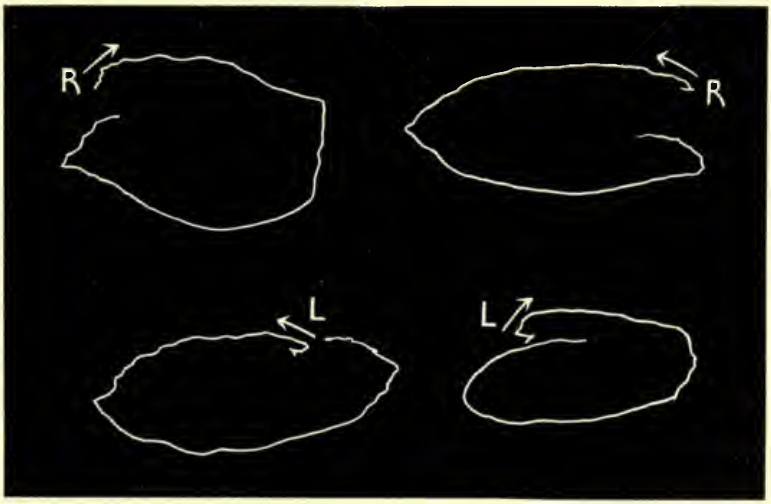

FIG. 6. (Half size.)

Reagent watching a person with an object move around the room in closed curves.

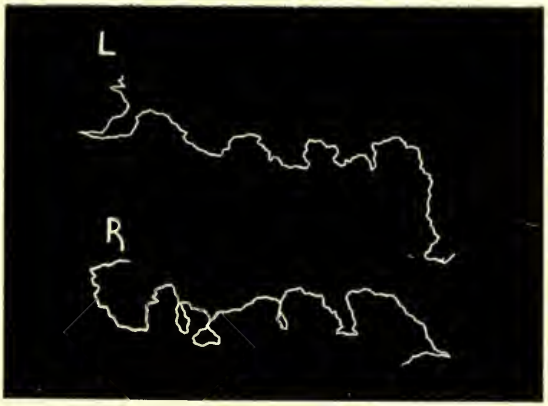

FIG. 7.

Reagent reading 11 columns of figures up and down.

FIG. 8.

Reagent reading 5 rows of figures back and forth.

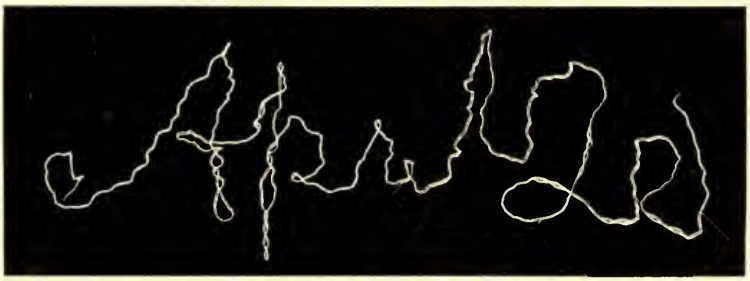

FIG. 9.

Reagent simply thought of the date, "April 20," and the hand wrote it in answer to a question requiring a date.

comes as an irresistible impulse or an inevitable consequence by the persistence of the idea.[1]

With six reagents in thirteen cases, where disturbances occurred or the attention was drawn to something else, the hand-movements were abnormal or there was no movement at all. When the reagents were tired, worried or confused, irregular results followed. In fact the experimenter could always tell by the irregularity of the lines when the attention of the reagent was distracted.

Figure 2 illustrates how the idea of motion is taken up. In seven trials Miss E. had given irregular movements three times and had followed the moving object four times. Between the third and fourth trial the cabman called for her. After finishing, the experimenter told her that she had not held her attention on the moving object in the first three trials. Somewhat surprised, Miss E. said such was the case; that the arrival of the cab had aroused her attention, so that she fixed it on the moving object during the last four trials.

Our investigations would indicate that the whole body moves when we think, though, of course, almost imperceptibly. Reagents often turn the head or sway the body so one can see them move at the same time and in the same direction as the hands and arms move. Especially is this often marked when they think of moving objects with the eyes closed. With children the head often nods and the face scowls. The tendency of the amateur bicycle rider to be "fascinated" by an obstacle is an illustration of this tendency in movements.

This view disagrees with Stricker when he states that the remembrance of motion of inanimate objects is mostly associated with the sensations in the muscles of the eyes. Yet we must remember that Stricker only observed the feeling by muscular effort, and had no delicate means of marking it. The view disagrees with Jastrow when he states that the hands tend to move toward stationary objects to which the attention is directed. The experiments tend to substantiate the views of Féré and Lehmann, as previously given.

To sum up:

1. There is a physiological tendency for the hands and arms resting in front of the body to move inward toward the median plane of the body.

2. There is no certainty that when we see an object we tend to move toward it. We may think of it simply as an object at rest, and the idea of motion is necessary to cause movement in that direction.

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[1] *Ibid.*, p. 45.

3. Involuntary muscular movements may be controlled by the influence of the sight or vivid visual remembrance of moving objects: and the imitation of the direction of moving stimuli is the result.

4. Children are govered by and subject to the same laws as adults, but to a less extent.

5. There is no sex or age difference in children, either in involuntary or controlled muscular movements.[1]

[1] The writer is under many obligations to Dr. Frank Angell for valuable assistance and many suggestions, as well as to Mr. W. S. Libby; also to Mr. C. J. C. Bennett, and the many others who kindly and carefully assisted in the experimentation. For the opportunity of experimenting with the children, the writer is indebted to the courtesy of the teachers of Mayfield, California.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY.

COMMUNICATED BY E. B. TITCHENER.

XII.—A STUDY OF CERTAIN METHODS OF DISTRACTING THE ATTENTION.

I.—ADDITION AND COGNATE EXERCISES: DISCRIMINATION OF ODORS.

BY F. E. MOYER, PH. B.

INTRODUCTION.

The experiments to be described in this paper were performed at the Cornell University during the academic year 1895-96. The ultimate purpose of the whole investigation, of which this is the first part, is to discover a reliable *measure of the attention* by means of some form of distraction which shall possess at least the qualities of (1) capability of gradation, (2) continuity and (3) possibility of general use with normal subjects. The present writer has tried only to accomplish the following: first, to examine the most commonly used form of mental distraction, addition, in order to find out if it affects all persons in the same way, and can therefore be considered a measure of the attention; and, secondly, if addition cannot be so considered, to examine other forms of mental distraction with the object of finding one which gives promise of possibility of use as such a measure.

The problem is an important one in every investigation into which attention and inattention enter. If the form of distraction used does not affect all the subjects equally, evidently the investigator will be dealing with varying degrees of attention, and, indeed, may not reach the state of inattention in any one of his subjects. To assume under such circum-

stances that all are completely and thoroughly distracted precludes, of course, results of any great value.

Several writers have recognized the inadequacy of our present methods of measuring attention. Thus Professor Külpe[1] remarks: "It is clear . . . . . that the mere employment of distracting stimuli of a certain intensity or number is absolutely no guarantee that a corresponding distraction of the attention has actually been accomplished. The discovery of a reliable measure of the attention would appear to be one of the most important problems that await solution by the experimental psychology of the future." Professor Stanley in an article in the *Psychological Review*[2] for January, 1895, raises the question: "What is 'full' attention? Is it a scientifically determinable state, and one which can be induced as readily as securing air full of moisture at what we term saturation point? How can the experimenter be sure of attention at a certain degree? The inexactness of experimental psychics as compared with physics is certainly great. The intensity of cognitive effort is neither easily discernible nor measurable." As yet, however, there has been published, so far as we know, no experimental investigation of the actual workings of a distraction. The present study, although brief and very incomplete, will, it is hoped, at least call attention to this problem as a fruitful one for exact experimental inquiry.[3]

Section I.—Addition as a Distraction.

The work for which addition was given as a distraction consisted in the discrimination of various shades of gray, procured by revolving black disks with white sectors. The amount of white in the disks varied from 65° to 115°. The experiments were given in a series of ten each, with differences of 10° and 15° in one series, 10° in another, and 5° and 10° in the third. The subject was allowed to look at each disk for three seconds, the interval between the showing of the disks being six seconds. No attempt was made to keep the interval between the experiments more than roughly constant.

The discrimination was made under varying conditions of

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[1] "Outlines of Psychology," 1895, p. 429.

[2] Vol. II, p. 53.

[3] Other papers dealing more or less directly with this problem of distraction of the attention are: Swift, E. J., "Disturbance of the Attention during Simple Mental Processes," Am. Journal of Psychology, Vol. I, p. 1. Smith, W. G., "The Relation of the Attention to Memory," Mind, N. S., Vol. IV, p. 47. Bertels, O., *Die Ablenkung der Aufmerksamkeit*, Dorpat, 1888.

distraction. Approximately 300 experiments were performed with each of three subjects.[1] In 100 of these no distraction was given, in 50 there was distraction while the first disk was being shown, and in another 50 distraction while the second disk was being shown. With the other 100 experiments the distraction began before the first disk was displayed, and continued until the second had been shown. In every case the subjects were requested to give as much attention as possible to the addition problems, which were read to them by the experimenter.

The results are shown in Table I, the figures representing percentages of correct judgments.

TABLE I.

Subject.	No Distraction.	Distraction. Shown 1st.	2d.	Distraction During Whole Experiment.
P.	75	73	75	59.5
		Average 74		
H.	84	82.5	74	77
		Average 78.25		
R.	74	81.5	86	85
		Average 83.75		

An examination of this Table shows that of the three subjects *P.* alone gives very nearly the results we might expect if we assume that addition is a continuous distraction, producing practically a state of inattention. And yet his average of correct judgments is as high when he was distracted while the second disk was being shown as when there was no distraction at all. The results of *H.*, if the average of the second and third columns be taken, show a slight tendency downward from the experiments with attention to those with 'inattention,' but the difference is much less than might be expected. Moreover, *H.* shows a higher percentage of correct judgments with distraction during the whole experiment than with distraction only while the second disk was being shown. *R.*'s results are the most surprising of all. If the average of the

[1] Miss H. I. Root (*R.*), Miss A. J. Hamlin (*H.*), Dr. W. B. Pillsbury (*P.*). [For the general plan of these experiments, see Miss Hamlin's paper on "Addition and Distraction," American Journal of Psychology, VIII, pp. 47, 53 ff. It may be mentioned here that the subjects in Miss Hamlin's investigation were Professor Hammond (*H.*, wrongly given as *A.* on p. 48); Mr. Moyer (*M.*); Dr. Pillsbury (*P.*); Miss Root (*R.*); Mr. McVannel (*V.*); Professor Margaret Washburn (*W.*). Mr. Moyer's subjects had, therefore, all had experience in work similar to his; and their results, though comparatively few in number, may be relied upon.]

second and third columns in her results be taken, as with *H.*, the three numbers,—74, 83¾, 85,—show that the judgment improves with increase of the amount of distraction. These results clearly show, first, that addition as a distraction affects different people differently ; and secondly, that it cannot be depended upon to produce uniform results, even with the same subject. These conclusions are also borne out by the notes taken while the investigation was in progress. As these notes explain, to a considerable extent, the numerical results given in the Table, some of the more important of them, particularly those which describe the actual effect of the distraction on the mental processes of the subject, are given here.

Especial care was taken to secure from the subjects as full a description as possible of the mental processes involved in the addition. (1) *P.*'s method of adding was somewhat peculiar. The addition as a whole seemed to be visual, but the actual process of adding was tactual-verbal. *P.* first visualized the numbers on a black background, the numbers themselves being white. They were not projected to any part of the room during the process ; but sometimes the subject had a vague, indefinite idea of the inside of his skull as a background, which at such times appeared black, and not red, as he usually thinks of it. As soon as the numbers have been visualized clearly, their visual images fade away and the actual process of adding begins. In adding 236 and 189, for instance, *P.* begins with the hundreds column. Without really adding the tens column, he "knows" that there is one to carry and says "4." Then he "thinks about the rest." The addition for a moment becomes indefinite and is partly automatic. The mind seems to relax between the first and second parts of the work. It is during these intervals between the partial results of the addition that the image of the disk, which had dropped out of consciousness when the numbers were first visualized, again comes in. But it immediately disappears as soon as the subject 'gets down to business' again, just before announcing the full result.—This description, although taken from the notes of an addition performed while the first disk was being shown, applies equally well to the other two cases. In adding during the whole experiment, when a number is given him to add to his first result, *P.* keeps the first result in mind, but usually thinks of the disk at the same time, and gathers up the fragments of its memory image as much as he can. The two processes conflict, however, and in addition during the whole experiment, the memory image of the first disk is, according to the subject's own account, very vague. This is borne out by the sudden falling off in the Table of his percentage of correct judgments

in distraction during the whole experiment. When the addition is given only while the first disk is being shown, he has plenty of opportunity to gather up the fragments of the image caught in the intervals of the addition, and so gets a fairly definite idea of it. The slightly higher percentage with distraction while the second is being shown bears out his statement that he did not pay as much attention to the addition in that case, because he was more interested in the disk, having had an uninterrupted view of the one first shown.

(2) *H.*'s method of adding can be best described by giving her own account of an actual case. The numbers given were 147 and 178. The first process was visual: she saw the 147 as if printed in black on a white background. The figures were situated at about the place from which the sound came. When the 178 was given, she seized on the 17 and saw it under the 14, but did not visualize the 8 at all. Then the addition began, as with *P.*, in the hundreds column. The 3 "comes" without any conscious process. She says the 3 aloud, and then continues, "4 and 7 are 11." This she both hears and seems to say. Then, "8 and 7 are 15, 25;" and the 3 having been already pronounced, the addition is complete. Evidently the process is visual-verbal at first, and afterwards auditory-verbal and tactual-verbal. In this case *H.* saw the disk after saying "4 and 7 are 11," but she not infrequently, especially towards the close of the experiments, saw the disks while adding; that is, she coördinated the two to a greater extent as she became more practised, so that the distraction became less and less effective. In direct contrast with *P.*, the adding at the end of the experiment seemed to *H.* the most distracting of all, because it came as an interruption and completely drove out the memory image of the first disk. The Table shows that her lowest percentage of correct judgments came in this column. In adding during the whole experiment, *H.* says that the memory image of the first disk goes entirely, but she is usually able to call it up at the end. The second addition in this case is usually slower than the first, because she cannot visualize with her eyes open, and so does not group the numbers very well. It is important to note, also, that the disk always seems clearer to her while speaking, and she frequently gets her best ideas of the disk when announcing results. In nearly every case she manages to catch an instantaneous glimpse of the disk at some time while it is displayed. These glimpses, indeed, seem to be her main reliance when she is adding.

(3) *R.*, in adding, visualizes the numbers as they are given, but, unlike the others, does not see them in connection with each other. In adding 127 and 236, for example,

she saw the numbers on a gray background (situated, probably, in the back of her head), but not in connection. The actual process is thus described in her own words : "I say 200+100=300. I do not make my lips move, but am perhaps conscious of hearing myself say them. Then I say 20 and 30 are 50, without connecting it with the 3 at all. Then, 7 and 6 are 13. Then I hear myself say : That would make 63. Then I take up the 3 and see the whole result." (When questioned on other occasions she was not sure that she saw the result.) The important thing to note in connection with *R.*'s adding, however, is that the thought object, the figures, and the real object, the disk, never interfere with each other. Ordinarily she says that she sees the disks just as clearly and remembers them just as well when adding as when not. And this sight of the disk is continuous, and not merely in the intervals of the addition. She frequently says: "I didn't have a moment free, but I saw the disks well." Indeed, the results would tend to show that the addition acts as a stimulus; and that conclusion is highly probable. There were times, however, when the addition acted as a real distraction. This occurred when some mistake annoyed the subject, or something in connection with the addition amused her. At such times she got only a general impression of the quality of the disk, not the usual clear memory image that she generally had.

Introspection and results agree, therefore, in pointing to the conclusion that addition as a distraction affects different subjects in widely differing ways, and that it is frequently no distraction at all. In some cases it may produce a certain degree of inattention, but it cannot be depended upon to produce equal states of inattention in different subjects, or in the same subject at different times.

Section II.—Other Forms of Distraction.

The work in connection with which the various methods of distraction described in this Section were used consisted in the discrimination of the intensity of two sounds, produced by the falling of ivory balls upon ebony plates. The balls were noiselessly released by an electrical attachment. The distance through which they fell varied from 25 cm. to 80 cm. The experiments were given in series of ten each, with differences of 10 and 15 cm. in the first series, 10 cm. in the second series, and 5 and 10 cm. in the third series.[1]

The forms of distraction used were addition, writing the

[1] See *loc. cit.*, p. 48.

words of a sentence in reverse order, writing the letters of a word backward, translation of simple sentences into a foreign language and writing the words and letters in a reverse order, and discrimination of odors. The details of each method will be described later. One hundred experiments without distraction, and fifty with each method of distraction, were performed with each of three subjects, *R.*, *Pa.* and *M.*, except in the case of the odors, of which 100 were given to both *R.* and *Pa.* Table II shows the results obtained, the numbers representing percentages of correct judgments.[1]

TABLE II.

Subject.	No Distraction.	Addition.	Writing Words of a Sentence Backward.	Writing Letters of a Sentence Backward.	Translation.	Discrimination of Odors.
R.	65	78	74	72	56	47
Pa.	77	69	69	56	68	60
M.	84	76	69	62	—	58

The distraction by addition was not quite the same as that described in Section I. In that case the numbers were read to the subject, while in these experiments the numbers were selected from logarithmic tables. The subject was directed to add across the page, selecting the figure next to the last in each group-column. In no case was the distraction at all serious, except with *Pa.* at times; and she frequently asserted that the selection of the figures, and not the addition, was what caused her trouble. These results agree, therefore, with those given in the previous Section in discrediting addition as a reliable method of distraction.

In distraction by writing the words of a sentence in reverse order, the sentence was read to the subject just before the first ball was allowed to drop. This distraction proved to be more effective than addition, but was not continuous; the attention was released, in good part, from the process just as soon as the reverse order of the words came into the subject's mind. The mechanical process of writing the word distracted to a very small extent only.

Spelling words backward proved to be fairly effective ex-

[1] The subjects are Miss Parrish (*Pa.*), Miss Root (*R.*) and Mr. Moyer (*M.*),—all highly practised subjects.

cept with *R.*, who did better with it than with no distraction. The distraction was more nearly continuous than in the case of writing words in reverse order, because the mind could not think very far ahead and then leave the rest to the hand. It worked particularly well with *Pa.*, who in eight cases out of fifty was unable to give any judgment at all, the distraction having driven all memory of the first sound from her mind.

The most complicated mental distraction given consisted in translating simple sentences into a foreign language, and writing both words and letters in reverse order. It was found best to let the subject translate into the foreign language with which she was most familiar, because inability to think of any form of expression at all results in poor distraction. *R.* therefore translated into Latin, and *Pa.* into German. Both subjects were uncertain about their judgments, although nearly always, especially in the case of *Pa.*, some attention was given involuntarily to the sounds. *R.*, who has devoted a good deal of time to Latin, was particularly interested in the work, and frequently became so absorbed in it that she did not remember the first sound at all.

The last method tried was the discrimination of odors. For this purpose thirty-three vials were provided, each containing about one dram of some essential oil or other easily procurable odorous substance. These were kept in a box at the side of the subject. At the signal "ready," the subject put the hand into the box, drew out a vial and uncorked it. As it was found that this operation required about four seconds, the signal " ready " was given four seconds in advance of the first sound, so that the sound and the first impression of the odor might be nearly simultaneous. The subject was asked to name the odor if possible, and, if not, to tell what it suggested. In case the name was thought of before the second sound came, the subject was requested to think of as many associations as possible in connection with the odor. This last was done to insure some distraction after the odor had been recognized, for it was found there was not time for the subject to attempt to recognize another odor.

Certain facts were apparent as soon as the work had been well started. Very faint odors, odors so well known as to be recognized immediately, and entirely unknown odors, do not make good distractions. A very faint odor is likely to start no train of thought at all; an odor which is immediately recognized ceases to hold the attention; and one that is entirely unknown fails to attract the attention, and so is practically no distraction. The most complete distraction is produced by those odors which are familiar, but the names of which

elude the subject. In such cases distraction is complete, because all the elements of good distraction—continuity, interest, a strong affective tone (annoyance, usually) and active thought processes—are present. To secure such distraction, odors of the kind described must be provided. It is well to have enough odors to avoid giving the same one twice at one sitting, and the stock must be revised daily for each subject. For this a large number of odors will be required, but any chemical laboratory can supply them. The results given in the Table do not, of course, show the best results possible with this method; the results from good and bad 'distractors' are simply averaged. But it seems possible that a series of odors could be made out for every subject, which should secure all necessary degrees of distraction, from minimal to maximal.

Summary.

The conclusions reached as a result of this investigation may be summarized as follows:

1. Addition as a distraction does not affect all persons or the same person at different times in the same way, and in some cases does not act as a distraction at all.
2. Practically the same thing may be said of writing the words of a sentence in reverse order, and of spelling words backward.[1]
3. Even so complicated a distraction as translating into a foreign language, and then writing both words and sentences in reverse order, does not produce results which show steady inattention. The best results reached with it were caused not so much by the complexity of the process as by the affective tone given to the distraction by the interest of the subject in the operation.
4. The method of distracting by requiring the subject to discriminate odors approaches most nearly of all the forms examined to the production of a state of inattention which is continuous, capable of gradations, and uniform. With care in the selection of the odors given, the method may quite possibly furnish the measure of attention required for experimental work.

[Note.—During the present year, 1896-7, a special investigation into the efficacy of odor-series for distraction is in course in the Cornell Laboratory.—E. B. T.]

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[1] Table II shows that *R.* gives better results with distraction than without it, except in translation and discrimination of odors.

XIII.—AN ATTEMPT TO TRAIN THE VISUAL MEMORY.

By Ellen Bliss Talbot.

During the university year 1895-'96, I made a systematic effort to overcome some of the defects of my visual memory. The results gained are not startling, but a brief account of the experiment may be useful to others by way of suggestion.

At the beginning of the year, my attention was called to the fact—which had never particularly impressed me before—that my visual memory was rather defective. Unfortunately, at that time I had had no training in introspection; and in describing my memory as it was before the beginning of the exercises, I must rely somewhat upon subsequent recollections instead of depending wholly upon introspection made at the time. Where this has been the case, however, the fact will be explicitly stated.

The chief points that I noticed in regard to my memory were these:

(1) It was predominantly verbal-auditory and verbal-motor, with the first factor a little in the lead.

(2) The direct visual memory was somewhat developed, though not to the same degree as in most persons. *E. g.*, the name of some one whom I knew rather well would almost invariably call up a visual image, and with some effort I could make its details (form and color) fairly distinct. On the other hand, as I now see upon looking back, class-names very seldom called up a visual impression.

(3) My verbal-visual memory was very defective. Dates I ordinarily visualized, but not words. So far as I know, I had never at this time had a visual picture of a written or printed word. Of course it is possible, however, that, just as one may have a visual local sign without being aware of it until one's attention is called to the matter, so I may have had verbal-visual images, which served their purpose in associations without rising into distinct consciousness.

(4) When I was listening to something that was read aloud, my impressions took the form almost exclusively of verbal-auditory and verbal-motor images. I never consciously visualized the words uttered by the reader, and only rarely did I picture objects or scenes represented by them. What I seemed to do, for the most part, was to hear the words again in my own voice and to feel them forming in my throat. This was the case, at least, when I was listening to anything that was somewhat hard to follow. When listening to something simpler, I was less often conscious of translating from the reader's voice and intonation into my own; but even here, I had few direct visual and, I think, no verbal-visual images.

Professor Titchener, whom I asked to recommend some exercises for training the visual memory, suggested two, both of which were used. In each of them I worked with a companion whose visual memory was also defective. The account will be confined, however, to my own case, as my visual memory was the poorer of the two, and as the results were more marked with it than with the other.

For one exercise, we used poems containing lines of very unequal length. One of us would read to herself a few lines, paying special attention to their appearance on the page, then close her eyes and describe to the other the position of the lines, their relative length, and any other details that had been noticed with regard to the general appearance of the page. The assistant would draw the lines as directed; and when this had been done the result would be compared with the page in the book and all mistakes marked.

In the other exercise we used colored Japanese pictures. One of these was exposed to the view of the subject for ten seconds, and she was then required to indicate by a rough sketch, supplemented by an oral description, the distribution of colors in the picture, and, as far as possible, the objects represented. The assistant compared the sketch with the original without showing the latter to the subject, and passed judgment upon the value of the work.

The amount of time given to these exercises was from one and a half to two hours a week. To the pictures we usually gave two periods of thirty minutes each; and to the poetry two or three periods of from twenty to thirty minutes each. The exercises were continued from the latter part of October till the middle of May. There were two breaks, however, of about three weeks each; and during the rest of the time we were not able to practice so regularly as might have been desired.

With the poetry my work improved steadily from first to last.

At the outset six or seven lines was as much as I could keep in mind at once; near the close of the work I could sometimes give from twenty to twenty-five without a mistake. It must be confessed, however, that I did not always succeed in making my memory purely visual; often I found myself remembering the length of a line in terms of eye-movement.

With the pictures the progress was not so evident. Naturally, it was harder in this case to say whether one was improving or not; especially as each picture in the set was given several times. I am inclined to think that there was a slight improvement, but it certainly was not marked.

The direct results of the exercises, however, did not particularly concern us; the task had been undertaken rather for the sake of the indirect results. About three months after the beginning of the work I noticed that the visual factor was usually, if not always, present when I tried to spell a word orally. Shortly after this it occurred to me to make a definite attempt to visualize words. I found myself able to visualize familiar ones of three or four letters, but when I tried a longer or less familiar word, the best that I could do was to spell it out letter by letter instead of seeing it as a whole. At this time the visualization of even short words came only by definite effort; at least, I was never conscious of visualizing them without trying to do so.[1] Toward the close of the university year, however, I found that with a slight effort I was able to visualize long words as wholes, and that occasionally, without any effort, I had a visual image of a word of several syllables. Somewhat later, when the exercises had been discontinued for about four months, I began to visualize words a little when listening to a reader. At the present time, seven months after the conclusion of the work, I notice considerable improvement, both in the direct visual and in the verbal-visual memory. In attempting very recently to commit some poetry, I found myself depending to a considerable extent upon my verbal-visual memory, whereas a year and a half ago I should have relied wholly upon my verbal-auditory and verbal-motor memories. The effect of the change was apparent rather in greater accuracy than in increased speed of memorizing. In my general reading, too, I have more

[1] The ability to visualize short words and the presence of the visual element in oral spelling do not necessarily indicate any improvement. Perhaps if I had thought of trying to visualize words before the exercises began, I should have been able to do so. As for the spelling, I became conscious of the visual element in it in consequence of a question that was asked me; and it may very well be that if the question had been asked three months earlier the visual element would have been discovered then.

pictures than I used to have. I am not conscious of visualizing any *better* than formerly—*i. e.*, with any more detail,—but I am conscious of visualizing *more frequently*.

It should be observed that while the exercises seemed more likely to affect the *direct* visual memory, the greater improvement and the one first noticed was in the *verbal*-visual. This may be due to the fact that the verbal-visual memory was the more defective, and that therefore a slight improvement in it would be more likely to attract attention.

It is difficult, of course, to say how much of the improvement should be attributed to the use of the exercises, and how much to the fact that I have begun to pay attention to my visual memory and have been on the alert for instances of its working. However this may be, I am sure, at any rate, that my conscious dependence upon it is greater than it used to be, and also that it comes into play, without effort on my part, more frequently than before. It is still the case that my memory is predominantly verbal-auditory and verbal-motor; but the visual memory has improved; and there seems to be reason to suppose that the improvement has not yet come to an end. Moreover, I cannot see that the auditory and motor memories have suffered any loss from the improvement of the visual.

PSYCHOLOGICAL LITERATURE.

I.—BOOK NOTES.[1]

(G. S. H.)

The Energy of Living Protoplasm. By OSCAR LOEW, Ph. D. London, 1896, pp. 116.

The author, a professor in the University of Tokio, argues that the death of protoplasm is analogous to the change of a labile substance to stable form by atomic migration. Aldehydes poison living, but have no action on dead substances, while labile amido groups are poisonous for living and also act on dead protoplasm. There is great activity in the form of oscillation of certain atoms in labile position in the proteids of living matter which leads to respiration and is intensified by it. This is the source of vitality, and is one of the vicissitudes of solar energy.

The Cell, its Development and Inheritance. By EDMUND B. WILSON, Ph. D. New York, Macmillan & Co., 1896, pp. 371.

This is the fourth volume in the Columbia University biological series, and appearing so soon after Campbell's translation of Hertwigs' book on the same subject, seems to invite comparison. Wilson's work is more attractively bound, better indexed, more copiously illustrated with better drawings (139 cuts), etc. Despite the author's modest disclaimer in the introduction, his book is an admirably full and clear treatment of the modern cell doctrine, and is almost a godsend to the few psychologists who are turning more and more to biology for their foundations. The general impression left on the present writer's mind after a pretty full and careful study of the book is that the present limits of microscopic vision are so strained and the field of meta-visual conjecture so assiduously cultivated that the signs are that this field, which has been so cultivated of late, is liable to gradually take a less prominent place, and other lines, less overworked, to come to the front.

Le Déterminisme Biologique et la Personalité Consciente. Par FÉLIX LE DANTEC. Paris, 1897, pp. 155.

This is an amplification of the conclusion of the author's "New Theory of Life," published last year. There is a fixed and immutable conscious element in atoms which is aggregated into a molecular consciousness, and so on up to plastidules and nervous systems. This makes it possible to explain the epiphenomenon of mind in man, which can also be explained without admitting anything contrary to chemical determinism. There is no mysterious intervention of an immaterial principle. Psychic phenomena are inactive witnesses, and their study is useless in aiding the study of life. If

[1] Notice in this section does not preclude fuller notice later.

bodies conserved all their properties exclusive of consciousness, all would happen just the same. Brain matter is subject to physical and chemical laws exactly like all else, and if we could construct one of the same matter arranged in the same way consciousness would be its property.

Étude sur l'Hérédité Normale et Morbide. Par I. ORCHANSKY, Prof. Agrégé à Charkow. St. Petersburg, 1894, pp. 2 w. quarto.
L'Hérédité dans les Familles Malades, et Théorie Générale de l'Hérédité. Par I. ORCHANSKY. St. Petersburg, 1894, quarto.

These elaborate *mémoires*, with scores of tables and twenty pages full of curves and other ingenious and original methods of graphic presentation, constitute altogether one of the most comprehensive summaries of current theories of heredity known to us, but they are chiefly devoted to extensive researches of the author mostly among Russian peasants. Measurements of different parts of the skeleton are fullest and best, but atavism, sex and diseases receive much attention.

Matière et Mémoire. Par HENRI BERGSON. Paris, 1896, pp. 279.

The long discussion has been whether memory is a function of the brain or not. This the author attempts to solve by suggesting that the recognition of images is a cerebral act and the revival of them an act of spirit. The work is chiefly theoretical, and its point of closest approximation to concrete fact is in the domain of aphasia.

Angio-neurosis. By W. RAMSAY SMITH, M. B: C. M: B. Sc. Bristol, 1897, pp. 78.

To urticaria, hay-asthma, Graves' and Raynaud's disease the author adds angio-neurotic œdema and erythema-urticaria; and discusses heredity, peripheral irritation, emotion, toxis and climate as factors. The action of the vaso-constrictor nerves stimulates the vaso-dilators near by and causes hyperæmia or effusion.

The Physiology and Pathology of the Cerebral Circulation. An experimental research, by LEONARD HILL, M. D. London, 1896, pp. 208.

Dr. Hill, with a new trephine tube, showed that cerebral pulsation is least when the intra-cranial tension is normal, and that increased tension of the duramater decreases the cerebral pulse. The brain expands by the ebb of the cerebro-spinal fluid into the less rigid vertibral canal. Experiments on filtration by injection show that the brain and cord could be harmlessly irrigated through one opening and at low pressure, so irrigation is suggested for high tension diseases like meningitis. Cerebral anæmia is probably not due to arterial spasm, nor are there vaso-motor nerves in the brain. Pressure and volume change very little. Arterial hyperæmia, unlike venous congestion, is of slight significance. The brain does not transmit pressure equally in all directions.

Gehirn und Seele. Von Dr. PAUL FLECHSIG. Leipzig, 1896, pp. 117.

This is a second revised and enlarged edition, with fine plates, of an address delivered in Oct., 1894. It embodies the essential results of years of painstaking research, and shows real and important progress since the publication of the *Leitungsbahnen*, but less than the writer's best friends hoped and expected. It is devoted to new

or better defined motor tracts, tracts for hearing, seeing, smelling, touch and special association fibres within the left hemisphere. From the tactual cortex the author thinks he has also traced sensory nerves for muscles and intestines. These latter and the lateral fibres are widely and chiefly irradiated in the third frontal convolution.

Die Motorisches Wortvorstellungen. Von Dr. RAYMOND DODGE. Halle, 1896, pp. 78.

After a special analysis of motor sound concepts, the author discusses in successive chapters word concepts during speech, hearing, reading and writing. It is a careful, detailed experimental study, which makes original contributions of value, and which merits fuller presentation.

De L'Aphasie Sensorielle. Par le Dr. C. MIRALLIÉ. Paris, 1896, pp. 220.

This *mémoire* is from the laboratory of Dr. Dejerine, from whom a very extensive *mémoire* covering the entire field is awaited with great expectation. The best part of the present work, if we except the bibliography, which is by far the best yet made, is the carefully described cases with autopsies and the actual localizations in the cortex, and especially fibres to which they seem to point. The diagrams are not schematic, but anatomical.

Recherches sur l'Epilepsie, l'Hystérie et l'Idiotie. Par BOURNEVILLE. Paris, 1896, pp. 254.

This is the sixteenth annual publication of the most important work and cases of the Bicêtre Hospital, and contains thirty-one figures and eight plates. Best of all are the accounts of the peculiar educational methods in singing, excursions, plays and games, museum for instruction in things, dancing, the use of fun, simple drawing, pyramid of pegs, balls in holes, savings, visits, and other details.

La Contagion du Meurtre. Par PAUL AUBREY. Paris, Alcan, 1896, pp. 303.

This study in criminal anthropology, with a preface by Corre, is a well put up volume with good index, literature, etc., which tries to assign to the press, the witnessing of public executions, intercourse among prisoners, and the family, each its relative prominence as a factor in the contagion of murder. Part II shows the effects of contagion in the methods, of the revolver, poisoning, infanticide, suicide, duels, etc.; and the third part is devoted to war, anarchy, regicides, crowds and social influences. In some parts of Italy murders increase directly as the number of strangers. This country figures prominently. Several curious cases of suicide for fear of death are given. Dual murders and murder with rape are suggestively treated. It is a work of facts and cases rather than of generalizations.

Le Diagnostic de la Suggestibilité. Par le Dr. L. MOUTIN. Paris, 1896, pp. 110.

This dissertation first argues that recent hypnotic studies have shown psychic factors hitherto unknown in many diseases, briefly digesting recent literature, with a good bibliography arranged by years. The second part argues for a hitherto unknown property of

the nervous system which acts at a distance like heat, light or electricity, and is very effective with some cases.

The Mystery of Sleep. By JOHN BIGELOW. New York, 1897, pp. 139.

Sleep is not merely for rest, but "the nighttime of the body is the daytime of the soul." It has much to do in developing the soul's waking time. The art of sleeping will be taught and studied as systematically in schools of the future as physiology now is. It makes us unworldly and tends to spiritual regeneration. At the ages when the mind is growing fastest, most hours of sleep are needed. Life must be quietly ordered so as to get most benefit from sleep, and even to sleep in church may not be so bad. It is perhaps Swedenborg's internal inspiration. We are nearer to God and to visions.

Alterations of Personality. By ALFRED BENET. Tr. by HELEN GREEN BALDWIN, with notes and preface by J. MARK BALDWIN. New York, 1896, pp. 356.

It was a happy thought to put this valuable work, already well known to experts especially interested in its theme, into good English, as is here done.

Bird-Lore Echoes. By C. C. ABBOTT. Philadelphia, 1896, pp. 270.

A volume of bird portraits, illustrated by W. E. Cam. It is chatty, full of love of not only birds, but nature, with incidents and sometimes anecdotes and much valuable observation. It is the work of a field ornithologist ranging over limited but well populated acres.

The Evolution of Bird-Song, with Observations on the Influence of Heredity and Imitation. By CHARLES A. MITCHELL. London, 1896, pp. 253.

Voice originated as involuntary movement in combat. The puff, hiss, etc., became a menace, and alarm cries arose. The call notes came later, but are rare with great singers. In breeding season they are repeated and varied, and strains arise. Small male tree birds who are mature, and in morning and evening, produce most bird music. Stately, big and laborious birds sing but little. The songs of allied species resemble each other, and many birds imitate others more or less. In the song of the same species and of the same bird there are great variations. Some songs seem entirely perpetuated by imitation and others are purely innate. There are many similarities between bird songs and the elements. Some show traces of our scale. One thrush sang sixteen hours in one day. Calls and alarms are first acquired and least varied, and show wider affinity between species than do songs. One commonest note shows a common ancestry. Often birds begin and end their one song by imitation of other birds, and they imitate oftenest in morning and spring. We can predict the hours of the first morning song to almost a minute.

Psychologie du Caractère. Par A. LÉVY. Paris, 1896, pp. 207.

The author of this contribution to ethnology is a doctor of philosophy and letters at the University of Brussels. After discussing ethnology and character in general, he first considers the natural factors of character or temperament and heredity, and then the three social or acquired elements of the original, social and personal factors, and finally discusses pure and mixed psychic types.

He is widely read and writes clearly, and his digest of contemporary opinions (for little more is attempted) is convenient and instructive.

Anregung zur Reform der Physiologie des Menschen. By Dr. F. JEZEK. Stuttgart, 1896, pp. 192.

This rather amazing work is devoted chiefly to the physiology of nutrition, including the physiological causes of metabolism, digestion and respiration. Some of the current doctrines this author thinks to subvert are those of resorption through chyle vessels and through the portal vein, the filtration of urine in the kidneys, and the origin of the bile. The author's view is that change of pressure and electricity, which experiment shows to be generated in the alimentary canal, are factors in digestion. He finds electro-chemical forces in every stage from mouth to anus, and also from the blood to the cell, as the place of final deposit, as well as in the details of respiratory and circulatory mechanism, where electrical pressures are dominant.

Pensée et Réalité. A. SPIR. (1837-1890.) Paris, 1896, pp. 566.

This essay toward the reform of the critical philosophy is translated from the third German edition by A. Penjion. The end of philosophy is to produce certainty: but mediate rests on immediate certainty, so the former is the primal quest. The author's great work has excited great interest, and is almost a new system of philosophy. The principle of identity expresses the law of the absolute, which rules consciousness like the sun. It makes valid the only proof of God, viz.: that of Descartes. Theism is the condition of all logical thought, which can explain all but the imperfect. The unconditional is one, and not the general being of pantheism.

Empfinden und Denken. Von A. RAU. Geissen, 1896, pp. 385.

This is a physiological study of the nature of the human understanding, and treats quite fully the pros and cons of the specific energy of sense nerves, vitalism and spiritualism in Lotze's sense, Helmholtz and tone sensations, with a final chapter on the philosophy of sense. Thought is repeated but sublated sensation. Like the works of so many anthropologists, this book is largely made up of quotations and digests, and the author claims everything human as the domain of his science.

L'Immanence de la Raison. Par GÉDÉON GORY. Paris, 1896, pp. 346.

Like Spir, this author seeks to clear up the sensible world by introducing the idea of being and the sovereignty of immanent intelligence. But for the spark of reason all is dark. Let us fear it piously, for it is God in us, and He is all, absolute, one, perfect and infinite. Piety is not servility or mutilation, but using our glorious liberty as divine thinking beings that God may reveal Himself. Theology is the metaphysics of the perfect, cosmology the metaphysics of the infinite, and monism is the metaphysics of the one, or the *Tout Absolu.* To free thought and keep it supreme is to advance God's kingdom. God lives in nature, but His perfections are human because rational. If we are free we free God, personality must not limit Him.

Théorie de l'Ame Humaine. Par J. E. ALAUX. Paris, 1896, pp. 557.

The author's psychology is confessedly metaphysical, dealing with the nature origin and destiny of the soul, and he assumes that the

problem of materialism versus spiritualism is a badly stated one. The soul is eternal and immortal, both power and substance endowed with freedom and conscience. The other aspect of this Algerian professor's metaphysics is theology, and this will follow in another book.

Die Autonomie der Moral. Von Kr. B. B. Aars. Leipzig, 1896, pp. 123.

The feeling of guilt is the author's dominant idea. It involves a sense of the causality of the will and of the constancy of the ego. The acts are outer forms of self, and the total ego is expressed in its total acts. A *realized* form may be in some degree extinguished, but not entirely escaped. The sense of guilt thus has but partial justification.

Christian Ethics. (Bampton Lectures.) By T. B. Strong, M. A. London, 1896, pp. 380.

The Christian Ethics is a new life based on the radically new fact of the incarnation, and this book is a detailed presentation of this fact in relation to first, the end of life and human nature; second, the theory of virtue; third, the idea of evil, and fourth, the general order of the world. To separate Christian life from Christian truth is to relapse to paganism.

Die Freiheitslehre bei Kant und Schopenhauer. Von David Neumark. Leipzig, 1896, pp. 89.

Freedom and the reality of the external world are the two problems of contemporary philosophy. If causality is an intelligent mechanism, then moral freedom does not treat of the texture of experience. Kant makes the free act a choice, Schopenhauer an essence. This thesis attempts only interpretation.

Hegel's Philosophy of Right. Tr. by S. W. Dyde. London, 1886, pp. 365.

The translation has appended a convenient index of topics and a still more to be desired index of German terms, with the translation of the same. The paragraphs proper, as Hegel wrote them, the notes, and the additions taken from students' notes of the master's explanations and illustrations, are wisely distinguished throughout. It is tasteful and well printed.

Studies in the Hegelian Dialectic. By John McTaggart Ellis, M. A. Cornhill (Eng.), 1896, pp. 259.

Four of the seven chapters are based on the author's doctoral thesis in 1891. Perhaps the most valuable and certainly the most interesting part of this work is the application of the dialectic to nature, history and religion. All true philosophy must be mystical, but its methods must be clear, and its purpose is to imitate, although it cannot grasp an ultimate harmony between knowledge and reality.

New Essays Concerning Human Understanding. By Wilhelm Leibnitz. Tr. by A. G. Langley. New York, Macmillan & Co., 1896, pp. 861.

This is a very convenient and timely work with helpful notes, and an appendix of nearly 200 pages of translations of his minor papers on various subjects from the original Latin, French and

German, also with notes embodying the results of careful scholarship.

Jacob Froschammer. Von F. FÜRTH. 1896, pp. 98.

This is a good picture of the great philosopher of the imagination. His life, writings, and philosophy in general are briefly treated in the first 39 pages, and a clear *résumé* of his pedagogy follows, in about 50 pages. The influence of his philosophy and a few illustrative quotations conclude the work.

Lehrbuch der Psychologie. Von FR. JODL. Stuttgart, 1896, pp. 768.

This is still another general text-book on psychology, with nothing to especially justify its appearing except the author's standpoint. In its nearly 30 pages of literature there are startling omissions; topics that to many psychologists seem cardinal nowhere appear. The chapter on speech, and to some extent that on will, seem to the writer inadequate. The author is first a philosopher, and psychology is only one branch of his field, and he apologizes in the preface for treating the senses at such length, as this is a department of physiology to which he can contribute nothing new, but suspects of confusion, speculation and inaccuracy. Despite its obvious defects, the book has a value, however, which grows as we turn its pages, and for the student and teacher of secondary schools to which it is addressed, it has on the whole high merit, and the semi-Herbartian point of view sheds many interesting side lights.

Essai sur les Fondements de la Connaissance Mystique. Par E. RÉCÉJAC. Paris, 1897, pp. 306.

After describing divers attitudes of the mind toward the absolute, especially the mystic, symbols, inspiration, the heart and conscience are discussed as organs of knowledge. The present alternative is science or inspiration; the author prefers a God sensible to the heart.

A Study of Kant's Psychology with References to the Critical Philosophy. By EDWARD FRANKLIN BUCHNER, Ph. D., Lancaster, Pa. Also Supplement No. 4 to the *Psychological Review.* Jan., 1897, pp. 208.

This is a Yale dissertation and treats Kant's psychological problem, the phase of psychology in Kant's Encyclopædia, Kant's positive conception of psychology and empirical and rational psychology, and is a very careful, valuable and interesting study, and like all the work of the *Psychological Review*, most attractive also in type and paper. It is pleasing to see that it is written with so frank a recognition of Kant's lamentable underestimation of the value of psychology in solving metaphysical problems.

Psychic Philosophy: A Religion of Law. By V. E. Desertis. London, 1896, pp. 342.

Prof. A. R. Wallace in his introduction describes this book as a harmony between psychic research and spiritualism on the one hand and modern science on the other, leading up to a religion of natural law. The author yearns to believe in current Christianity, but cannot. The properties of ether as "unconscious soul" are discussed, and the conclusion reached that it is the medium of telepathy and of spirit life, for the souls of the departed declare that their bodies are made of the same substance as ours. The path of

science must no longer be strewn with the corpses of dead theologians.

God, the Creator and Lord of All. By SAMUEL HARRIS, D. D., LL. D. New York, 1896. Two volumes, pp. 579 and 576.

Apart from the interest generally extending to allied departments when a mature professor carefully edits the substance of oft-repeated lecture courses, there is a special interest attaching to this work not only because of the ability of the author, but on account of a growing new and wide-spread interest in his theme. The scope is broad, Part I treating God as the only absolute Spirit; II, Creator; III, Providence; IV, as a moral Governor. The prominence given to sentiment and feeling not only in the last, but in each of the other parts, is a prominent feature.

Jesus Christ before His Ministry. By EDOUARD STAPPER. Tr. by L. S. Houghton. New York, Scribner, 1896, pp. 182.

The childhood, early beliefs, temple period, first impressions and experiences, study and reading, Pharisees, Essenes, etc., are pleasantly and conjecturally described, with archæological details and a faint historic background. Jesus was small, plain, simply dressed, with striped mantle, staff and turban, and filled with the one great original conception of full unmovable and conscious union with God. The picture is very vivid in externals.

History of Philosophy. By ALFRED WEBER. Tr. by Frank Thilly, A. M., Ph. D., 1896, pp. 630.

This is a welcome text-book, on the whole better, as it is somewhat larger, than Schuyler's hitherto incomparable little handbook. It begins with the Greeks and ends with Schopenhauer, Darwin and Comte. The points of view are often new and striking, while those emphasized in other brief histories of philosophy are often quite passed by. The author is clear and concise, is not doctrinaire, but broad in his sympathies, and in general his book will probably slowly supersede Schuyler's, as,we say with some sadness and reluctance, it should.

Infallible Logic: A Visible and Automatic System of Reasoning. By THOMAS D. HOWLEY of the Chicago Bar. Lansing, 1896, pp. 659.

The universe of discourse is represented by a reasoning frame, in which a simple system of signs and capital letters for positive signs and small letters for negative ones, a line for au, etc., is made use of in a way designed to help lawyers, ministers, teachers and students to eliminate all fallacy from their thinking. This system is said to do away with all doubt and uncertainty.

II.—REVIEWS.

Analytic Psychology. By G. F. STOUT. Macmillan & Co. Two vols., pp. 595. $5.50. Library of Philosophy, edited by J. H. Muirhead.

In his preface Prof. Stout states that when he first planned the present work, it was his intention to follow the genetic order of treatment, but he found himself driven to pave the way for genetic treatment by analytical investigation. The "Analytic Psychology"

must therefore be regarded "as a fragment of a larger whole." He acknowledges special indebtedness among others to Dr. JamesWard and Mr. F. H. Bradley; and the reader will easily recognize, even in a hasty review of the work, the influence of these two writers.

The introductory chapter defines psychology as "the positive science of mental process;" "positive" is here used to indicate that psychology "investigates matters of fact, instead of laying down canons of criticism." In the sections on the data and hypotheses of psychology, the necessary distinction and legitimate connection between psychology and physiology are clearly and carefully defined. The two important hypotheses that have been the outgrowth from introspective data are stated to be: (1) the doctrine of Psychical Dispositions; and (2) the doctrine of Sub-consciousness. The author criticises adversely the attempt to make the latter theory fulfill the office of the former in explaining the whole system of our mental experience. The importance of psychical dispositions "as an indispensable factor in mental process throughout conscious life" is frequently brought out in the course of the work.

The whole work proposed by Prof. Stout includes three books, with the following headings: I. A general analysis of consciousness. II. The laws of mental process. III. The origin and growth of certain products of mental process. The present treatise takes up the first two topics, leaving the third for a future work.

The first chapter of the "General Analysis" treats of "The Method and Principle of Division of Ultimate Mental Functions." Prof. Stout follows Brentano in making the positive principle of division "the mode in which consciousness refers to an object." He asserts that the triple division of mental functions has been ordinarily received without any adequate justification of the classification. (I, p. 39.) Although he accepts Brentano's principle, Prof. Stout arrives at somewhat different results. Brentano makes a threefold division into presentation, judgment or belief, and interest or liking. Prof. Stout, on the other hand, maintains that the fundamental division is that which distinguishes the cognitive, the conative, and the pleasure-pain attitudes of consciousness, and regards presentation and judgment merely as sub-divisions under cognition.

In order to explain and establish the fundamental principle adopted in this chapter, the author should have expounded clearly his use of the words "reference to an object;" but the pages devoted to this topic (I, pp. 40-46) seem to us to contain several obscure passages. At one time he defines an object as "an appearance in consciousness; what Brentano would call a content of presentation." (I, p. 41.) On the next page he says, "Thus, even according to the sensational idealism of Mill, we must deny that the perceived object is a content of consciousness;" and on the next page he adds, "Throughout the whole of this discussion the word 'object' is used as correlative with thought; its actual existence or non-existence is a matter of indifference." We look in vain for any discussion of the construction and nature of this "object." Possibly it is reserved for the promised "Genetic Psychology," but we think it is needed here. One point, however, the author makes clear, viz., that any single experience is not a mere momentary appearance in consciousness. It is invested with attributes and relations which are not themselves immediately experienced at the moment.

In accordance with his fundamental principle, Prof. Stout analyzes cognition into two constituents: "(1) A thought-reference

to something which, as the thinker means or intends it, is not a mere modification of his individual consciousness. (2) A more or less specific modification of his individual consciousness, which defines or determines, the direction of thought to this or that special object. This special mode of subjective experience we may call a presentation." (I, p. 47.) When the presentation is relatively independent of the thought-reference, we have mere "Sentience or *anoetic* consciousness." (I, p. 50.) The other two fundamental cognitive modes are simple apprehension and belief. The chapters discussing these modes show in a marked degree the influence of Bradley's Principle of Logic, and will be of special interest to those who are seeking for psychological analyses of logical terms.

The last chapter of Book I passes to the consideration of "Feeling and Conation." "Every mental attitude which partakes of the nature of volition includes two modes of reference to an object,—(1) being pleased or displeased with it or its absence, and (2) striving after it or striving to avoid it,—desire or aversion." This chapter contains a suggestive discussion of the relation between conation and attention, and of the characteristics of voluntary action.

The second book opens with a chapter on the concept of mental activity, which brushes away many of the cobwebs that have gathered about the term. Following Bradley's suggestion, our author regards it as applicable to those cases in which we are dealing with "immanent causality," or in which the "return of causal process upon itself is especially prominent or important." The physiological correlates for the passive and active sides of consciousness are found "in the disturbance of neural equilibrium from without," and "in the spontaneous tendency to recover from the disturbance in certain specific ways determined by the constitution of the nervous system." (I, p. 151.)

The mental process first treated is that of attention. In the two chapters devoted to this process the most characteristic sections are those on the teleological aspect, the inhibitive aspect, and the physiological correlate of the attention process. The last two sections are a good complement to such discussions of attention as those by Wundt and Külpe. The inhibitive aspect,—or the basis for the unity of attention,—is regarded from a purely psychological point of view. The physiological correlate of attention, suggested only as an hypothesis, is an adaptation of Dr. Hughlings Jackson's theory of high and low level centres. (I, pp. 198-200.) The hypothesis is more consistently developed than any other with which we are familiar.

In the next two chapters the most important line of thought is that which traces the comparative rank and function of association, and of what the author calls "noetic synthesis." The argument deserves careful consideration, but within our present limits we can only indicate the author's general position by the following quotation from his final remarks: "It may be said that at present the psychological world is divided into two camps: on the one side are the champions of association, on the other the champions of apperception. In the present chapter I have definitely sided with the second party. I cannot find in association, in the widest sense of the word, the sole ultimate form of cognitive combination." (II, p. 41.) At the same time the author maintains that "his position is not open to the objections brought by such critics as Münsterberg against that of Wundt;" for "his conception of noetic synthesis as a schematic apprehension of a whole recognizes it as a distinct content of consciousness and a distinct factor in

mental process." We think the same may be said of Wundt's conception as he explains it in his fourth edition in the concluding sections of the chapter on *Aufmerksamkeit und Apperception*.

In chapter VI, under the title "Relative Suggestion," the author considers that aspect of association, and especially of association as controlled by noetic synthesis, which appears in its most developed forms in reasoning and constructive imagination. 'Some of our most distinguished modern psychologists have shown a strong disposition to recognize in the elementary processes of perception and association the rudimentary presence of higher mental operations.' (II, p. 43.) "The fundamental fallacy of the associationists, as exposed by Mr. Bradley, lies in their bias towards psychological atomism. Behind this tendency there lies an obstinate disposition to explain the nature and existence of a whole exclusively by reference to the nature and existence of the parts which are combined in it. From this primary fallacy there flow three derivative errors:" . . . (1) 'The exclusive emphasis laid on mere combination. (2) The failure to recognize the apprehension of synthetic *form*. (3) The disposition to regard mental elements into combinations without themselves undergoing transformation in the process.' (II, pp. 47-49.)

In the chapters on "Comparison and Conception" and on "Thought and Language," Prof. Stout gives a clear and ample analysis of the function of images, words and gesture language. He does full justice to the importance of language in mental development. These chapters also contain sections of special interest to students of logic. In a chapter on apperception the author incorporates into his own system what seems to him to be of greatest value in the Herbartian psychology. After a chapter treating of "Belief and Imagination" in terms of their relation to activity, the work closes with a chapter on "Pleasure and Pain," defined from the same standpoint. As the author says, "The reader is already familiar with my general doctrine. . . . Our starting point lies in the concept of mental activity as the direction of mental process towards an end. . . . The antithesis between pleasure and pain is co-incident with the antithesis between free and impeded progress towards an end." (II, p. 270.) This theory is elaborated with special reference to Mr. H. R. Marshall's "Pain, Pleasure and Æsthetics."

As we conclude the work we feel that it is, as the author says, "a fragment of a larger whole," and that final judgment must be reserved until the entire work is completed. Yet the "Analytic Psychology," by itself alone, is a valuable contribution to psychological literature. The two volumes present a thorough, systematic analysis of their topics, from what we may call a *dynamic* point of view. Their author regards consciousness as essentially active and constructive; at the same time he avoids the error of referring to activity in a vague, undefined and undefinable fashion. Psychologists of every school, we think, will value the book as an important addition to the works representing the school of the apperceptionists. Its close connection with "the newer logic," though not without certain advantages, has been made too prominent, and has introduced confusion into the analysis or psychological terminology of the whole. The style is rather heavy and slow, but, as a rule, plain and well-balanced, and the terms in use are carefully defined. The book has a fair amount of illustrative matter, and a liberal range of reference to English writers. The least conclusive portion of the work, in our opinion, is the chapter on the ultimate mental functions, although just here it specially professes

to be initiating a reform. It announces that it is going to give an adequate, positive justification of its classification of ultimate mental functions, but we are unable to point to the fulfilment of the promise. In this connection, too, we are left with unanswered questions as to the author's understanding of the meaning and mutual relations of "object" or "reference to an object," mental content, process, state and attitude. The whole subject would have been clearer if it had been presented with reference to the methods of classification which this system hopes to supersede.

The book is a treatise and not a text-book. It possesses, on the whole, the solid virtues, and can dispense, without great loss, with the lighter ones that make a book popular.

It is unfortunate that where the substance and typography of the treatise are so good, the binding is not of equal quality. We are satisfied with cloth covers, but we also wish to have a secure and even binding. ALICE J. HAMLIN.

Studies from the Yale Psychological Laboratory. Edited by EDWARD W. SCRIPTURE, Ph. D. Vol. III, 1895.

Vol. III of "Studies from the Yale Psychological Laboratory" contains an experimental research on Measurements of Illusions and Hallucinations in Normal Life by Dr. C. E. Seashore, another on Studies of Fatigue by Dr. J. M. Moore, a short report of experiments on the Reaction-time of a Dog by E. M. Weyer, and Notes on New Apparatus produced in the Yale workshop by Dr. Scripture.

Of these articles Mr. Seashore's research is the most extended and the most important contribution to psychology. It is divided into three parts. Part 1st deals with illusions of weight, and gives the results of five series of experiments, of which Series I tests the influence of size upon judgment when size is estimated by direct sight; Series II tests the persistence of the illusion; Series III the dependence of the illusion of weight upon the directness of sight; Series IV the dependence of the illusion of weight upon the senses by which knowledge of size is acquired, and Series V the illusion of weight due to the knowledge of the material of which the weights are made. Part 2nd deals with the principle of suggestion as experimentally applied to the normal presentations of sense. It is worked out in detail for hallucinations of warmth, for illusions of photometric changes in gray and white, and for hallucinations of an object, sound, touch, taste, smell and electric stimulus. Part 3rd consists of the deductions, experimental, pathological and epistemological, from Parts 1st and 2nd. The method of Mr. Seashore's research is a combination of the experimental and statistical methods, and the results have been carefully worked out.

Mr. Moore's studies in fatigue are directed toward two points, the effect of fatigue on binocular estimation of depth and the effect of fatigue on monocular estimation of depth. Both series of experiments point to the strain of attention as an important element in fatigue. The relation of atmospheric changes to fatigue and the effect of fatigue on the maximum rate of voluntary movement are also discussed.

In the work on the reaction-times of a dog the average time found was 89σ, the median 86σ, the mean variation 4σ.

In the notes on new apparatus several pieces are described, the most notable being a new pendulum chronoscope. Other pieces mentioned are a standard drum, an electric color wheel with speed indicator, color sight tester and several reaction keys.

THEODATE L. SMITH.

NOTES AND NEWS.

Prize Advertisement.

The editors of the *Vierteljahrsschrift für wissenschaftliche Philosophie* offer a prize of five hundred marks for the best essay upon the following topic:

"Nachweis der metaphysisch-animistischen Elemente in dem Satz von der Erhaltung der Energie und Vorschlag zur Ausschaltung dieser Elemente."

Competition is open to all without restriction. The essay may not exceed in length three or four forms of the page size and type of the *Vierteljahrsschrift*. It must be written in German, and reach the address of the editors (Privatdozent Dr. F. Carstanjen, Zurich V, Englisch Viertel 49; or Dr. O. Krebs, Zurich V, Minervastrasse 46), not later than October 1, 1897.

The essay must be headed by a motto, and accompanied by a sealed envelope containing the writer's name and address under the motto chosen. The Committee of Award consists of Professor E. Mach, Vienna; Professor A. Riehl, Kiel; and the two editors of the *Vierteljahrsschrift*.

Bibliographies.

The *Psychological Review* makes the following announcement (March, 1897):

"The *Psychological Index* for 1896 will be issued about the middle of March. The arrangement whereby it is also published in the *Année psychologique* is continued, and the *Index* will hereafter have the coöperation of M. N. Vaschide of the Sorbonne in the preparation of the French titles. We are glad also to announce that, by coöperation between the *Review* and the *Zeitschrift f. Psychologie u. Physiologie d. Sinnesorgane*, an interchange of titles between the English and German bibliographies has been arranged, so that, beginning with the *Index* for 1896, the two will be in these respects substantially alike. A difference in the number of titles in favor of the German bibliography will, however, still be probable in view of its later date of publication."

The new chair of mental philosophy and logic in Cambridge University has been filled by the appointment of Dr. James Ward, well known by his article on psychology in the *Encyclopædia Britannica*. Dr. Ward, who is one of the editors of *Mind*, has a comprehensive work upon epistemology in preparation.

Mr. G. F. Stout, senior editor of *Mind*, has been appointed to a lectureship in comparative psychology in the University of Aberdeen.

Professor Wundt is engaged upon new editions of his "*System der Philosophie*" and "*Grundriss der Psychologie*."

Professor Titchener's "Outline of Psychology" has appeared in a second edition, with revisions and corrections.

Two important treatises upon psychology have recently been published in Germany: Professor Jodl's "*Lehrbuch der Psychologie*" and Professor Ebbinghaus' *Psychologie*, Vol. I, Part 1. The latter promises to be a clear, thorough and up-to-date manual of psychology.

Dr. W. B. Pillsbury, whose study of Apperception is contained in this number of the Journal, has been appointed instructor of experimental psychology at Cornell University.

THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

VOL. VIII. JULY, 1897. No. 4.

A STUDY OF PUZZLES WITH SPECIAL REFERENCE TO THE PSYCHOLOGY OF MENTAL ADAPTATION.[1]

BY ERNEST H. LINDLEY,
Fellow in Psychology, Clark University.

Recent researches, stimulated largely by increasing educational concern for the capacities and interests of childhood, have resulted in a heightened scientific appreciation of play activities not only as one of the supreme revelations of human nature, but also as a most fruitful field for the study of mind. An important and rapidly growing literature, psychological and anthropological, has added much to our knowledge of the history and nature of plays and games.

One form of play, that represented by puzzles, has, however, received little attention. To show the range of this aspect of play and to indicate its somewhat special relations to fundamental problems, is the chief purpose of the present study.

Its chief lines are:

1. A consideration of some of the wider aspects of play activity, and its relation to puzzles.
2. A classification and a brief analysis of puzzles, together with a description of the puzzle *quale*.
3. A consideration of puzzle-interest, as determined by examination of questionnaire data.

[1] I wish to express my very great obligation to all the members of the Psychological Faculty of Clark University for valuable assistance,—especially to President Hall for kindly and generous coöperation at all times, and to Dr. E. C. Sanford for the suggestion of the topic, and for advice and criticism in the working out of it.

4. An experimental study of typical modes of mental reaction; (a) as determinative, in part, of the puzzle *quale*, but chiefly (b) as supplying a basis for the comparative study of the natural logic of children, men, animals.

5. Some practical applications of the foregoing.

I.

The Biological and Psychological Import of Play. What is play? Is it meaningless outflow of energy; or may it be of serious import for the life of the animal?

Two chief theories are in the field. One, that of Schiller and Spencer, interprets play as an expression of the overflow of energy. Movements are indulged in because there is a surplus of energy which must somehow be expended. Whatever useful practice and experience may result from this random activity is in a sense accidental. This view has long held a prominent place in psychology, and has certainly given important emphasis to the physiological prerequisite of play. But it is at best only a physiological theory. It fails to explain adequately why plays should assume this and that form, why these forms should vary so considerably among different species of animals and races of men.

As supplementing the Schiller-Spencer physiological view with a biological explanation, the theory of Prof. Groos [1] marks an important step in advance.

While recognizing the importance of abundance of energy as a precondition, Groos denies its universal validity, citing instances of animals which play, even when fatigued almost to exhaustion. Play is the expression of an instinct, whose teleological import is discoverable in most of the movements of animal or child. Play is a "*Vorübung und Einübung*" of activities which soon are to be necessary to the serious life of the adult animal. Of course the teleology of play is not conscious in the young. Its immediate motivation is pleasure:

1. Pleasure in the satisfaction of instinct.

2. Pleasure in vigorous activity, as such. This certainly has high value. Wundt considers it the chief motive in many forms of play. The heightened circulation of the blood, and the like, may be conceived to increase the excitability of the brain, and thus facilitate formation of new association paths.

3. Joy in "being a cause." This introduces an emotional element. Preyer emphasizes it as important. Lessing

[1] Karl Groos: "*Die Spiele der Thiere*," Jena, 1896.

thought it gave the child a deeper sense of his own reality. Not only do children exhibit this delight, but according to Groos, the kicking of a stone, the striking down of weeds with a cane by an adult in the course of a pleasure walk, may be interpreted as the expression of a pleasure in producing change.

This "*Freude an Ursache-sein*," in last analysis, may be pleasure in triumphing over obstacles, the joy in success, victory. Nietzsche translates Darwin's "struggle for existence" into a struggle for power, contest for dominion over surroundings. Its first expression in the young infant is in its attempt to master its own body. So joy in the overcoming of difficulties may be the ultimate and ripest motivation of these activities.

Many movements of the young thus represent a kind of experimentation. The stretching out and drawing in of limbs, seizing, clawing, scratching, gnawing, trying the voice, lifting and letting fall of objects, tearing, pulling, are some of the animal movements of this sort, many of which also appear in children.

It is of central importance to note that most of these play instincts are not highly specialized at birth. Most are more or less general and rudimentary forms, which may be largely modified by experience.[1] The significant point is that they furnish the initiative, at least, for certain activities essential to the life of the organism. They, together with imitation, thus protect the animal until intelligence is ripe enough to mediate proper adaptations. They also prepare the way for intelligence by leading the animal to exercise itself in many ways, and thus acquire a large repertoire of coördinations which intelligence may later utilize; for intelligence and reason cannot utilize any "material" which has not already been a part of the conscious experience of the individual. As is well known, no act can be accomplished voluntarily whose elements, at least, have not already been performed without volition.

The educability of the animal, that is, its adaptability to new conditions, obviously would be decreased by too large a number of instincts of a highly elaborated and specialized kind. Therefore these general play instincts and imitation must have fair field in order that the creature may be most responsive to new conditions. So important is individual

[1] "*Alle Jugendspiele beruhen auf Instincten. Diese Instincte sind nicht so vollkommen, nicht so sehr in allen Details dem Gehirn eingegraben, wie sie es sein müssten, wenn sie sich erst im Ernstfall äussern würden; dafür treten sie aber schon in der Jugend auf und können in Folge dessen durch Uebung noch rechtzeitig ausgebildet werden.*" P. 74.

experience for the elaboration and adaptation of these instincts that Groos declares there must be childhood in order that there be time for play.[1] "*Die Thiere spielen nicht, weil sie jung sind, sondern sie haben eine Jugend, weil sie spielen müssen.*"[2]

To Groos, plays thus face the future. They are a definite preparation for the serious life of adult years. Moreover, as a preformist, he would even deny that any of these activities are due to the inheritance of the results of the conscious activities on ancestors. Without entering the discussion of Weissmannism *vs.* Lamarckianism, suffice it to say that some recent writers,[3] as well as earlier ones,[4] insist upon the "lapsed intelligence" view of the instincts involved. In this view, plays may be reverberations of activities of ancestors. To choose a single instance: the fighting plays[5] of boys, and indeed the whole round of activities of a certain period which mark the average youth, for a time, as a "young savage," find their readiest explanation not in relation to a serious life of the present, but in the fact that the individual is a recapitulation of the race, and that the activities in question are such as primitive man engaged in with full consciousness and definite purpose. The implications of the "reverberation" view might seem to threaten the prospective-reference aspect of Groos's theory. The dispute, however, concerns the origin of instincts, and given the instincts both parties may well agree in their propædeutic value.

Many psychologists seem to assume that certain special instincts have value for the individual, in that they are ephemeral. They rise, and under favorable conditions stimulate somewhat the unfoldment of the organism and decline. Their chief value, indeed, lies in the fact that after making their contribution to the enrichment of "soma" or "psyche," they fall away, and leave either more valuable habits, or plasticity in possession.

Nothing seems more certain than that the congenital inheritance of the child, rich as it is, does not provide sufficiently for the exigencies of his life.[6] Just this distinction marks him off from the young of the lower animals. The

[1] *Ibid.*, p. 68.
[2] Introduction, p. 6.
[3] "A Study of Fears," G. Stanley Hall, Am. Jour. Psych., Vol. VIII, p. 2.
[4] G. H. Schneider: "Der Menschliche Wille," Berlin, 1882, p. 68. G. H. Lewes and E. B. Tylor also.
[5] "Teasing and Bullying," F. L. Burk, *Ped. Sem.*, Vol. IV, p. 3.
[6] The child may, as James says, have a larger absolute number of instincts than lower animals. However that may be, *relatively* to the needs of his life, the child is less adequately provided for.

latter come into the world with a relatively highly developed instinctive equipment. And in the words of Preyer "the more kinds of coördinated movements an animal brings into the world, the fewer he is able to learn afterwards." In the child "the equipment of the lower animals is replaced by the plasticity for learning by consciousness."[1] Learning must be provided for through instincts of the more general sort, as imitation and those of play; or through intelligence; or through both instincts and intelligence. For Baldwin, the play instincts are not alone sufficient, and for Groos imitation is not. Certainly the acquisition of the mental legacy involves more than either,—intelligence.

Play and imitation, as yet, have been considered only in so far as they enable the individual to acquire the simple elements of his inheritance. Even here there may be need of invoking intelligence. But man is inventive as well as acquisitive. Intelligence "grows from more to more," if not phylogenetically, certainly from infancy to maturity in the individual.[2]

Assuming as the criterion of mentality "the pursuance of future ends and the choice of means for their attainment,"[3] intelligence may be regarded as a variation which enables the organism to make better adaptations. Its neural prerequisite is plasticity. But efficient plasticity is possible only through wide variety of experiences. The modification of the nervous system, produced by experience, exhibits two opposing tendencies: one conservative, the other radical; one making for automatism, the other for variability.

The tendencies which make for mechanization include the arsenal of specialized instincts as well as the simpler forms of imitation. The echolalia of children exhibits the tendency of the circular form of reaction, in its simpler aspects, to produce the reiteration which makes for habit. Mere variety of experiences raining in upon the nervous system is not enough to preserve plasticity. In the teeth of this gravitation toward fixedness, there must be a spontaneity to take advantage of this variety. The animals most gifted with experimenting tendencies, those which utilize changes in environment most promptly, will be favored in the struggle for existence.[4]

The case is similar with man. Granting that an advanced

[1] Baldwin: "New Factor in Evolution," *Am. Naturalist*, July, '96, p. 540.

[2] Morgan: "Habit and Instinct," pp. 343 ff. Gladstone, Benjamin Kidd and Edward Bellamy are quoted as disbelieving in a progressive increase in mental capacity in the race within recent times.

[3] James, Vol. I, p. 8.

[4] Cf. H. R. Marshall: "Consciousness and Biological Evolution," Part II, *Mind*, Oct., '96.

civilization demands a degree of adaptiveness for which inheritance cannot adequately provide through specialized instincts, granting also that mental adaptation, as such, constitutes a distinctive feature of life in a highly organized and rapidly changing social environment, the play activity assumes the double function of furnishing exercise both to those instincts which represent the relatively unchanging core of life, and to intelligence itself.

Let it be called a general impulse or general instinct to exercise the intelligence as such.[1] Such a gymnastic must consist in the most widely various sorts of activity, a deployment as far as possible of all resources of body and mind in ways which are to be of use later. Those races and individuals that feel strongly the impulse thus to deploy the intelligence and exercise the "mental muscles," and find it a joy in itself, must be favored in the struggle for existence. The play instinct thus marks its possessors as the bearers of those qualities which guarantee the continued growth of science, invention, and civilization.

The classification of plays and games, by Johnson,[2] well exhibits how they shade by almost imperceptible gradations from the forms which exercise the muscles, up to those in which the mental gymnastic predominates. Of puzzles, the majority are stimuli to intellectual effort, and thus one of the various forms of this propædeutic activity.

Many plays and games, also the more serious occupations of children, may draft off this spontaneity, and disguise it under forms of action for practical ends. The impulse, cannot well at any stage be entirely "blind," and the original motives may be greatly elaborated and modified. Instead of the mere pleasure in activity continuing to furnish the sole motive, joy in being a cause, pleasure in triumphing over difficulties may become prominent. One aspect of the latter must be the feeling of rivalry. Many social games of higher

[1] Lloyd Morgan would call these highly complex and indefinite coördinations "impulses," restricting the word "instinct" to the more definite coördinations. But in spite of this narrower use of instinct, Morgan admits that some instincts are only relatively definite (*Nature* 18, A, p. 95). Marshall (*Mind*, N. S. 5, p. 380) insists that "impulse" connotes a subjective condition, and that instinct viewed as unconscious action for ends, must be expanded to cover all complex actions which bear such mark, no matter how variable may be the coördinations. "Paternal instinct," "maternal instinct," are highly complex, and represent highly indefinite coördinations, many of which are unpredictable. Nevertheless they *are* instincts. So in the latter sense have we ventured to use the word "instinct" in relation to the mental tendency discussed above.

[2] "Education by Plays and Games," G. E. Johnson. *Ped. Sem.*, III, 1.

grades are largely motivated by this spirit of competition, and even in puzzle activity it sometimes appears. But it seems probable that there is in all play activity a residuum of pure delight in activity as such. If the competition motive were the sole incentive to play activities, its explanation on some association hypothesis, as an acquired interest, might be available. Such a view, however, would need to explain why such activities should be made a basis of rivalry unless they first possessed a certain inherent interest.

Restricting the discussion to puzzles, the following are offered as some of the evidences of the existence of the instinct in question. Most people who really enjoy puzzles say they solve them simply for the sake of learning how. Many specifically deny the existence of competition as an incentive, and many prefer to work alone.

Furthermore, in spite of the mental strain and dilemma produced by a puzzle,—an unpleasurableness, which with some persons may become strong enough to produce nervous distress and marked aversion,—the mind is again and again attracted and engaged. Many persons report a distaste for puzzles, but say they find themselves drawn to them, and once having begun, find difficulty in letting go. It is hard to believe, however, that the difficult as such, without relation to possible practical experience, can be uniformly attractive. It seems rather that the difficult as represented by games and puzzles is a special aspect of the baffling which epitomizes and typifies most of the intricate forms of reaction which are met with in the actual experiences of the individual and which perhaps have been important in the history of the race. This, of course, implies a definite propædeutic function. Whether definite or only general, and whether or not the difficult, as such, is alone sufficient under any circumstances to stimulate human interest and excite intellectual activity, the above facts seem best explained by the assumption of a general intellectual play instinct or impulse.

Summary. Intelligence is no exception to the law of exercise. Just as those animals, which by fortunate variation were born with a tendency to indulge in preliminary exercise of those activities which were to serve the serious ends of adult life, were favored by natural selection, and were able to transmit such advantage in the form of general play instincts, so in a more special way those creatures, endowed with the strongest tendencies to exploit the intelligence, may have perpetuated this superiority as a general intellectual play instinct.[1]

[1] It need hardly be explained that the designation of the above tendency as "intellectual" disregards the old tripartite division of

Classification.

So far as known, no attempt to classify all varieties of puzzles has hitherto been made, and even those writers who have sought to reduce to some order the multiform mathematical recreations have failed to find an adequate scheme of classification, while those who have attempted to arrange mechanical puzzles have fared no better. These failures are not strange when it is remembered that many puzzles are "*sui generis*." Others possess characteristics which require their classification in several distinct rubrics. In the present study the systematization is of the most tentative nature and is merely designed to indicate the wide range of puzzle materials and to emphasize the more important types. The groupings will therefore often be somewhat arbitrary.

The chief groups are: Language and Word; Mechanical; Mathematical; Logical and Philosophical; Dilemmas of Etiquette, Ethics, etc.

Language and Word Puzzles.

One of the most primitive groups. The most prominent varieties are:

The Riddle:—A question usually describing the object in question in a paradoxical or ambiguous way.

The riddle which is reputed to have caused the death of Homer, and which is still current in Brittany, is as follows: "What we caught we threw away; what we could not catch we kept."—Lice. Another, found in both France and Germany: "Lives without a body, hears without ears, speaks without mouth, to which the air alone gives birth."—Echo.

The Rebus (literally by things):—Generally a riddle, part of which is expressed in pictures or symbols. Sometimes the Rebus is little more than interpretation of pictures or symbols, the content being in no other way ambiguous.

The Conundrum:—Usually a riddle, where the play is upon words rather than upon things. The solution often turns upon a pun: "Why is O the noisiest of the vowels? Because all the rest are inaudible."

The Enigma:—More poetical form of riddle. Often involves, also, a play upon words: One of the most excellent of this category is the following by Schiller, on the *Rainbow*:

"A bridge weaves its arch with pearls
High over the tranquil sea;
In a moment it unfurls
Its span unbounded, free.
The tallest ship with swelling sail
May pass 'neath its arch with ease,
It carries no burden, 'tis too frail,
And when you approach, it flees.
With the flood it comes, with the rain it goes,
And what it is made of, nobody knows."

---

mind into Cognition, Feeling and Will. Intelligence is conceived to be not merely cognitive, but all these. Later in this paper we hope to show how voluntary ability is fostered and developed through the demand of these activities for voluntary attention and persistence in general. Even the moral nature thus becomes involved to a degree.

The Charade:—Often nowadays used synonymously with "Enigma." More properly it is usually a series of riddles or enigmas, each of which has reference to a single letter, or syllable of a word, or parts of a compound word, the whole series taken together referring to some word-total. Archbishop Whately is credited with the following charade: "My *first* is equality, my *second* inferiority; my *whole* superiority."—Peerless (Peer-Less). The following by Charles James Fox has the metrical form:[1]

> My *first* is expressive of no disrespect,
> But I never call you by it when you are by;
> If my *second* you still are resolved to reject,
> As dead as my *whole*, I shall presently lie."—Herring (Her-Ring).

There are many minor variations of the charade—some of more juvenile form—as, "My *first* is in lamb, but not in sheep; My *second* in shallow, but not in deep," etc.—where each line refers to a single letter. Another species, also, of great popularity among children is that in which action enters. Many of the objects are suggested by gestures and other expressive movements, by costume, and the like, thus bearing some resemblance also to the Rebus. The dramatic element appeals powerfully to the imagination, and hence is the earliest form of the charade which interests children.

Word Squares, Diamonds, etc.:—A series of riddles the answers to which are words which are to be arranged so as to form certain geometrical figures, as squares, diamonds, etc. Here an element of geometry of situation may also enter. Furthermore, induction and deduction of very definite sort are demanded. If one of the riddles be guessed outright and the word put in its proper place in the scheme, it often serves as a basis for the deduction of the remaining words. This type is too familiar to need illustration.

The Acrostic is similar to the Word Square, but usually is more difficult because only the initial letters of the discovered words are used to spell the required answer. The Double Acrostic uses both initial and final letters to spell two words. This latter form has had a special vogue in some quarters, notably in Ireland. A collection entitled "Dublin Acrostics" was published a few years ago. The Acrostic is also so prominent in puzzle columns of periodicals as to need no exemplification here.

Logogram, Metagram, Decapitations, Curtailments, Retailments are a few varieties of the puzzle wherein the word in question is made to undergo various changes. Macaulay, Fox, and William Pitt have written classical examples of the above types. The following by Macaulay illustrates the metrical type of the Logogram, although poetical form is not necessary:

> Cut off my head, how singular I act!
> Cut off my tail, and plural I appear!
> Cut off my head and tail—most curious fact!
> Although my middle's left, there's nothing there!
> What is my head, cut off? A sounding sea!
> What is my tail, cut off? A flowing river!
> Amid their mingling depth, I fearless play,
> Parent of softest sounds, though mute forever.
>
> Answer: Cod.

Hidden Words, and the like, are somewhat similar to the above group. Altogether there are more than thirty species of language and word puzzles. It is obvious that many of these not only challenge ingenuity and involve the logical processes, but also have point as information tests.

In most of the puzzles above described, the riddle element persists, however complicated by logical, verbal and other conditions.

[1] "Cassell's Book of Sports and Pastimes," p. 953.

Mechanical.

This class includes almost all the puzzles of commerce. They are denominated mechanical[1] because of their more or less substantial construction (being made of wood, iron wire, etc.), and present the conditions of the problem in tangible and portable form. Hoffman, whose book includes the most extensive treatise on the puzzles of commerce, describes upwards of 140. The main lines of his classification are followed in this section.

1. *Those puzzles dependent on dexterity and perseverance.* This group forms an exception to the definition of a puzzle as "a demand for an intellectual adjustment." While discrimination is indeed to a considerable extent involved, the main requisite is a nice coördination of muscles. Among the representatives of this group is the familiar "Pigs in Clover."

2. *Those dependent upon some trick or secret.* This is also a low type of puzzle, but requires more ingenuity and resource than the foregoing class. As examples here, are magic money-purses with hidden lock, money-banks and snuff-boxes. In these the illusion of impossibility is strong, and the secret is usually discovered only after repeated trials and in the most unexpected places.

3. *Physical Puzzles.* Most of these involve unique applications of well-known physical laws, as those of motion and gravity. Accordingly, some of the best of this class can be performed with very little apparatus, and in consequence are not fully represented among the puzzles of commerce. These are classified here because they represent a certain degree of advance in mental difficulty over the preceding group. More familiar examples of this sort are "the blowing of a small cork into a bottle"; "removing a napkin from beneath an inverted goblet of water, without moving the goblet or disturbing the water." The totally unfamiliar action of physical laws perplexes and baffles.

4. *Dissected or Combination Puzzles.* Includes all materials so constructed that from given fragments other figures or designs are to be made. All "cross" and "square" puzzles, as well as forms analogous to dissected maps, where materials and not simply diagrams are used, are included. The characteristics of this class will be considered under the head of Geometrical Puzzles. The geometrical imagination seems the chief faculty exercised.

5. *More complicated and elaborate puzzles.* A somewhat miscellaneous group. Many are constructed of wire—others of rings and loops of cord. The usual task is to separate links or remove rings from loops of cord, and the like. They represent a distinct advance in complication over the foregoing types. The element of illusion is often strong. Some appear entirely impossible. They require procedure so unaccustomed that the individual is unable to picture the solution. They are designed to baffle the visual, and chiefly the geometrical, imagination.

As early suggested the above classification makes no claim to completeness. It only serves to pass in review, and to characterize roughly the puzzle materials in question. Mechanical puzzles of

[1]Hoffman: "Puzzles Old and New," N. Y., 1893.

still higher order are also mathematical, and hence will be considered in the latter group.

Mathematical.

Here will be followed the classification of the mathematicians. "After the recreations which depend uniquely upon number, come those in which position is concerned. After the problems involving number and position, should come those recreations into which movement enters."[1] Leibnitz's suggestion offers a practical basis for the grouping of a large majority of mathematical puzzles, and in lieu of a better scheme it will be followed in this section.

1. *Numerical Puzzles.* Chiefly arithmetical. Bachet and Ozanam, whose works are the chief sources, offer a large number of these numerical and arithmetical problems. Nearly all play, either upon the application of unfamiliar properties of number, or else derive their puzzle quality from the fact that their solution is possible only through higher mathematics, whereas the ordinary man tries to solve them by means of arithmetic, and hence fails.

Some of the most famous of these puzzles are as follows:—1. To find a number selected by some one; 4 solutions. 2. "To find the result of a series of operations performed on any numbers (unknown to the questioner) without asking questions." Others partake less of the trick-nature than the above, as: "What number which divided by 2 gives a remainder of 1; divided by 3, remainder of 1; divided by 4, 5 or 6, remainder 1; but divided by 7, no remainder?" Also problems of fractions dealing with queer legacies and the like, abound. Some contain little of the real puzzle quality, but it is difficult to draw the line. Puzzles involving arithmetical progression form a rather distinct class. Some are mechanical puzzles, as the Tower of Hanöi and "Cardan's Rings" (better known as Chinese Rings). The puzzle quality depends upon the fact that no novice will appreciate that they involve progression, but will proceed in a simpler way.

Geometrical. All these problems deal in a special way with form and position, and the larger proportion also with number.

1. *Dissected and Combination Puzzles.* Nearly all geometrical. A given figure having been cut up into various segments, the experimenter is required to rearrange the fragments so as to form another figure or figures of different character. As already mentioned, the dissected map game and the well-known Richter building block games are analogous to these. There are perhaps fifty puzzles in this group. A single instance:—"Given a Greek cross of card-board. Required by two straight cuts so to divide it that the pieces when united shall form a square." The draft on discrimination, imagination and constructive ability is considerable. Sometimes the problem is purely synthetic; from given fragments, a figure of a specified design is to be constructed. The fragments are often bizarre, and the usual modes of conceiving the figure avail little. In short, the whole procedure is set contrary to habitual modes of imaginative construction. Many of the familiar puzzles with matches also belong here.

Another small group so emphasizes certain aspects of the puzzle

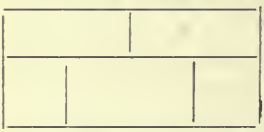
[1] Leibnitz's Letter to De Montmort, July 29, 1715.

quale as to deserve passing mention. One of the most prominent of these is as follows: A rectangle containing 64 small squares of equal size, is to be cut and reconstructed as a rectangle of different dimensions, and containing 65 apparently equal squares instead of the 64. This problem, in a way, gives the key to the paradoxical quality of most of the puzzles of the group. These paradoxes involve the element of illusion, and that in turn depends almost entirely on the inability of the eye to compare correctly the dimensions of figures where their relative position is changed.

2. *Statical Puzzles of Position.* Some of these are not clearly marked off from those of the foregoing group. The element of position is here the distinguishing feature. Number, also, frequently enters. Points, cards, counters are to be grouped in difficult combinations; as, for example, the sixteen court cards are to be arranged in a square. No row, column or diagonal is to contain more than one card of each suit and rank. Tesselation problems, map-painting puzzles, where, with a small number of colors, all the counties of a state are to be so painted that no two contiguous counties shall have the same color. Also many very familiar problems current in advertising literature, as: "How may a gardener plant eleven trees in such manner that they shall form twelve rows, with three trees in each row?"

3. *Dynamical Puzzles of Position.* These involve movement as well as position, and include nearly all the puzzles with counters, all chess and checker puzzles, railway switch and ferry-boat problems, the 14-15-16 puzzle, and many others. The "ferry-boat" problems come down from Bachet and even earlier writers. Of several varieties, the following is one of the simplest: "The captain of a company of soldiers comes to a river. The only means of transit is a boat wherein two children are paddling about, and which is so small that it will only hold the two children or one grown person. How is the transit to be effected?"

4. *Unicursal Puzzles.* A given figure is to be traced without retraversing any part of the route. Mazes, labyrinths, the knight's tour on the chess-board are examples. By formulæ the mazes may be analyzed, and the correct starting-points, as well as the minimal number of strokes necessary to trace the whole figure may be determined beforehand. A well-known simple case of maze is given on the margin. Some have extremely elaborate and tortuous forms.



Logical and Philosophical Puzzles permit of little classification. For the reason, also, that they cannot well be treated apart from their historical setting, they are included in the Appendix within the appropriate historical sections. For somewhat similar reasons Dilemmas of Etiquette, Strategy and Ethics do not appear in this scheme of classification. See Appendix.

The foregoing survey suffices to show the wide range of puzzle materials. It may be safely said that puzzle interest has levied tribute in every domain of culture material.

What marks distinguish a problem as a puzzle, and what is the "puzzle" state of mind? Each of these questions obviously involves the other, and hence both will be consid-

ered in this section. De Morgan defines a paradox as "something which is apart from general opinion, either in subject matter, method or conclusion."[1] A puzzle may be defined as a problem which is apart from the usual experience of the given individual either in subject matter or method. The method, however, is the relatively more important trait. Any problem which fulfills these conditions and which is tried chiefly for the sake of the reaction, and for the solution as such, may be a puzzle. It follows as a necessary corollary that the puzzle *quale* is in part a function of the experience of the given individual. To a mathematician armed with the principle involved, no new form of unicursal problem can possess more than a minimal puzzle element. As previously stated, nearly all puzzles make chief draft upon the more intellectual capacities. And herein lies the possibility of the introduction of every resource by which the mind may be confused and perplexed.

Some are puzzles by sheer superlativeness of intricacy. They bewilder through the multiplicity of alternatives presented. The "*Umfang*" of consciousness is not great enough to take in all the conditions necessary at any stage of the procedure. The complexity of conditions is rendered still more serious through modes of construction, which prevent the usual foresight of the end, and often, also, throw considerable difficulty in the way of mentally registering the steps already taken. A familiar instance is the recent mechanical puzzle "16 to 1." The edges of an almost closed ring are to be worked to the centre of a disk which contains a labyrinth on either side. While the subject is intent upon planning the next move on one side, the difficulties on the opposite side drop from memory, along with the whole plan of this obverse side. The puzzle thus hampers both retrospection and prevision.

Most of the possible devices which may produce *illusion* are found among puzzles. This is a distinctive feature of many. Of the rich variety of modes of this illusion quality, a few are as follows: *Geometrical illusion.* Where an unusual manipulation of a figure produces an effect simply because the geometrical imagination is not able to picture the exact consequences. The illustration, already mentioned, of cutting a rectangle containing sixty-four small, equal squares, so that it may be reconstructed into another rectangle containing sixty-five equal squares. *Illusions of impossibility:*—A wire ring is placed over large wire loops and presented in such a way that the removal of the ring seems out of the question.

[1] "Budget of Paradoxes," Introduction.

Manipulation of the wire loops may quickly modify the general form sufficiently to dispel the illusion. *Illusions of simplicity:*—The task is made to appear much simpler than it is in fact. The result is that the experimenter begins with too little consideration of the conditions involved. In many puzzles the possibility of success or failure is decided by the first step in the procedure. Apparent simplicity, therefore, leads to a premature reaction, and once drawing the mind into the maze produces a perplexity often beyond extrication. This type of puzzle seems especially effective for persons of "explosive type" of will. *Suggestion of false method:*—Of course mere intricacy may have the effect of so clouding the issue that the important features are not easily discoverable. But more definitely to produce this result, many puzzles suggest at every turn a *modus operandi* which always leads to failure. The real method is often veiled with consummate skill. As simple illustrations, may be mentioned arithmetical puzzles which really demand algebraical treatment; many mechanical and labyrinth puzzles.

Search for a general psychological explanation of the above facts brings one to the consideration of the nature of mental reactions. Modern theories of apperception have emphasized anew the truth that the mind acts in more or less habitual ways. It tends to follow lines of least resistance. There are varying degrees of elasticity of these mental habits. At one extreme are what may be termed mental reflexes—with fixed range of routine—analogous in definiteness to spinal cord reflexes. These correspond to certain uniformities in the experience of individual and perhaps of race. At the other extreme are generalized habits with fixed but wide range of plasticity. Witness the habits governing the use of syntax, and the like. These correspond to a considerable variety in the general uniformity of experience. When the mind is confronted by the new, what happens? Those ideas and remembered adaptations which seem to be most closely related to the new phenomenon are called up by association. The law of analogy holds here. Now, if the new suggests analogies to *many* different complexes of ideas, the process of assimilation is checked until one or another complex becomes prepotent. Finally, if the phenomenon is so constituted that it not only elicits many different habits, but also emphasizes unimportant features of its own content as essential, we have the discharge of a reaction which temporarily clears the field. But such an inadequate response usually multiplies the former difficulties, and so there is a new strife of tensions, more painful deliberation, which in time may be eliminated by the discriminative selection of the appropriate

mode of procedure. The progressive discovery of more and more important and vital resemblances or analogies between the new and old, is of course one of the most significant factors in producing successful adaptation.[1]

This is exactly what happens in the puzzle. The individual brings to bear reactions which are not adequate. On the one hand the old habit is attempting to reduce the new to terms of itself. On the other hand the new is waging war on the fixed, the habitual, and thus makes for new adjustments and a higher degree of plasticity. More definitely, many typical puzzles are thus designed, first of all, through wide or simply perverse suggestiveness, to "swamp" the mind with the multiplicity of more or less incongruent trains of ideas and motor tendencies called up. The dice seem loaded against the normal exercise of what James calls "sagacity"—the ability to pick out the essentials and ignore the accidents. For it is obvious that "sagacity," everything else equal, is potent inversely as the number of alternatives presented. Complexity may quickly reach a point where it is impossible for even a Newtonian mind to single out the essentials. Mind, as we know it, "cannot drive the whole universe abreast," but must take it tandem.[2]

To summarize briefly:—In spite of wide diversities of mental experience of human beings past and present, there is also evidence of great uniformity. Every creature shares to a degree in such uniformity, for all inhabit, roughly speaking, the same world. Uniformity and reiteration of experience make for habitual modes of response. The facts of association of ideas and of perception express these uniformities of mental deportment. These fundamental modes

[1] As this is intended only as a rough sketch or scheme of the processes, no account is taken of the processes of judgment, and the like, which certainly enter with deliberation, but which act only on materials which association offers.

[2] Since writing the above my attention has been called to the following from Mach: "A considerable portion of mental adaptation takes place unconsciously and involuntarily under the natural guidance of the facts presented to the attention. If this adaptation has become sufficiently comprehensive to embrace the vast majority of the occurring facts, and subsequently we come upon a fact which runs violently counter to the customary course of our thought without our being able to discover at once the determinative factor likely to lead to a *new* differentiation, then a *problem* arises. The new, unusual and marvelous act as a stimulus, which irresistibly attracts the attention. Practical considerations, or even bare intellectual discomfort, may engender a volitional frame of mind requiring the removal of the contradiction, or a consequent new mental adaptation. Thus arises *purposive* thought, adaptation, *investigation*." "Analysis of the Sensations," Chicago, 1897, p. 159.

of adaptation in men and animals, may be conceived to have survived because, on the whole, more successful than other possible modes. As has been shown, it is not necessary to assume that they have been thoroughly adequate to all experiences with the new. Indeed, if such adequacy existed, the history of human perplexity and the toilsome progress of attempts to penetrate into the unknown would be different from what we find them. Developed first in accordance with the needs of practical life, and in its lower forms adjusted to a narrow range of possible experiences, the unusual and baffling need not be especially complex. It need only present unfamiliar connections of things. Therefore, as we hope to show in the section devoted to experimental data, puzzles largely derive their "*quale*" from the fact that they thus set against the current of natural tendencies and habits.

II.

Puzzle Interest. Questionnaire Results.[1]

In order to secure data for the study of interest in puzzles, a syllabus was issued, containing the following questions, among others.

1. Have you ever been interested in Puzzles, some of the types of which are as follows:

A. *Mechanical Puzzles.* (1) Those dependent largely upon manual control and dexterity, as Pigs in Clover, Spider and Fly, and many others. (2) Those dependent on some trick or secret, as magic match-boxes, purses, money-banks, ball in barrel, key and ring, etc. (3) Those puzzles, as united hearts, interlaced triangles, ball and spiral, links, circles, and the like, wherein the problem is to separate the parts, or to remove rings or loops of cord from wire circles or loops of twine, etc. (4) More complex forms such as Chinese rings, Tower of Hanöi.

B. *Geometrical Puzzles.* (1) Dissected or combination puzzles, analogous to dissected map game, where geometrical forms are to

[1] For the data obtained, the writer wishes to express his thanks to a large number of persons who contributed valuable individual reports, and also to the following, who collected considerable masses of data: Miss Lillie A. Williams, State Normal School, Trenton, N. J.; Dr. Gertrude Edmund, Superintendent of the Training School, Lowell, Mass.; Miss Laura Teft, Superintendent of Kindergarten, and Prof. A. P. Wills, both of the Colorado State Normal School, Greeley, Col.; Dr. Theodate L. Smith, Mount Vernon Young Ladies' Seminary, Washington, D. C.; Principal George C. Purington, Maine State Normal, Farmington, Me.; Prof. Will S. Monroe, State Normal School, Westfield, Mass.; Prof. Noble Harter, Superintendent of Schools, Brookville, Indiana; Superintendent C. L. Hunt, Clinton, Mass.; Principal F. W. Doring, High School, Woonsocket, R. I., and many members of the Association of Collegiate Alumnæ.

be constructed from given fragments; or to cut a given figure into a certain number of pieces so as to produce another given figure, etc. (2) Other geometrical puzzles involving movement and position, as arrangement of counters or checkers in certain forms, arrangement of cards in peculiar squares or other orders in which they possess a unique sequence. (3) Tracing of intricate figures, as mazes, labyrinths. (4) Chess and checker problems. (5) Ferry-boat and railway switching problems. (6) The famous 14-15-16 puzzle, and those of similar nature. (7) Geometrical figures made with given numbers of matches, and the like.

C. *Physical Puzzles.* Where the play is upon some unusual or unexpected effect of well-known physical laws, as those of gravity, equilibrium, motion; blowing a cork into a bottle; removing a napkin from beneath a glass of water without touching or removing the glass; balancing coins, horses,—are a few of the many puzzles of this type.

D. *Arithmetical Puzzles.* Very numerous. Chiefly involve peculiar and unfamiliar relations and properties of numbers.

E. *Quibble and Catch Puzzles.* Also numerous. To give a single instance: how take one from nineteen and leave twenty?

F. *Language and Word Puzzles.* Riddles, rebuses, enigmas, charades, conundrums, anagrams, hidden words, word squares,—diamonds, etc., beheaded words, dropped letters, doublets, and many others.

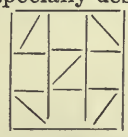
2. When was your interest in any of the above types of puzzles greatest? In what kinds did you find most pleasure? *Did the order or preference change with age, and if so, in what direction?* Please name any puzzles that have lately interested you. Will you kindly name and describe what seems to be the best puzzle you have seen?

Remember that answers in the negative are not without value.

3. When are you, or were you, most interested in working out puzzles—when alone, or during a social evening? Are they ever resorted to as a relief from ennui? Ever as a mental gymnastic, or is the competitive spirit uppermost? Do you usually persist until the problem is solved, or do you give up easily?

4. Do you know persons of pronounced puzzle interests? If so, please state age, sex, temperament; are they usually strong in school work or study? In what kinds of mental work do they seem most efficient—mathematics, physics, literature, etc.? Do they seem especially original or inventive?

6. Please note cases of children proposing more or less original riddles, even in such simple forms as "Guess what I have!" "Guess who!" where the question is clearly put as a poser, and not simply to attract attention. Also any cases of punning, making charades, guess-games, more or less spontaneously entered into by children. Any cases of "stumping" or "daring," where the task is really a puzzle and not merely a feat of strength or courage. The ages of greatest pleasure in riddles, as well as in conundrums and puns, are especially desired.



Trace a figure similar to the illustration without retracing any lines, and without lifting the pencil. Note time required for solution. How many trials before successful? Mark starting-point in each case with a large dot, and enclose the paper in your answer to this syllabus. Any notes on your method will be of value.

9. Is the puzzle-loving mind or state like that of the scientific man bent on solving problems of laboratory or study? Or do puz-

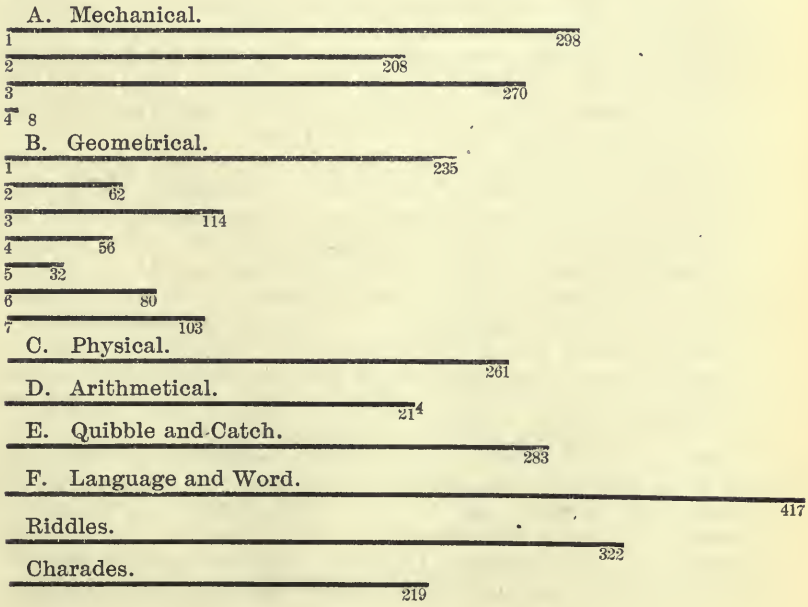
zles cultivate love of unsolvable questions, and make one impractical? Is it in danger of becoming an absorbing passion? What is the educational value of puzzles? Do children ever get nervous about difficult ones?

In response were received 556 reports, many complete, others containing replies to only a few of the questions. Of the 556 papers, 416 were from women and girls, 140 from men and boys. Ages varied from 10 to 40 years. Most of the returns, however, were from pupils in normal and training schools, with ages ranging from 16 to 30 years. Less than two per cent. report no interest in puzzles. A considerable number testify to only a mild interest.

Distribution of Interest. The chart on page 449, based upon the replies to the first question, furnishes a graphic demonstration of the wide variation of puzzle interest. Every mention of interest in any of the types is recorded. Language puzzles are more generally interesting. Next in order come mechanical, quibble and catch problems, geometrical puzzles, etc. Among the sub-classes Riddles lead, while, as A (1), mechanical puzzles dependent largely upon manual dexterity rank second. The prominence of these classes seems easy of explanation. They naturally represent the earliest and most rudimentary aspects of puzzle interest, and appeal to many in whom that interest never becomes a plant of further growth. The "mechanical" appeals probably because the problem is presented in so concrete and portable form. The definiteness of a problem may be assumed to be a condition of its attractiveness, and the delight in physical activity may be a motive. Children often value physical activity above mental activity. The delight in perception of motion also has strong influence with the same. Several children said they liked to watch the "pigs" move in "Pigs in Clover." In such puzzles the object is sometimes a drop of mercury, which has strange fascination. Had a larger number of men been represented in the above report, the relative importance of the mechanical type would doubtless have been much accentuated. As it stands, the first three sub-classes of *A* rank high. The Riddle, as indicated elsewhere, reveals a very fundamental and universal aspect of mental activity and human interest. Its very early beginning, and its perennial and permanent charm for many, render it one of the most significant of all the types of puzzles. Quibble and catch problems, while taxing and stimulating mental alertness, also often possess an element of humor of the crude sort. The prominence of many of the geometrical types seems largely due to their concreteness and to the constructive interests of the young. The earlier

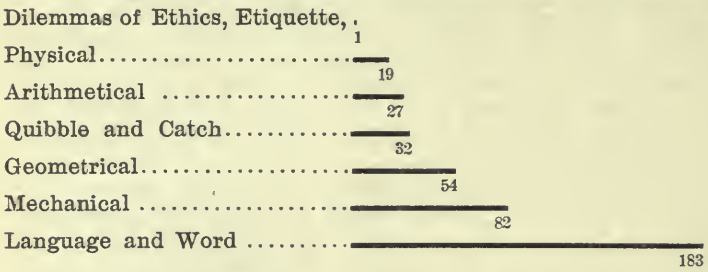
interest in geometry, as compared with number, as shown below in the curves of puzzle interest, suggests important pedagogical applications. Two classes, Logical and Philosophical, and Dilemmas of Etiquette, Ethics, etc., naturally did not find many devotees among persons of the ages of most of those reporting, although many confess to great interest in dilemmas of a personal nature, without being able to offer concrete illustrations. A few of the cases described are here given:

F., 20.—Specially fond of dilemmas of a personal nature. *F.*, 17.—Always interested in these. Remember one when quite small. Picture of man unarmed crossing a stream on a log. On his left a huge hippopotamus, on his right an alligator, behind a tiger, in front a great python. I pondered over this, trying to find some way to save him, but finally decided he must die, and thought if I were in his place I would choose the snake-bite, as that would not hurt him so much, and then I thought there was a possible chance of his jumping by the snake. *F.*, 17.—Interested in picture of ship in storm. Man overboard; large fish coming towards him. How save the man. *F.*, 20.—Very fond of scenes in books which involve dilemmas, as, where Enoch Arden returns home. In Silas Marner, etc. *F.*, 17.—Wonder what I would do if placed in an awkward position. *F.*, 18.—Interested when several persons are together to discuss them. *F.*, 18.—Very polite major bicycling with two ladies as rain began to fall. Lady Maud said, "I shall go back." Lady Mary said, "I shall go on." What did the major do?

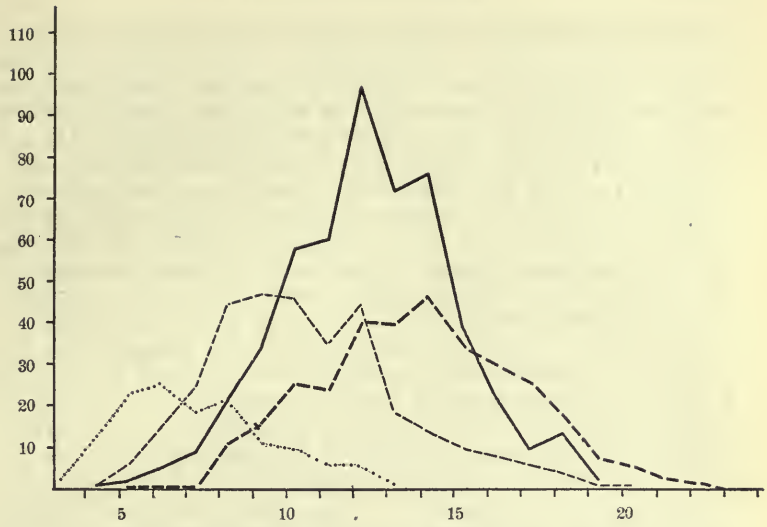


Cases of Special Interest. In examining the returns there appeared many instances of extreme pleasure in a certain kind of puzzle, an interest which, in most cases, did not later shift in full intensity to those of any other type. The appended diagram indicates the great predominance, in this respect, of language puzzles. It must be kept in mind, however, that the majority of those reporting are women. The number of persons represented is 286, some appearing more than once in the record where a new group of puzzles was taken up with the old interest.

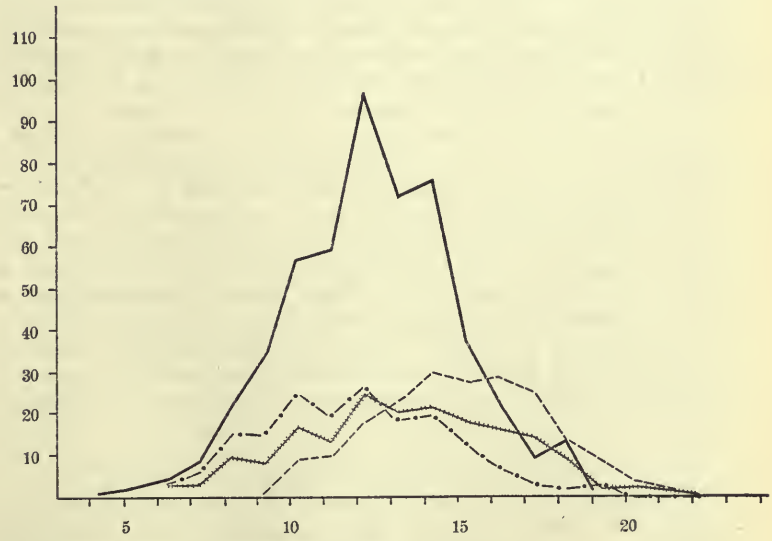
THE PUZZLES IN WHICH THE GREATEST PLEASURE IS TAKEN.



Age of Greatest Interest. The following diagrams contain not only the curve of greatest general interest, but those of the greatest interest in many of the different types. The "general" should, of course, include all the others but the incompleteness of data has prevented. For instance, some persons report only age of greatest general, while others give only age of special interest. All those, furthermore, who give but one terminus to their period of greatest interest in general or in particular, could not be included. Cases of persons of pronounced interest among those much older than any represented in the curves, suggest that the curve should not approximate so closely to the base line from 17 on. The sharp breaks are due largely to preference for even numbers in reporting. The summit of the theoretically correct curve would probably be at 11, 12 and 13. Among details of special curves, guess-games and simple riddle-making begin earliest, say, at 3 years, and reach the highest point from 5 to 8. Riddle interest proper, beginning at 4, culminates at 8, 9 and 10. Language puzzles, exclusive of riddles, are most in favor from 12 to 15, while arithmetical, beginning about 9, reach their height from 14 to 17. Geometrical, of simplest forms, similar to building-blocks and dissected games, appear at 6, culminating at 11 to 14. The curve for mechanical puzzles has a much more symmetrical form, but the cul-



Curve of General Puzzle Interest, 150 persons.
Curve of Greatest Interest in Language Puzzles, exclusive of Riddles, 78 persons.
Curve of Greatest Riddle Interest, 108 persons.
Curve of Greatest Interest in Guess Games and Original Riddles, 121 persons.



Curve of General Puzzle Interest, 150 persons.
Curve of Greatest Interest in Mechanical Puzzles, 65 persons.
Curve of Greatest Interest in Arithmetical Puzzles, 60 persons.
Curve of Greatest Interest in Geometrical Puzzles, 53 persons.

mination is reached considerably earlier, say from 10 to 13.

The above curve, of "greatest interest," manifestly can only be roughly representative of the facts. The data are not sufficiently accurate to indicate a difference between the sexes in this regard, a difference which probably exists. But allowing for obvious sources of error, the curve indicates, with a high degree of probability, that the culmination of the puzzle aspect of the mental play instinct falls in the immediate prepubertal stage of growth. It marks the close of the period just preceding adolescence. Curiously enough the culmination coincides with the period of highest "specific intensity of life"— that is, the period when "children attain and pass the flood tide of growth and of their vitality, as measured by their power to resist death."[1] "In respect to specific intensity of life, that of girls maintains a relatively high level from 9 to 12, inclusive, culminating at 11 to 13, while that of boys maintains a high level from 10 to 15, having its culmination at 12 and 13.[2] The greater surplus of energy at this period may be one reason for the greater puzzle interest. But most important is the neurological evidence. With decrease in rate of growth of bulk of the brain at about the 9th year, at which time its weight is not far short of what it is to be throughout life,[3] it is fair to assume *a priori* that the systems of cortical association fibres now begin to develop more rapidly. And, indeed, Wernicke states that at about the 12th year there is a marked increase in the medullation of these fibre-systems, which must be present before there is great activity of reason.

Experimental data concerning growth of reasoning power, though, as yet, all too meagre, furnish corroboration for the above neurological assumption. Hancock[4] finds ability to solve arithmetical problems to vary with the rate of growth. Girls show a decreased rate at 9 or 10 and 13; boys at 8 and 14. The 12th year in both sexes is therefore a period of rapid improvement. Mrs. Barnes[5] finds the power "of legitimate and imaginative inference" to have strongly developed at 12 and 13. "On the critical side the power is rare, but when present, clear and strong from the age of thirteen and upwards." Such evidence, whatever modifica-

[1] Hartwell: "Report on Physical Training," Boston, 1894, pp. 50-51.
[2] *Ibid.*, p. 51.
[3] Donaldson: "Growth of the Brain," New York, 1895, p. 104.
[4] J. A. Hancock: "Children's Ability to Reason," *Ed. Rev.*, 1896, pp. 261-268.
[5] "The Development of the Historical Sense in Children," Part I, *Studies in Education*, No. 2, p. 52.

tions later researches may impose, points to a rapid and considerable expansion of "elaborative" mental processes in this period. It is thus an intellectual age par excellence.[1]

Now, as to the general relation of puzzle activity to this prepubertal period, the following tentative explanation is offered: The culmination of boyhood and girlhood witnesses the individual comfortably adjusted to his environment. Ideals have changed only slowly. New interests have not intruded abruptly. "Being a boy" or "being a girl" has, in short, become easy, and the energies are not all taxed to maintain the equilibrium of life. Thus a mental surplus which expends itself in play. Adolescence comes with its vast enlargement of horizon. As by a leap the boy has approximated to the stature and many of the ideals of a man; the girl those of a woman. The feeling of mal-adjustment, the strain of adaptation to the new and strange demands which crowd one another, may well call out all the reserve of mental and moral strength; and in the "*Sturm und Drang*," intellectual play languishes.

Furthermore, may not this prepubertal intellectual play activity bear direct propædeutic relations to adolescence? The resulting flexibility of mind, due to the breaking up of narrow modes of thought, and the accompanying increment of gain in strength and poise of intellect and will, may help somewhat to mitigate the dangers of the "new birth." While such a suggestion is, as yet, almost wholly speculative, it seems probable that more intimate knowledge of adolescence may show that in spite of its apparent abruptness, the organism has long been gathering its forces for such a crisis.

Change of Order of Preference with Age. The obvious facts are: (1) That order does change with age. (2) The change is from the simple to the more complex forms. (3) Riddles, Rebuses and simpler Charades give way to the Conundrum, Enigma, Word Square, Hidden Words, and the like.

No typical order is derivable from the data. Wide individual differences prevail. The following order seems, however, roughly true for the largest number of persons: (a) Riddles and simpler forms of Mechanical Puzzles. (b) Charades, Conundrums, Quibble and Catch Puzzles, simpler forms of Geometrical Puzzles. (c) Arithmetical, more complex Mechanical, Geometrical, Language. (d) Logical and Philosophical. Dilemmas of personal nature.

In reading the returns it was impressive to note the logical development and the growth in mental versatility indicated

[1] Twelve is the age when Rousseau would have Emile, after the years of freedom from restraint, put under formal tuition.

in the shiftings of interest, as age increases. The Riddle, Rebus, Charade and simple Mechanical Puzzles, which, at most, call into exercise only the crudest and simplest logical methods, gradually, but perhaps not uniformly, yield to greater complication and refinement of procedure in the Word Square, and the like, with their more sustained and definite use of inductive and deductive processes. In complex Mechanical, Arithmetical and Geometrical problems, not only is procedure more involved, but the value of increased mental span, of improved geometrical imagination, is much in evidence. With age, the increase in value of "information," or knowledge, for successful solutions, notably of Language Puzzles, is also marked.

Original Riddles and Guess Games. This category belongs so largely to games, rather than to mere puzzles, that it seems best to give to it separate consideration. Here one glimpses the incipience of the originating and the inventive faculties in a somewhat striking way. The appended records furnish a better picture than would any description:

F., 9.—Little girl, has made up a half-dozen very good riddles. *F.*, 6, 8 and 13.—Very fond of making up riddles. Will sit by the hour and give riddles to each other. *F.*, 12.—Composes the names of "hidden trees" and other hidden words. *F.* and *M.*, 9.—Children of this age greatly interested in riddles. Will spend nearly all the noon-time intermission at school in telling and trying to guess riddles. Nearly all boys. *F.*, 5 and 6.—After looking at picture-book, one said, "Now let us play; you take the book, and I'll guess what picture you turn to." *F.*, 8 and 9.—In the evening the little girls would sit on the lawn and play a game, such as, "I see something beginning with O.; what is it?" When raining would play charades. *F.*, 5 and 6.—I'll guess what picture you turn to. *M.*, 6.—Very fond of having person guess any problem he may put. Gets angry if some one does not guess. When he has heard a riddle will apply the same conditions to some other object, and then is much vexed when laughed at. Instead of saying, "What is it a wagon cannot go without, and yet is not necessary to it?" W. B. might say, "What is it a lamp cannot go without?" *M.*, 8.—Likes riddles, and never so happy as when some one will sit down and amuse him with such questions. Having heard, "What has eyes and cannot see?" he made up a riddle, "What has feet and cannot walk?" Answer, a table. *M.*, 8.—Made up riddle, "Why is an apple round like an orange?" *F.*—Guess color, the initial being given, or person's name. *M.*, 4.—Hands behind back, "I've got something round and green, with a hard coat inside the green. Guess what it is?" Answer, walnut. *F.*, 6.—Often goes out of the room, wraps things up, and then will come in saying, "You can't guess what I have here." *F.*—"Guess what I have?" "Guess where I'm going?" etc., are a few of many forms of problems, mostly given, perhaps, for the sake of attracting attention, but occasionally through real desire to put a problem. Children usually prefer to set the problem for others; some, however, have a passion for answering. The passion for dramatic action also finds frequent expression in their delight in charades, many cases of which are reported. A single instance: *F.*, 17.—When

11 or 12 years old, my schoolmates and I were very fond of charades. Saturday afternoons we would arrange curtains, dress to represent different characters, and spend whole afternoons acting charades. Another reports, when 6 or 7 years old, playing charade. In one a snake was represented by the children lying on floor and crawling in imitation of snake.

Some of the Motives and Conditions favorable to Puzzle Activity. Of 419 who answered Question 3 of the syllabus, 189 prefer to be alone when working puzzles; 22 sometimes like to be alone, sometimes prefer trying in a company; 224 are most interested in puzzles during a social evening. With many, the desire to work alone is evidence of greater interest. Some say they prefer to try the more difficult ones away from the distraction of companions. The significant fact here, however, is that almost half the total number reporting prefer to try puzzles alone. This number includes nearly all those of "pronounced interest." The replies to the following questions were vague and unsatisfactory: "Are they (puzzles) ever resorted to as a relief from ennui? Ever as a mental gymnastic or is the competitive spirit uppermost?" Many seemed unable to tell why they attempted to solve puzzles. But the results, such as they are, yield the following statistics; 67 say they resort to puzzles as a relief from ennui; 47 as a mental gymnastic; while 165 find the competitive spirit to be stronger than the above motives. Many of the above 165 are persons of no great interest in puzzles. The interest in such cases is by contagion and imitation. The desire to work alone, and for the pleasure of the work, which is predominant in those who testify to a marked puzzle interest, strongly suggests some of the conditions of scientific research, which often needs to be unsocial and for the love of the work, in order to be most effective.

In response to the last question, "Do you usually persist? etc.," a large majority claim to persevere. But most important of all the facts discoverable in the responses to the question, as to motives, etc., are the persistence and tenacity with which a puzzle bids for attention, and holds it. The problem often needs to be examined in a most casual way, and for the briefest time, in order to cramp the attention and give to the relevant ideas, together with desire to solve the problem, many of the features of a fixed idea or dominant impulse. Nothing perhaps more strongly evidences the instinctive substrate of puzzle activity. The following are a few of the cases which have called attention to this point:

M., 38.—"I dislike puzzles extremely. But if I 'fool' with one for a little while, it seems to challenge me, to 'dare me' to work it, and I cannot 'let go' until it is solved. On one occasion, I was busy in conversation in a store, and my hand and eye accidentally

and automatically became engaged with the 'Tower of Hanöi.' Before I fully realized what it was all about I was deep in the attempt to solve it."

F., 17.—"I generally lose patience the first time and put the puzzle away then. I take it up again in a few days and try at different times until I get it."

F., 13.—"Have often become disgusted with puzzles and tried to push them aside, but they would remain in mind and bother me so much that I would be compelled to go and finish them."

F., 17.—"Generally work until I get the puzzle. Always feel uneasy if I don't and can't settle my mind on anything else."

F., 14.—"If it takes two or three days, I work till I get it."

F., 14.—"Usually persist until I get angry with puzzles. Then I will put them aside for awhile, but invariably take them up again."

Pascal somewhere says that men strive to accomplish difficult feats in a game, in order that they may boast of it to their friends. That the competition motive also accounts for much play activity needs no further evidence, but in view of the considerable number who solve puzzles for the mere pleasure, who may not even have in mind the gymnastic value, there is ground for the belief expressed in the opening chapter of this study, that puzzle activity is an expression of an intellectual play instinct. Any number and all varieties of conscious motives may cluster about the activity, but the instinct furnishes the initiative, and brings it about that puzzles are a congenial exercise.

Opinion Concerning Educational Value. In answer to the question, "What is the educational value of puzzles"? a wide variety of responses was received. Nearly all, however, ascribed greater or less value to puzzle activity. A few considered it harmful or useless. The pooling of opinion results as follows: Heading the list of those capacities which are thought to be improved by such exercise, stands reasoning or thinking. 37 persons say puzzles make one a "good thinker"; 72 persons say it cultivates "reasoning faculty"; 18 emphasize "accuracy of thinking"; 19, "trains one to think quickly"; 31 specially urge that it develops "tenacity, perseverance, patience"—as one writer put it, "it gives a moral training"; 35 mention its value in developing "power of concentration"; to 25 it has great value as "general mental discipline"; 19 mention that it trains the "power of close observation and accurate perception"; 13 mention it as a valuable "memory training."

Although such a consensus can have only suggestive value, it must be said that many of the above opinions are from teachers of long experience, many of whom write from personal observation.

The almost unlimited range of puzzle material, and what is more important, the range of capacities which may through

them receive valuable exercise, reveal the thoroughness with which the intellectual play impulse is equipped to do its work in producing versatility. While most puzzles represent odd and unusual modes of presenting a difficulty, they nevertheless deal with the fundamental principles of the sciences from which their material comes. A well arranged series of arithmetical puzzles would induct one into an intimate knowledge of the more important properties of number. Geometry might well be largely appropriated in the same way. Moreover, the forms of illusion and distraction which make the puzzle quality are such as one must experience in ordinary dealings with the new. Puzzles tend to emphasize the usual sources of error into which the mind is prone to fall in its every-day experiences. In such facts as the above rests security from wasteful use of energy. So impressed with the value of the puzzle was Chalotois, a French royal commissioner of education, that in his "*Essai d'éducation nationale*," published 1763, he wrote as follows: "I take it for granted that a child already knows how to read and write, and even to draw; these are necessary. I think that the first things which should occupy him from 5 or 6 to the 10th year are history, geography, natural history, *physical and mathematical recreations*,—knowledge which is within his reach because it falls under the senses, because it is the most agreeable and consequently the most proper to occupy the child."

Cases of Pronounced Puzzle Interest. Had the correspondents, who themselves possessed pronounced puzzle interest, added their own cases to those reported under this head, the number would have been greatly augmented, perhaps more than doubled. As it stands, 128 such persons are reported, of which number 36 are women and 92 men. Distribution as regards age shows 97 to be 24 years or less; 24 from 24 to 48, and 23 from 50 to 80 years. 90 of 109 are reported to have been studious and proficient in school work. Some of the remaining 19 were reported as bright, but not interested in school work, while a few were positively dull. One city school principal writes that the majority of those in one of his classes, who solved a given puzzle most readily, were among the weakest in school work.

Among the subjects in which persons of pronounced puzzle interest are said to be most efficient, Mathematics is mentioned in 62 cases; Literature, 20; Physics, 17; Mechanics, 5; Drawing, Language, Music and History, each 3. Some, of course, excel in more than one branch. As to originality and inventiveness, 82 are reported as one or both, while 18 are neither inventive nor original. The words are

evidently used in a somewhat ambiguous sense, occasional returns showing that originality may consist in the simple ability of dazzling others with novelties, in the way of tricks, etc. Nevertheless, considerably more than half the whole number can be safely credited with real originality, though in varying degrees. Some have done creditable literary work; others are successful inventors. The temperament in only 32 cases is reported, but even these data are sufficient to prove that not only the nervous and sanguine, but also the bilious and phlegmatic may possess remarkable interest in puzzles. Below are some of the cases:

M., 10.—Bright in mathematics, but poor speller. Constantly working at puzzles, riddles and rhymes. Very original and inventive. *M.*, 12.—Very fond of puzzles. Will not give up until he can do it. Very inquisitive. Asks the "whys and wherefores" of all machinery he sees. Inventive, but poor in school-work. *F.*, 9.—Greatly interested in puzzles of all kinds; sometimes makes puzzles out of picture cards, etc. *M.*, 10.—Originated some kind of puzzle with strings—a very good one, too. When younger was very fond of guess games. *M.*, 12.—Tries for puzzle prizes. Very persevering temperament. Fond of arithmetic, specially original and inventive. Remarkable child. *M*, 13.—Fond of puzzles, and quite successful. Not very strong in school-work, but passionately fond of reading. Power of invention marked. *F.*, 15—Spends much time solving puzzles and making puzzles for magazines. Best in arithmetic. Very skillful at making things about house, being very original and inventive. *M.*, 15.—Often made puzzles for his own use. Has a book of puzzles. If he sees a good one, he will cut one out of wood for himself. More interested in physics than in any other study. *F.*, 16.—Long an invalid. During this period delighted in puzzles, original. *M.*, 15.—Fine at anything mechanical, yet not a particularly brilliant scholar. Not specially original in thought, but extremely so in practical affairs and construction. *M.*, *M.*, *F.*, 17-21.—One family. Girl almost entirely deaf and has been nearly blind. Not good in school-work; exceptionally dull at all kinds of work. Takes to music pretty well, but that is all. Poor readers, but enjoy games, riddles and puzzles. Not original. *M.*, 18.—Very queer, not very bright nor studious, but a good typesetter. Always trying something new, but seldom succeeding. *M.*, 14-18.—Peculiar temperament, no business ability, no interest in school, but great reader; best in literature; neither original nor inventive. *F.*, 10.—Would give herself up completely to puzzles, until they were taken away. *M.*, 14.—Would work for hours on a puzzle, but could not put his mind to the most simple problem in arithmetic for five minutes. Actually stupid at some things. Far behind class of pupils of his own age. *M.*, Adult—Fond of mathematical puzzles, strong in mathematics, and has done some very creditable work in literature. Not specially original or inventive. *M.*, 60.—Scholar. Especially original thinker. Never gives up a puzzle when once begun. Daughter inherits his love of puzzles and works at them with some energy. *M.*, 36.—Always prided himself on his puzzle collection and on his ability at chess. Good in arithmetic and a great reader, but seems weak-minded or crazy on mining. Not the least original, inventive or

practical. *M.*, 50.—Believe he would neglect his meals any time to work out a puzzle. Very intellectual, shrewd in business, fond of study. Specially original. *F.*, 30.—Invalid. Unusually strong mind. Fine student. Omnivorous reader. Comes of a family of inventors, and seems to inherit some of it. *M.*, 25.—As a boy I have often gone to his house on rainy days, and found him making and solving puzzles of string and wire. No interest in school-work. Specially original and inventive. *M.*, 29.—Extremely fond of puzzles. Most efficient in reasoning logically and thoroughly. Extremely original and inventive. Spirit of investigation wonderful. Devoted to experimentation and devotes most of his spare energy to it. *M.*, 52.—Minister. Especially strong in literature. More original than inventive. *M.*, 22.—Whole family very quick at puzzles. Excellent in drawing and mathematics. Is now a draughtsman. Has devised and patented several puzzles. *F.*, 17.—Whole family exceedingly interested in puzzles. Enjoying making and inventing puzzles. Every new visit to their home reveals some new puzzle which they want you to try. *M.*, 22.—Has a perfect mania for chess problems. I have seen him go off by himself at a picnic to work such problems. Is a professor of mathematics. Do not think he is specially original or inventive. *M.*, 28.—Cannot read at all. Solves puzzles of all kinds and seldom fails. Specially original and inventive. *M.*, 50.—Tries each new puzzle as soon as it comes out. Very bright, well-read man.

F., 70—It has been a serious question whether I have not foolishly spent a great many precious hours in the last sixty years which might have been more profitably employed than in solving charades, anagrams, enigmas, etc.

In a way it may have had an educational value, but that was not my *object* in doing it. It has been for *pure enjoyment, recreation* and FUN, and I have got lots of each of them out of it. I *do* think it quickens the perceptions and keeps the mind active. It has led me to study in the direction of history, biography, literature, mathematics, astronomy, and mythology, not for the sake of the *information*, but to find solution of a puzzle. I cannot remember the time when not interested in these things, and interest increases rather than diminishes with years. I best enjoy solving *alone*, as I want no hint of solution and want all the *time* necessary. Numerical enigmas interest me very much. I have learned more of Bible geography, biography, feats of valor, words of wisdom, numbers, as "enigmas of forties or of sevens," from this kind of enigmas than I ever did from consecutive reading. Very few names or places in the Bible seem unfamiliar. For years a column in ——— was devoted to Biblical enigmas, which I never failed to study out, some having as many as 150 or 200 letters, and the whole being some passage or passages of Scripture.

In later years, have enjoyed anagrams very much; only last month sent in solution for a prize; conundrums and puns do not appeal so strongly to me; mechanical puzzles I like, but they tire me; I get nervous if I cannot see through them. Only yesterday I came across my "Pigs in Clover," and stopped all work till I had them in the pen. I never stop at a railway station where there are handbills, without taking some prominent word and trying how many words I can make from it. I can get few persons interested in this; have one brother and a niece who enjoy it as much as I; another brother cares nothing about it; not inherited, this interest; don't like studies requiring memory chiefly, but like anything I have to *dig* out.

M., 45.—Nervous; mechanical genius, an inventor with notions and hobbies. *M.*, 44.—Nervous; inventor; they say he has never failed to work any puzzle; designer, draughtsman, inventor and practical mechanic. The puzzle characteristic is peculiar to his family, and they all have mechanical skill, ingenuity, but little business ability. I am convinced that "puzzle" ability goes with inventiveness, mechanical skill, etc. Men excel; they excel in mathematics, physics, etc.

In a sketch of the late Prof. Sylvester, the great English mathematician, published in a recent issue of the New York *Post*, the following statement appears: "Prof. Sylvester was all his life long, down to his latest years, an indefatigable solver of exercise problems, such as are proposed in the *Educational Times*. He considered them an indispensable whetstone of the wit; his whole style of analysis carries the marks of such exercise."

The significant points, in résumé, are that the puzzle interest may endure throughout life; that, on the whole, persons of pronounced puzzle interest make a favorable showing intellectually. Most are interested in every-day problems, and succeed in practical affairs; they certainly stand high for originality and inventiveness. Is this sustained puzzle interest different in kind from that which marks the prepubertal period? With the insufficient data at hand, no satisfactory answer can be made. With some individuals, it may well be an abnormal persistence of tendencies which should have fallen away long before the individual had reached maturity. But in others, as in Prof. Sylvester, the play instinct has been fostered, apparently because it served the purpose of intellectual gymnastics. Among very old people of leisure, it may be a veritable recrudescence of play activity.

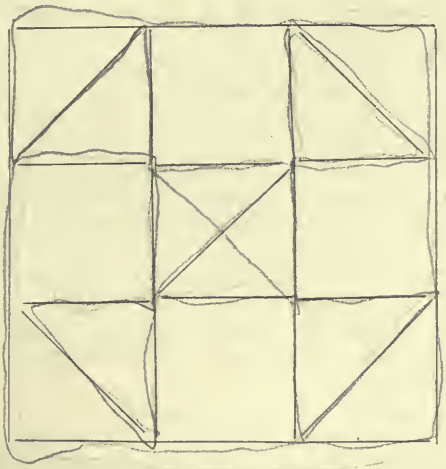
Summary.—The most salient facts concerning puzzle interest are as follows: The interest is fairly general among young people; interest is distributed over a wide range of puzzle materials. Of these, the mechanical and language groups are most popular; puzzle interest shifts with age. In general the change is from Riddles, and the simple Mechanical and Geometrical Puzzles, to more complex forms of the Language, Mechanical, Geometrical, and also Arithmetical types; the age of greatest general interest in puzzles is about 12. No difference in this respect as regards sex is discoverable. This prepubertal stage is probably marked by rapid development of the elaborative mental processes, and may be denominated as largely an intellectual epoch; puzzle interest may persist throughout life; most persons of pronounced puzzle interest seem original and inventive, and are not as a rule unpractical.

III.

EXPERIMENTAL.

For the purpose of making experimental determination not only of methods of solving puzzles, but chiefly of the development of mental adaptation in general, the following problem was submitted to children in the schools of Worcester.[1] These results were, in turn, compared with those gained from tests upon adults.[2]

The puzzle used belongs to the unicursal or labyrinth types and was devised by Tait. An illustration is here appended.



This puzzle was chosen mainly, because: (1) The problem is sufficiently difficult of solution to require a number of trials. (2) The instructions as to procedure are easily followed. The subject is required merely to trace all the lines without lifting the pencil and without any retracing of lines. A sheet containing twelve reproductions of the

[1] These tests were rendered possible through the courtesy of Superintendent Carroll and the school authorities of Worcester. I was assisted in the supervision of the experimentation by my wife, and by Mr. E. W. Bohannon of the University. The work was also greatly facilitated by the cordial coöperation of the principals and teachers of the schools above specified. The generous and able assistance of Miss Emily Viets in a series of valuable preliminary tests in the kindergarten of the Salisbury street school deserves special mention.

[2] The experiments outside the University were conducted at Providence by Dr. Hattie E. Hunt, of the Training School; and at Indiana University by my friend and honored teacher, Dr. W. L. Bryan. Their important contributions are gratefully acknowledged.

design, eleven of which were in broken lines, the other serving as a model, was supplied. When the subject had failed on one figure, he was required to try the next, and so on, taking care to mark the starting-point each time in some distinguishable way.

The figure is so constructed that the place of beginning is of prime importance. There are only two points from which successful movements may start, and these are on the inside of the figure, at the termini of the middle diagonal.

The mathematician Euler developed a formula for such figures, and for one conversant with his rules, this problem offers no real difficulty. Using such a mathematical analysis as a norm, it may be assumed, a few chance successes apart, that all cases of failure are due to an inadequate conception of the problem. So it might be possible to arrange in a series all analyses of the design, according to the degree of adequateness of conception. So much for the purpose and import of the problem.

After a series of preliminary tests upon members of Clark University, the experiment was made in the third, fifth and eighth grades of the Oxford street and Elizabeth street schools, and in the third, fifth and ninth of the Woodland street school. A later series of individual tests was made at the Salisbury street school, also on teachers of the schools of Providence, and lastly on advanced students in psychology at Indiana University. These individual experiments will receive separate consideration.

Mass Tests.

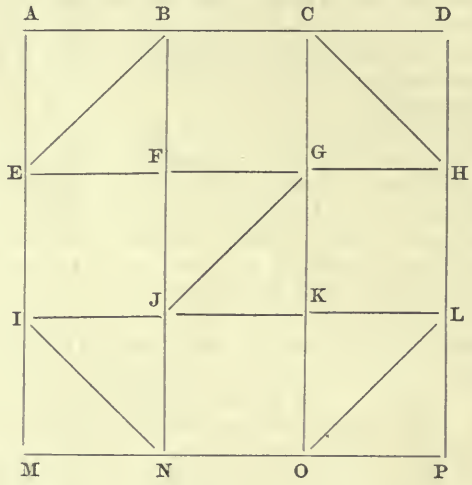
At the first three of the above-named schools, the problem was given to all the children in a room at the same time. They were furnished with uniform papers, were given explicit directions, and were more than once reminded that they could begin anywhere they chose. Twenty minutes was the allowed time. If a pupil thought he had succeeded he made the fact known, and the time required for solution was recorded. The total number tested in these mass trials was 471, distributed as follows: 169 in Grade III, 154 in V, 61 in VIII, 87 in IX.

Almost without exception the children entered into the problem with great interest, and there is every reason to believe that most of them made every effort to solve the puzzle. Participation in the test was entirely voluntary in every case. Most of the children voted that they liked puzzles, and many wished to continue after the expiration of the allotted time. There were some failures to follow the instructions, not only in the lower grades, but sometimes in the higher. In the

first series, in Grade III, Oxford street, the children were allowed to decide for themselves when they had solved the problem. On inspection many had omitted lines, and some were greatly surprised when the fact was pointed out. Others plainly had lifted the pencil in order to escape failure, while still others had retraced certain lines. As most of these mistakes seem to have been made without intent to deceive, observations were made on further cases of like kind, and will receive consideration below. After this experience the instructions were made still more explicit, with the result that the proportion of errors of this nature in later tests was materially reduced.

Results. From these mass tests only qualitative results of the more general kind were expected. The average number of trials does not greatly vary with age, although the younger children show a slightly greater number. The circumspection with which pupils proceeded increased noticeably up the grades. The youngest children worked rapidly, and failing, passed quickly to the next figure. While this was also true of some in the higher grades, it was nevertheless patent that these pupils exercised more deliberation, and there was a greater attempt to analyze the figure and to determine the causes of failure. While it is impossible to make a precise quantitative statement of the increase in *variety of attack* in the higher grades, this fact was most prominent. The younger children, with few exceptions, show little ability to profit by their errors. They either began in the same place in many successive trials, and seem to have repeated their former unsuccessful movements again and again, or their variation was too slight to be of consequence. In Grade V there is a smaller proportion of these automatic repetitions, while in VIII and IX they had still further decreased, although it must be noted that such cases occur even among adult subjects. As regards ability to profit by errors: In case of a few pupils of Grade III, and in still larger proportion with those of V, more marked variations are produced by a former error. The new movement shows vague appreciation of the total conditions of the problem, and there is less focusing on single lines than calculation of the effect of moves on several lines. In VIII many show radical reconstruction of order of moves, following failure, and usually the *adjustment is prompt.* In V radical reconstruction does occasionally occur, but more slowly. It appears that among younger pupils, error must be repeated before its full significance is appreciated. With age, the movements seem more and more directed by deliberation and fuller realization of the conditions of the problem.

Conventional Reactions:—Examination of the nature of the beginnings in the separate trials brought forward some facts of interest. All subjects were explicitly told to begin wherever they chose, and among the younger children the reminder was repeatedly given. In spite of this, however, the beginnings are of a very conventional sort.



In the figure here given the junctions of the lines are lettered, for convenience in indicating various parts of the figure. Barring a few cases, where beginnings were made in the middle of some line, these junctions represent the range of starting-points. If the "dice were not loaded," the starting-points would be distributed equally among 16 positions. As there are 4 inside and 12 outside points, 75% of the beginnings, on such an assumption, should be on the outside.

Results:—The percentage is too great in favor of the outside among the younger children, and too small among the older. In Grade III, 87% of *all beginnings* are on the outside; in V, 83%; VIII, 73%; while in IX only 68%. For adults only 61%. In only a relatively small number of cases is the starting-point of the first trial on the inside. A view of the distribution of beginnings among the various outside points throws yet more light on the question. As to beginnings in upper left-hand corner: In III, 41% of all beginnings were at *A;* V, 29%; VIII, 22%; IX, 15%; adults, 10%. Furthermore 57% of all beginnings are somewhere on the top

tine *(A, B, C or D)*, while only 10% were on the bottom line *(M, N, O, P)*.

Now, if we consider the *number of individuals* who begin at any given point, we find that 57% of all persons begin sometime at *A*. In Grade III, 66%; V, 66%; VIII, 45%; IX, 43%; adults, 36%. When the construction of the puzzle is recalled, and especially the fact that only beginnings at two inside points can possibly lead to success, this predominance of outside starting-points, notably among the younger children, is of considerable significance. It shows that children are probably under the sway of a deeply set habit, learned from reading, writing and drawing. This leads them to begin at the top and generally at the upper left-hand corner of the design. Failure is not effective in inhibiting this tendency. In older pupils and in adults this tendency seems, in part, overcome by other conditions, although it still exists. Their range of experience is wider, and hence the predominance of any one fixed tendency is minimized.

Furthermore, these beginnings throw some light upon the perception of the figure. Very many of the youngest children invariably went round the square, suggesting that this form, which is at once most familiar, and so placed in the design as to constitute the outline of the whole, catches the attention and holds it at the expense of the other possible combinations of form. This view is corroborated by the testimony of adults, namely, that first trials were often haphazard, preceded by little analysis of the figure. This, together with the general absence of deliberation in children, would seem to prove, pretty conclusively, that nearly all first trials, at least, are not planned, and hence the outline of the figure, and the usual method of drawing, are all the more potent in determining procedure. Still another fact points to the rôle of these habits. Many who studied the figure discovered the error of beginning on the outside, by their inability to dispose of the inner diagonal. This usually suggested that the diagonal be disposed of first, and hence beginnings on the inside were almost imperatively indicated. In spite of this difficulty, however, one which nearly every subject must have experienced in some degree, the outside initiative still tended to persist.

Individual Tests.

In order to observe more exactly how far age influences capacity to vary effectively, to profit by errors, a series of individual tests was made on pupils of the Salisbury street school. Of a total of 64, 11 boys, 10 girls were from Grade III; 11 boys, 12 girls were from V; 11 boys, 9 girls from

VIII. Both boys and girls were chosen in alphabetical order. They were brought into a room in groups of six, and two children were assigned to each of the three observers. They were given instructions as above described, and the observers attempted to record each move made in the attempted solution. While it would be highly desirable to make a quantitative formulation of results, the complicated conditions prevent. So many are the possible permutations, so diverse may be the causes of any slight change, and so unequally effective in altering the picture of the whole is such a variation, depending on whether the change comes near the beginning or toward the close of the trial, that in view of all these difficulties, resort must behad to the clinical method of presenting typical cases. The following seem as nearly representative, as possible, of their respective grades. In the tables a sufficient part of the total movement in each case is given to convey a fairly accurate notion of the whole. The letters refer, of course, to the lettered diagram above :

ORDER OF MOVES IN TYPICAL ATTEMPTS AT SOLUTION.

GRADE III.

R. F., boy, age 8.
M I E A B C D H L P O N M
C H L O — N I — E A *
E A — C H*
E B C H L O N I E
E B C H L O N I E
E B C H L O N I E
I E F G H L P O N M I†
E F G H D C B A E I M N O P L H C G K O
M I E A B C D H L P O N M
M I E A B C D H L P O N M
M I E A B C D H L K J
E B C H
M I E B D H L P

* Omitted certain lines. Put in only the diagonals.

† Retraced from I to A a second time.

B. G., boy, age 7.
A B C D H L P O N M I E A
A B C D H L P O N M I E A
A B E I N O L H C D H L P
A E I N J F E B
A B E I M N I J K G J F B C G H C D H L P O L K O N J
A B E I N O L H C B I J N +
I N J G F J N I E B A E F B C D H C G
A B E F B C D H C G F J N M I N O K J G H L O P L K G
E I N J G C B A E B F G I M N O K +
A B F E I M N I J F G C B

G. A., girl, age 7.
$\frac{BC}{2}$ C D H L P O N M I E A
$\frac{BC}{2}$ C D H L P O N M I E A
$\frac{BC}{2}$ C D H L P O N M I E A

C D H L P O +*
B E F G H +
C D H L P O N M I E A B C G K O L K J I N J G E B F
C D H L P O N M I E A B C H G F B E F J G K J N I J
B F J G C D H — — — — — — — — — P O N J I M I E +
G J F B E A B C G H C D H G K G F E I J N +†
C D H C B A E B F G J I E F G H P
C D +
G H D C H L P O L K G C B A E B F +

* Gets inside for first time.

† Said she would begin on inside; perhaps she could do it that way.

J. F., girl, age 8.
A B C D H L P O K J I M +
A B E A B F J +
A B C D H L P O N M I E A
E B F J N I J G H C D H L K O L P O N M +
A B C H G K J G F E B F J I N M +
H +
J G C H G F B E I M N O L K J I N J F E A D H L P O K G

GRADE V.

M. C., boy, age 10.
C H G C D H L P O L K G F B E A B C
I J K L H D C B A E B F G C H G J F E +
J G K J +
J G C H D C B A E B F +

Never tried a puzzle before. Cannot always repeat his success.

J. D., boy, age 11.
P O N M I E B A E
D C G H C
M I N
A B E B C G
P O L K O N J G
P L O N J G H
D C B A E I M N O P K O L
F E A B
B A E F B C I J F G J K G H L K O L P O N M I N J

G. W., girl, age 11.
A E I M N O P L H D C B A
E A B F E B C G F J +
A E I M N I J N O P
B A E F G H D C B F J N +
B A E B F J N O +
B A E I M N O P L K J I N J +
C B A E I M N J +
D H L P O K G C H G F E B
G J N M I E F J I N O K G F B A E B C G H C D +
G J N M +
G J N I J K +
G J +

J. M., girl, age 10.
A B C D P O N M I E A
E B F J I N O L K J G F
C H G J I E A B C D H L O P L
O L K G J N O P L H G F E I
N I M N O P +
J G H L K J F E B A E I M N I J N O L P O G F +

GRADE VIII.

F. E., boy, age 13.
N I M O P L O K +
B E A B C D H C G +
E B A E I M N O P L H D C B F +
H G F +
D H L P O N M I N J +

E F B E A B C H
N M I J K G J F G +
I J G C D H +
Traces before marking.

M. E., boy, age 14. D C H G C B F E B A E I J F G J K G
C B F E B A E I J +
G C H D C B F E B A E I J F G K O L P O N M I N J +
Studies before marking.

E. A., girl, age 12. M N J F B E
N +
H D C H G C B A E B F E I M N I J N O P L O K J
J E K O P L O N J I N M I E F B E A B C D H C G H L K J F G
Studies it first, tracing with finger. Sees quite far ahead that she cannot succeed.

L. D., girl, age 13. M N O P L +
A E I M N I J F E B F G +
B E F B C G H C D H L P O L K O N J K G F J I M N I E A B
H C D H G C B +
E I M N I J N O K L O P L H G K J G F E A B F J
G J I E A B F E B C G F J N M I N O P L O K L H D C H G K J

Even from the cases given, one can scarcely get a full realization of the remarkable increase in variation from III to VIII. As in the mass tests, while automatic repetition, or slight and inconsequential variation, is the rule in the lowest grade, in V there is already appreciable growth in resource, initiative, intelligent utilization of previous failures. In VIII the progress has been relatively greater still. Even in the higher grades, however, appeared a few cases where routine prevailed. In other instances, where variation was considerable and intelligent, there were occasional relapses into routine. This latter may, in part, be due to a temporary relaxation of attention.

On a basis of the study of the records, supplemented by observation as well as occasional questioning of children in III, the following analyses are offered as fairly descriptive of their procedure; they throw much light on the above mentioned characteristics of their movements. There are two slightly different cases: (1) The child discovers in a just completed trial that one or more lines are omitted. These lines sometimes, of course, are on the inside, sometimes on the outside of the figure. No matter. The child starts again at the old beginning place, or as near to it as possible, and modifies his former movements just enough to include the line or lines in question. This generally results in the omission of other lines; and this, in turn, leads to similar slight modifications, and so on. (2) Lack of foresight is manifested in a slightly different way. Again repeating his former movement, the pupil comes, say, within a single move of his old dilemma. Only then does he veer, and then only just enough to avoid the immediate pitfall, without regard to

others into which his change hurries him. Comparing the most successful adaptations of these children with those of higher grades and of adults, the following seems in general true: The young children succeed through a long series of slight variations. Occasional relapses into movements which are useless, indeed occur; but the trend is by a slow and primitive method of exclusion, toward the goal. Among older persons, the adaptation is usually approximated more by leaps and bounds, that is, through wider variations.

Résumé. Without attempting here to coördinate intimately the main results of the above experiments, some such statements as these seem warranted: The lack of circumspection, the conventional beginnings, the automatic repetitions of former movements, the slight and inconsequential variations, the frequent relapses into former routine, after failure of a slight variation, in short, the general tardiness in profiting by errors, of children in III, slowly makes way in older children for greater prevision, more adequate analysis of the design, less conventionality and automatism in procedure, more radical reconstruction of plan in successive trials, all of which leads to greater promptness in profiting by mistakes.

Experiments upon Youths and Adults.

A large number of older persons, perhaps 300 in all, described their method of solving the same puzzle. Of this number, 72, who had some training in introspection, were given the task as a special problem. When they had successfully traced the figure, some such questions as the following were asked: 1. Why did you begin where you did in each trial? 2. Did you study the figure before beginning? Before each trial? About how long in each case? 3. Into what did you resolve the figure? Did conception of the figure change with successive trials? 4. Do you usually plan work thoroughly before beginning? How is it in composition, etc.? Some typical replies are here arranged so as to furnish a picture of the several degrees or levels of intelligent procedure, and to indicate some of the relations of visual and motor-mindedness.

Simpler modes of procedure: *F.*—No reason in beginning where I did in No. 1. Later attempted to cover lines not covered before; studied figure somewhat; 11 trials, 18 minutes. *M.*, 24.—Studied 20 seconds; began on outside; tried several times from about the same point; then began in the middle; chiefly guess. *F.*—No reason in No. 1; did not study; generally start in quickly on any subject. *F.*—No reason; changed beginning point because I could not cover lines first time; studied very little; did not analyze; 7 trials. *F.*—No reason; changed because I could not cover all lines; studied figure somewhat, but did not analyze; 5 trials. *F.*—No

reason; in second or third, saw that I could cross from one square to another by use of diagonals, and then fill out square; studied very little; generally start right in, then see my mistakes and correct them. *F.*—No reason; no reasons in others, but began at just any point. *F.*, 19.—Started in upper left-hand corner simply from force of habit; in fifth trial started at middle diagonal, because that had given trouble.

The following seem to represent some advance over the preceding: *F.*—No reason in No. 1; then the figure reminded me of another puzzle, but my trial did not succeed; in No. 3, after starting, saw my way; studied a little, then would try; saw figure first as a cross, then at last as squares and diagonals. *F.*—"E" looked like a good beginning; in No. 2 had another plan; in No. 3 supposed should have to begin somewhere in the middle; studied figure some time; generally studied first and arranged later; saw the figure as a lot of squares with diagonals. *F.*—Started to draw the square first, but at the same time wanted to get in the diagonals, so began at E. M.—No. 2 had no particular reason for beginning at N; in third, started with J G because it had given trouble; did not study figure much; usually do, however.

Some of the best types are as follows: *M.*, 29.—Mathematician; began at middle diagonal; sought points possessed of more than four lines; that suggested inner diagonal. *M.*, 33.—College professor; first tried by horizontal sections; then sought some principle; middle diagonal caught my attention; it must have some significance; after long inspection began there, and succeeded; in working puzzles always found it necessary to seek for a principle, rarely getting anything by chance or luck. *M.*—Studied short time; saw I could finish inner square first, then complete the rest. *M.*, 31.—Have had experience in mathematical puzzles; spent four minutes studying first figure before starting; about three minutes for second, which gave correct result; found myself continually running ahead of the lines to see that I kept out of the tendency to close myself in.

Visual and Motor Types: Although many of the cases already given suggest the somewhat fundamental differences in procedure of the eye-minded as compared with the motor-minded, this distinction seems sufficiently important to warrant special attention. The following cases are in point: *M.*, 60.—Worked it out by eye before using pencil; noticed continuity of  and  ; saw these two could be easily associated; then tried the inner oblique line, first making sure of connections of terminus in right-hand lower corner. *M.*, 26.—Tried to imagine the figure as two, or at most, three definite figures as follows:  ; saw I could trace the first two continuously, but did not know how to dispose of the diagonal in the middle; then I began disposing of it first, and the solution came with surprising quickness. *M.*, 23.—Looked it over before using pencil; two trials; in composition always plan arrangement or treatment before using pen.

While it is more difficult to point out those of more pronounced *motor-type*, a few, such as the following, seem to be dependent almost wholly for a connected view of the conditions, upon first tracing the figure. *M.*, 20.—Began on outside; rather haphazard beginning; repeat same beginning in order to hold it in mind; memory of figure improves with trials. *F.*—Did not study figure; my first

failure gave clue to second figure; generally start in upon work without thinking much about it; 4 trials. *F.*, haphazard beginnings; generally start right in, then see my mistakes and correct them; 3 trials. *F.*, nearly all early beginnings haphazard; usually start out at once, and see what I can make of it, and then I study it; 8 trials.

With persons of motor-type, there is a more or less tentative marking at first; the mind hovers until the actual experiences give a clear-cut notion of all the conditions of the problem; many of the early trials often seem aimless, but the record shows that although the "*motiles*" make a larger number of trials than the "*visives*," they succeed about as quickly. The "eye-minded" make few trials, and each stroke of the pencil is of high purposive import; they do their "fumbling" mentally; that most persons, however, are not predominantly eye or motor-minded, but rather belong to the "mixed type," goes without saying; the majority of those reporting are probably of the latter.

Abstracting for the moment, from the distinction just made, and considering the individual cases above given from the standpoint of the degree of intelligence of procedure indicated, it is possible to discriminate at least two, and perhaps three "levels." (1) *Conceptual.*—All those cases in which the search for a principle dominates, where careful analysis of the problem, where comprehensive appreciation of relations are marked characteristics, belong in this class. The word "Concept" connotes this level, which, however, is marked off from lower orders by no fixed boundaries. (2) *Receptual.*—Most of the numerous cases which fall below the highly rational types above designated belong here. These cases present almost infinite variety and resist hard and fast classification. They of course include eye-minded, motor-minded and the mixed type, just as does the conceptual group. They also represent varying degrees of approximation to the Conceptual. The word Recept designates the mental processes involved rather than Concept. The word is used with the realization that it connotes a lower stage of mental process than often appears in this group. But with this qualification it has value, in lieu of a better, in such a crude grouping. Reason, acute analysis, is here supplanted by a more hazy and insufficient realization of the relations involved. Errors, only by a considerable repetition, are able to produce any marked change in the order of the move; one sub-class may be distinguished, however, and some of its characteristics may be held to represent fairly the whole group. This subsidiary group we venture to designate "*Receptual motor.*" It possesses the following characteristics: There is a very great dependence upon preliminary tracings, for a realization of the conditions of the problem. Unlike the Conceptual-*motiles*, however, the experience gained does not result in a comprehensive concept of the

problem; there is no prompt discovery of the principle involved. With some, a Micawber-like disposition to wait for the difficulty to solve itself, seems prominent; some cases reported show as many as 15 trials, all in a measure haphazard; in others, the right notion of the figure slowly dawns after, say, 8 or more attempts. Repeated failures by a sort of summation thrust their import upon the subject, and like a composite photograph bring out the essential features of the required complex. While there may be considerable appreciation of relations, either the ability or the disposition to reason out the problem promptly seems lacking. This group, however, ranks higher than that of "sense-trial and error," to be considered later. Manifestly, it would be far from the truth to assert that a given individual in the prosecution of every sort of task need exhibit the same "level" of method. In proportion to the unfamiliarity and in general, the difficulty of the problem, his procedure may descend almost or quite to the lowest "levels." This fact must not be forgotten. Probably all inventors and discoverers often exhibit traces of many "levels" of procedure in the course of a single adaptation.

Of great value for the psychology of scientific method would be the detailed account of the procedure of the most successful experimenters. Unfortunately few have left even a general record of the kind in question. But there are enough data at hand to show, at least, how erroneous is the popular notion that the great discoverer in science somehow marches straight to the truth by some divine unerring method. "In all probability," says Jevons, "the errors of the great mind exceed in number those of the less vigorous one. Fertility of imagination and abundance of guesses at truth are among the first requisites of discovery."[1] Faraday said: "The world little knows how many of the thoughts and theories which have passed through the mind of a scientific investigator have been crushed in silence and secrecy by his own severe criticism and adverse examination; that in the most successful instances not a tenth of the suggestions, the hopes, the wishes, the preliminary conclusions have been realized.[2] Mach[3] and others have shown that accident may play an important rôle in discovery, but accidents can only be utilized by a mind quick to appreciate their significance. Newton seems to have been at times able to establish a theory by a series of experiments so carefully planned that

[1] "Principles of Science," p. 577.
[2] Quoted in "Principles of Science," p. 578.
[3] "On the Part Played by Accident in Invention and Discovery," *Monist*, Jan., 1896.

few, if any, were abortive and almost every one crucial. But of course we cannot tell how much preliminary mental "fumbling" took place in order that the happy result might be accomplished. Edison's account of the invention of his electric light gives an insight of rare value into methods of invention. "Through all those years of experimentation and research, I never once made a discovery. All my work was deductive, and the results I achieved were those of invention pure and simple. I would construct a theory and work on its lines until I found it was untenable. Then it would be discarded at once and another theory evolved. This was the only possible way for me to work out the problem. . . . . I speak without exaggeration when I say that I have constructed 3000 different theories in connection with the electric light, each one of them reasonable and apparently likely to be true. Yet only in two cases did my experiments prove the truth of my theory. My chief difficulty was in constructing the carbon filament. . . . . Every quarter of the globe was ransacked by my agents, and all sorts of the queerest materials used, until finally the shred of bamboo, now utilized by us, was settled upon."[1]

This method of Edison certainly does not belong to the highest level, but for exhaustiveness and for the particular demand of his problem, who can say it was not the very fittest? These data are not sufficiently specific to throw much light on our special problem, but they suggest the possible variation of method, with the task in hand, and also indicate somewhat of the importance to psychology of a mass of more specific data concerning invention and investigation.

Summary.—As to the method of youths and adults: 1. Nearly all study the figure; many see several moves in advance; few successive trials are without circumspection. 2. A large majority, nevertheless, make a haphazard beginning at first. 3. There are wide individual differences in the conception of the figure; and this often changes in successive trials. 4. Most are early struck by the middle diagonal as a clue. 5. As compared with children, nearly all profit quickly by errors. 6. Two stages or "levels" of procedure and adaptation are roughly indicated: the conceptual and the receptual. 7. Eye and motor-mindedness have considerable influence upon the resulting adaptations.

Animal and Child Method.

Certain considerations demand a wider survey of the prob-

[1] "Talks with Edison," G. P. Lathrop, *Harper's*, Vol. 80, p. 425.

lem of conscious adaptation. If, as every one to-day agrees, life is "the continuous adjustment of internal relations to external relations;"[1] if the whole nervous system of organisms is a differentiation of tissues with the supreme function of preserving the results of former adjustments and the effecting of new ones; if, furthermore, for creatures in the ascending scale of life, consciousness is increasingly the instrument or the concomitant of all adaptations to new conditions,—then may we confidently seek a genetic view of the natural forms of adaptation, of the natural logic which organisms employ in dealing with novel situations. Of manifest importance to biology and psychology would be the natural history of such processes, from the lowest forms of conscious life to man, as well as from primitive man and the child to the adult scientest. Some studies of animal method, notably those of Romanes, Lubbock, Lloyd Morgan, Binet and Hodge, have shown the richness of the field. Similar studies of children have as yet scarcely passed the anecdotal stage.

In the case of animals, Lubbock found ants to be very stupid about discovering larvæ, when the latter were removed only six inches. The tracings of the paths of these ants remind one of a badly tangled mass of threads. Bees also have in varying degrees the same difficulty in finding their way. Lubbock put a bee into a bell glass 18 inches long and with a mouth 6½ inches wide, and turned the closed end toward the window. After an hour's trial the bee failed to make its escape. Flies got out at once. Another bee tried fruitlessly for half an hour, when the open end of the jar was turned toward the window and the bee flew out at once. Bees slowly learned to find their way, after a number of experiences.[2] Hodge found that a blindfolded shepherd dog's logic of search was no more systematic than that of Lubbock's ants, while Lloyd Morgan says that dogs using both sight and smell show the same bungling researchings.

Turning now to a slightly different aspect of the question of method, we find by far the most elaborate and precise experiments upon dogs, made by Lloyd Morgan. So typical are they that it seems best to describe one of the tests somewhat in detail.[3]

The dog, Tony, is a fox terrier about 14 months old. The scene of operations is a field, along one side of which run vertical rails about six inches apart, between which the dog can readily pass. There is one place where a rail is absent, and the gap is therefore

[1] Herbert Spencer, "Principles of Biology," N. Y., 1882, I., p. 80.
[2] "Ants, Bees and Wasps," pp. 278-9.
[3] "Introduction to Comparative Psychology," London, 1894, pp. 255 ff.

wice the usual width. Along one side of the field, at right angles o that described, there is an ordinary open iron fencing.

"*First Day.*—Standing on the path adjoining the field, and separated from it by the first mentioned vertical rails, I sent the dog after a short stick into the field, and called him back through the railings. The stick caught at the ends; I whistled and the dog pushed and struggled vigorously. He retired into the field, lay down, and began gnawing the stick. I called him and he came up slowly to the railings, and stuck again. After some efforts he put his head on one side, and got the stick, a short one, through. I patted him, and showed him my satisfaction. Then I sent him after it again. He came up to the railings with more confidence, but, having the stick well by the middle, found his passage barred. After some struggles he dropped the stick and came through. I sent him back to fetch it. He put his head through and seized the stick by the middle and then pulled with all his might, dancing up and down in his endeavors; wriggling his head in the efforts, he at last got the stick through. A third time he again stuck; again dropped the stick; and again seizing it by the middle tried to pull it through. But when I sent him after it he went through himself, picked it up by the middle, and tried to push his way through, succeeding after many abortive attempts by holding his head on one side."

On the second day a short stick was first used. First time the dog brought it cigar-fashion, and when it struck a rail turned his head and brought it through. But in several succeeding trials always seized it by the middle, and struggled as on the first day; had same experience with longer stick, but soon hit upon the plan of avoiding the struggle and coming around by way of the open fence.

On the third day he showed no improvement, but more quickly shirked the problem by running around to open fence. After several weeks another trial showed no improvement.

In other experiments when the stick was so placed that it could most easily be seized in the most effective way, namely, by one end, the dog failed to take advantage of it, but seized it by the middle.

At another time the dog was given a cane heavily loaded at one end; at first he grasped it by the middle, which made the carrying of it a most awkward performance. After two hours' experience he had gradually learned to seize it at a balancing distance, nearer the heavy end. He had slowly learned to profit by his mistakes.

Hodge[1] in his study of the homing of pigeons was led to investigate the natural logic of search. Believing that those animals survive who have developed the most exhaustive methods of searching a given area for food, he sought to discover how nearly the procedure of carrier pigeons approximates to the ideal. For comparative determinations he devised the following experiment, which was chiefly tried by children and adults. A ball is so hidden in a square field that the ball can be seen when the observer is twenty feet distant. From a stake in the centre as starting-point, what is the best method of finding the ball? The mathematically best method

[1] "The Method of Homing Pigeons," *Pop. Sci. Monthly*, April, 1894.

is a path of spiral shape, the distance between the lines being 40 feet. This involves practically no researchings. Another logical method is that of a series of straight paths gridironing the field in a way. This involves the searching of some areas a second time. Simpler logical methods might be described here; but enough, perhaps, has been said to make clear the conditions of the test and the means of grading the methods. As to results, most of the adults approximated very nearly the theoretical curve. A boy of 12, however, starts for the fence, follows it for some distance, then turning in, discovers the ball by accident. His curve is somewhat logical, but naturally of lower degree than those of adults. Tests of a number of children varying in age from 3 to 12 show surprisingly little logic. The tracings of a bright six-year-old girl resembled the tracings of Lubbock's ants, revealing scarcely a trace of system, and full of researchings of areas, already searched time and again. After 75 minutes she still failed to find the ball, which adults discovered in from 4 to 12 minutes.

Experiments made by the writer upon a number of kindergarten children, by means of the "20-Question" method, also emphasizes the "hit-and-miss" nature of their logic. At first the children were tested individually. The teacher thought of some object, and as the familiar game goes, the child was to discover what it was by questioning, the questions being such as could be answered by "yes" or "no." In only one or two cases was there more than a suggestion of systematic procedure. The typical form was a series of questions about particular things: "Is it a squirrel?" and the like. The very same questions were occasionally repeated by the same child. In the few exceptional cases above noted, a general question, such as, "Has it four legs?"—"two eyes?" when answered was made little use of. For instance, the child immediately, when told it did *not* "have four legs," would ask, "Is it a bear?" Investigation of the nature of the questions shows that "recency and vividness" of concrete experiences were responsible for nearly all. There had been a squirrel in the room only a few days before, and so on. There was also a rather remarkable uniformity in the questions of the various children, indicating the narrow range of associations and memories available upon such a demand.

The test was much enjoyed by the children, and became a fixture in the program of the school, all the pupils taking part together. Gradually they began to use some methodical means and to appreciate the value of general questions. This was no doubt due in part to imitation, as the questions

gravitated quickly toward a stereotyped form, and that not the best possible. But even then, after somewhat narrowing the possibilities by the use of general questions, they tended to break away from system, and began to "plunge," by means of particular questions. The intuitive as well as the explosive nature of child thought would not down, and successes were often remarkable.

So much for animal and child method. The similarities are too obvious to need special comment. But we are brought face to face with the old question: Are these forms of reason, or can they be explained in terms of simpler processes? Lloyd Morgan, proceeding with the postulate, that no action is to be explained in terms of a higher process if it can as well be explained in terms of a lower, holds that animal procedure in general, although intelligent, is not reason. *The* method *par excellence* of dog and chick and monkey is that of sense-trial and error. The animal learns by sense experience and without the aid of the more direct path, namely, perception of relations. This perception of relations constitutes reason. True, according to Morgan's optical simile, such perception of relations is implicit in the animal's cognition, is in the indirect field of consciousness. It must come into the focus before it can be largely effective in determining procedure, and in Morgan's opinion it probably never does become focal in animals.

Another illustration may be taken from Morgan. The dog wishes to go out into the road; there is a fence between. In thrusting his head through successive spaces in the fence, as dogs are wont to do, he, by chance, strikes one space above which lies the latch of the gate. In throwing up his head the latch releases the gate. Meanwhile the dog has turned away as if to return to the house, all unconscious of his happy stroke. The noise of the swinging gate, perhaps, attracts his attention, and discovering his opportunity he rushes into the road. With remembrance of success he goes next day, and thrusts his head mechanically through many spaces until he finally strikes the right one, and again the gate opens. Now, according to the above view, if he perceived relations, if he were not the victim of his train of associations and coördinations fixed by the first day's experience, he would go straightway to the latch. But no. Three weeks of successive trials are needed to enable him to strike this space at once. Even then he continues to lift the latch with the top of his head rather than by the more economical method of using his muzzle.[1] This is one of the best illustrations of the bungling nature

[1] *Ibid.*, pp. 289 ff.

of the method of sense-trial and error. None of the links in the chain of associations lapse readily enough to facilitate readier passage to the goal. It is a process of slow and toilsome perfectioning, and indeed may never become quite perfect.

As to whether animals do not at all perceive relations, present knowledge cannot decide. Perhaps the more intelligent of them do have an awareness of simple relations and make use of them in adaptations. Romanes' Cebus[1], in his learning to unscrew and screw the handle of the hearth-brush, strongly suggests that there was some perception of relations involved. Hiram Stanley[2] has also urged that other animals are thus conscious. Certainly any attempt to draw a too sharp line of demarkation between man and brute seems to do violence to present views of mental evolution. This much seems true: some of the higher animals may have a rudimentary perception of relations. Most of the adaptations of animals are on the sense-trial and error "level."[3]

The features of this "sense-trial and error" method are briefly these: 1. Repetition of many useless movements, simply because they have been made before, and refuse to make way for a short circuit. 2. Relative slowness in profiting by errors. A number of repetitions is often necessary in order to effect any change in procedure. 3. When variations occur, they are in general relatively slight. In short, successful adjustment is the result of a large number of experiences, and is attained by a series of slight variations.

We have found the procedure of children predominantly of the "sense-trial and error" order; but that they may perceive simple relations and make simple adaptations thereby, is perhaps true. The very early appearance of this ability cannot be doubted. A case in point is the oft-quoted one of Preyer's child, who in the 17th month used a traveling bag as a foot-stool from which to reach for something.[4]

[1] "Animal Intelligence."

[2] *Psychological Review*, III, pp. 536-41.

[3] The above view receives some neurological support from Flechsig's recent work, "*Gehirn und Seele*." In this the author maintains that the cerebral cortex of adult man is composed not only of a number of sensori-motor centres, but also of areas of higher order, called "associational," which are assumed to be representative of the elaborative mental processes, which of course deal with "relations." In the newly born child no "*Associations-centrum*" is functional. In most animals these areas are not even present. The evidence as regards animals, while not conclusive, points in general to the distinction we have been considering.

[4] Preyer: "Development of the Intellect," N. Y., p. 12.

But most of the demands upon children are sufficiently complex to throw them back, in the absence of imitation, upon this last and deepest resource, "sense-trial and error."

As earlier suggested, in older persons also, this primitive mode has a much larger place than is often suspected. Not only excessive unfamiliarity and complexity of the new situation, but also fatigue, temporary loss of interest, a fleeting state of mental muddle may produce a relapse into the animal method. A well-known scientist reports that in dealing with complex tables and statistics, and the like, he often when tired finds himself repeating again and again some trivial or important step, long ago really disposed of. This phenomenon in the absent-minded is too familiar to need illustration.

We are now in position more fully to analyze and interpret the results of our experimental puzzle test. The problem of conscious adaptation resolves itself into two questions: 1. What is the nature of the perception of the difficulty? 2. What is the resulting method of procedure in solving the problem? First as to the nature of the conception of the problem. Introspective notes by the children not being obtainable, we must infer their notion of the problem largely from their procedure. Most began on the outside of the figure. A large number of the younger pupils drew the square first, and only after repeated trials did they press into the intricacies of the inside of the figure. From these facts we infer an incomplete comprehension of the design. How explain this inadequacy? (*a*) Recent studies of children's drawings, notably the investigations of Barnes, Lukens and Baldwin, show that children are most impressed with outlines. Any connected view of elaborate details is apt to escape them. In the above experiment the outline, *i. e.*, the square, is very familiar and simple. Some children, furthermore, thought they had traced every line, when some were really omitted. (*b*) Another factor which may have considerable significance is that the complexity of the inside of the figure may have at first repelled them. (*c*) The testimony of adults renders it extremely probable that the children, when they finally did enter the figure, were also troubled by the oddness of the middle diagonal; still very few seem to have attached to it any great significance.

As to procedure, may it not have been determined in somewhat the following manner? The outline square caught the attention and set going tendencies fixed by long habit, to draw the square, etc. This movement once made tends to be repeated. It may be a form of the circular reaction, if you please, and the child is doing just as the animal—"imitating"

his former movements, consciously or unconsciously. Repeated failures lead to a dissatisfaction with the movements, and the result is variation. But so great is the inertia of the nervous mechanism, so weak the power of inhibition, that repeated failures seem unable, in most cases, to produce radical removal of the source of error. In the light of the above facts, it may be said that the child, even so old as eight years, is rather like an animal in method of adaptation than like the human adult. The young child is a reflex and automatic organism. His narrow motor and sensory experiences enable a few tendencies and habits to rule with a potency, which yields only to time and wider experience. With age the motor habits become rich in variety, and when action is demanded tend to neutralize one another, and make for that hesitation which enables "considerations" to tilt the balance more easily in favor of the best alternative.

What, then, of the so-called "plasticity" of childhood? If the above conclusions are true, plasticity does not, as often implied, mean resource, initiative, promptness of adaptation to the new. It must mean, rather, that children are imitative beings, and hence can quickly learn new ways of doing. Every normal child may indeed be a "genius," but not of the inventive and creative sort. Just as recent researches indicate that he is less inventive in language than formerly thought, so in other phases of activity, less and less is being credited to his initiative, and more to imitation. This does not degrade the mental status of children, but rather dignifies imitation as the great means by which the mind gets experience. Inventiveness is a plant of slow growth. Protected as he is from the bewildering complexity of environment, the child only slowly gains the wide variety of experiences which favors creative activity, and which makes for the higher adaptability that is necessary for adult life.

It is a coincidence of some suggestive value that many of the characteristics of mental adaptation may be described in phrases descriptive of evolution in general. Evolution, as generally considered, is a series of small successive changes. Many facts accentuate the unequal rate of change. The extreme of this tendency is found in the theory which emphasizes "sports"[1] as the usual method of evolution. These "sports" represent a rapid summation of changes, thus supplanting *slow* unfoldment by spurtiness. Even Galton[2] admits that these "sports" *may* be conceived as accumulations of successive small increments, although he inclines to the view of large increments. Now, in almost every field of growth, spe-

[1] Cf. Galton: "Natural Inheritance," London, 1889.
[2] *Ibid.*, pp. 32 ff.

cial cases of the above are discoverable. The spurtiness of physical growth, the periods of slow unfoldment of a member or an organ, or of the whole body, followed by a rapid acceleration; in the psychophysic domain the summation of subliminal stimuli is too familiar to need further description. Moreover, in the field of conscious attention, favorable conditions, many of which are perhaps physiological, produce the same summation phenomenon. Bryan and Harter have recently shown that the improvement in learning to "receive" telegraphic messages, while rapid for a time, ceases at a point just below the required proficiency, to be followed later by a second stage of more rapid improvement.[1] This description seems generally valid for all complex mental adaptations, and suggests anew the important rôle of the subconscious physiological factors in producing occasional accelerations.

If the different methods of adaptation be arranged in a series, as follows: Sense-trial and error, Receptual, Conceptual, certain general statements seem warranted. (1) *Objectively viewed:* With approximation to the highest level, there is greater and greater acceleration of adaptation. Variations are wider, and the goal is attained more and more by leaps and bounds. Furthermore, adaptation is more *comprehensive*. This also represents acceleration. (2) *Subjectively:* There is a greater and greater activity and elaboration of central processes, conscious and unconscious. Sense-trial and error can cope successfully and promptly with only a relatively simple environment, whereas the methods of higher level are imperative for complex adjustments. The economy of time, with rise in the scale of method, measured both by gain in comprehensiveness as well as in promptness, may be found, on further investigation, to follow some such law as that of the improvement due to habituation.[2]

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[1] "For many weeks there is an improvement which the student can feel sure of, and which is proved by objective tests. Then follows a long period when the student can feel no improvement, and objective tests show little or none. At the last end of the plateau the messages on the main line are, according to the unanimous testimony of all who have experience in the matter, a senseless clatter to the student, practically as unintelligible as the same messages were months before. Suddenly, within a few days, the change comes, and the senseless clatter becomes intelligent speech."—"Studies in the Physiology and Psychology of the Telegraphic Language," Bryan and Harter. *Psych. Rev.*, Vol. IV, No. 1, p. 52.

[2] Influence of habit proper, in increasing promptness of conscious adaptations, is best seen in the operation of such generalized habits as those of the physician in diagnosing disease. Inquiry among members of this profession developed the fact that while the novice

IV.

General Conclusions. Psychic development results in conscious adjustments to outer relations, which increase in number, complexity and variety. As well known, this development is not uniform, but falls into fairly well-marked stages.

The play instincts bear teleological relations to this growth. (1) The play impulse probably arose through the fact that those animals which in play gained preliminary exercise of activities useful in maturity survived in the struggle for existence. Play also serves as an index of the nascence of certain interests, capacities and even epochs of development.

The intellectual play instincts seem ripest in the immediate prepubertal years, and may correspond to an increase in the medullation of the associative fibres of the cortex, which is the prerequisite of function of the elaborative mental faculties. Puzzles which epitomize the more complex types of relations which may produce illusion or error are most interesting at this period. Intellectual play may develop mental flexibility, versatility, and even power of will, which in turn are of manifest importance for the more exacting and intricate reactions which come with adolescence.

The line of growth in ability to cope with environment, is indicated by three roughly demarkated stadia or levels: Sense-trial and error, Receptual, Conceptual. The method employed in a given case is determined partly by the capacity of the individual, partly by the difficulty of the problem, but in general, Sense-trial and error is predominantly the level of animal and child.

In closing, one or two rather obvious connections of this study with Pedagogy and Individual Psychology may be pointed out.

If the business of Education is to help the child to acquire the most economical and adequate means of meeting the demands of increasing complexity of life, then it must provide

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slavishly follows some standard scheme of diagnosis, which is an exhaustive application of the method of exclusion, with experience, he gradually dispenses with the detailed scheme, and finally may learn to go straight to the mark as by intuition. One physician says, "When a man steps into my office, I may mentally say, without a moment's reflection, 'That man has valvular disease of the heart.' Now, if called upon to give reasons for my judgment, considerable reflection is required, and even then some salient details may not come into clear consciousness, although my diagnosis has been correct." Now, when it is remembered that physicians deal not with disease, but with sick people, and that perhaps no two cases are alike, hence offering a somewhat new problem, the gain in time is more significant.

for his induction in proper season, from the sense-trial and error level into the modes of more prompt and comprehensive adaptation. The early school years belong of course to the sense level, but the rising curve of puzzle interest marks the prepubertal age as the time to hasten transition to the higher mental methods. The young child's simple, crude, sketchy, halting, analogical modes of appreciating relations may now be safely supplanted by more rigid and logical regimen. Furthermore, if too great difficulty of task, fatigue, temporary muddle, or loss of interest, tend even in the adult, whose conceptual processes are long established, to throw the mind back upon lower levels of adaptation, the adjustment of task to pupil receives new emphasis. The hygiene and practical importance of attempting the difficult only when in the top of condition rests on this ground.

The present trend of Psychology, in many quarters, is clearly away from the simpler problems of sense and muscle, and toward the more complex and immediately interesting questions of emotion, psychogenesis, pedagogic and individual psychology, or in Wundt's phrase, "individual characterology." For the testing of some of the most important qualities of mind and character an unusually rich material is offered by the extant collection of puzzles, and a properly graded set of such tests could hardly fail to furnish much valuable data. It is very evident, from the progress already made in this field, that the simpler tests of reaction-time, memory-span and discriminative sensibility are not so well suited to bring out those individual differences that are of account in the general conduct of life as are tests more closely related to the complex activities in question.

Appendix.

Historical Notes on Puzzles.

An inventory of puzzles shows them to cover a wide field and to be rich in number and variety. But the varieties within a single group are often reducible to a relatively small number of typical forms, many of which are of ancient origin. This paucity of type-forms and their persistence seem to be a result of a sort of a survival of the fittest. Tylor,[1] speaking of games, says: " . . . . when a game is once worked into perfect fitness for its place in the life of boys and men, it may last on with remarkable permanence, as when we see represented in the ancient Egyptian tombs the counting game, well known to us by its Italian name, "*morra;*" . . . . . Thus there is always a fair chance of finding in existence in modern times any of the popular games of the ancients." That the same statement is equally true of many puzzles, can be easily shown. Especially true is it of the Riddle.

[1] E. B. Tylor: "Geographical Distribution of Games," *Journal Anthr. Inst.*, IX.

Language Puzzles.

The Riddle:—The origin of the Riddle is not known, but it has been and is now found pretty generally even among peoples of a low degree of mental advancement. To quote Rolland:[1] "From the Vedic riddles to the riddle contests of Scandinavian gods, or of German minnesingers; from the famous question of the Sphinx to the '*Philosophies des Enigmes*' of Menestrier; . . . . ; from the riddle that caused the death of Homer to those which amused all the Wolofs,—we find great variety, wide contrasts, but nevertheless a fundamental resemblance." They play upon analogies among things perceived. Essentially, the primitive mode of invention is as follows: Some one discovers a new analogy among natural objects, formulates a question concerning it, and thus a new riddle is born. While the most primitive forms have chief reference to natural objects, the evolution of the riddle reflects the shifting of man's chief interest from external nature to man himself. Some of the most famous riddles among the Greeks have this human focus.

Just when, in the development of a people, riddle-making begins and also the period when it loses its soberer aspect and becomes a mere sport or pastime, are not easily determined. They bear obvious relation to intellectual status. Tylor thinks that the simpler forms, the "sense-riddles," belong thoroughly to the mythologic stage of thought, and are in consequence found at home among the upper savages, and range on into lower and middle civilizations. "The making of riddles," says he, "requires a fair power of ideal comparison, and knowledge must have made considerable advance before the process could become so familiar as to fall from earnest into sport. In higher states of culture, riddles begin to be looked upon as trifling. They survive only as the remnants of child's play."[2] The rôle of the riddle in education among lower races must be important. Among the Basutos "riddles are a recognized part of education and are set like exercises to a whole company of puzzled children."[3] It is training in that analogy-thinking which is indeed the true father of generalization and classification, whose high perfection is reflected in modern science. Even among people of higher culture, the ability to answer riddles was considered a proof of great sagacity. The ability to interpret some of the replies of the Greek oracles was a supreme test of wisdom.[4] Among Semitic peoples the same criterion existed. Samson's riddle, and Solomon's success in answering the questions of the Queen of Sheba, need only be mentioned. Mr. Lockhart has translated a Hebrew manuscript which claims to give the list of problems proposed by the Queen of Sheba. There are nineteen in all, and some are certainly remarkable.[5] In Märchen, and ballads of a later period, the hero's chance of winning his beloved, or of escaping threatened punishment, often turns on his power of answering riddles.

Analysis of the riddle shows it to contain some of the chief elements of literature. The anthropomorphizing and personalizing tendencies, which often characterize it, show the riddle to be closely related to the fable. And having its deepest roots in the perception

[1] Rolland: *Devinettes ou Énigmes Populaires de la France.* Edition of 1877, Paris.
[2] Tylor: "Primitive Culture," I, p. 91.
[3] *Ibid.*, I, 90 ff.
[4] "Greek Oracles," F. W. H. Myers, Hellenica, London, 1889.
[5] "The Riddles of Solomon in Rabbinic Literature," J. H. Stewart Lockhart, *Folk Lore*, I, 1890.

of analogies in nature, the riddle is brother to the metaphor, which has been so important in the development of languages and myths. A riddle may, indeed, be defined as a metaphor or group of metaphors, whose usage has not yet become common and whose explanation is not evident.

The Enigma:—While the riddle may have been important in the intellectual life of the Hebrews, its wide development and rich elaboration seem to have been reserved to the Greeks. One of its modifications, the enigma, merely a riddle in poetic form, was tried by the greatest Greek poets, and some even devoted whole poems to them, as the Syrinx, attributed to Theocritus. In the "riddle-revivals" of later periods, as we shall see, the culmination was always in an interest in enigmas.

Before proceeding to consideration of the import of riddles, it is perhaps worth while to note several other forms of language puzzles at least three of which are closely allied to the groups already discussed. *The Rebus* also bears evidence of very ancient lineage. Generally it is a form of riddle in which the problem consists in the interpretation of pictures or objects. This use of object-method obviously requires in its simpler forms no very high degree of intellectual advancement. It may well be a reverberation of man's earlier modes of symbolic expression. One of the earliest examples recorded is as follows: When the Scythians were invaded by Cyrus, they sent messengers bearing arrows, a rat and a frog; implying that unless he could hide in a hole like a rat, or in water like a frog, he would not escape their arrows. André asserts that the rebus had a considerable vogue in ancient Italy. In Via Appia, Rome, is a tomb still existing, that of a certain Publius Philo-*musus* which has on it well executed bas-reliefs of *mice.*[1] Cæsar,[2] while one of the masters of the Roman mint, placed the figure of an elephant on the reverse side of public money in defiance of law, because "Cæsar" meant "elephant" in the Punic language. Even in England to-day, complicated rebuses abound on monumental brasses, tombs and sculptures.[3] In the rebuses most familiar among us, alphabetical writing and picture writing are usually combined. *The Conundrum* is perhaps of much later origin than the rebus. It is a riddle involving a play upon words, often in the form of a pun, and thus presupposes a considerable acquaintance with language and the facile use of a somewhat elaborate vocabulary. The conundrum is said to have been a favorite source of entertainment at the later Roman feasts. It is one of the last forms of riddle to fall thus to the level of a mere pastime.

The Charade is also an elaboration of the riddle. Two chief forms are distinguishable. In one, the object referred to is described by other objects, but generally by action or gestures of persons proposing the problem. In its higher form, it resembles the enigma in that it is set in metrical form, but the riddles involved have reference to words, or parts of words, instead of objects. This form of charade, which has maintained its dignity as an amusement for adults, is probably of very recent birth, not being known in France, at least, in 1771.[4] Within two or three years several volumes of charades have been published in this country and enjoy wide popularity.

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[1] J. Lewis André: "Puns and Rebuses in History and Archæology," *Reliquary*, XXIII, p. 169.
[2] D'Israeli: "Curiosities of Literature."
[3] André: *ibid.*
[4] D'Israeli: "Curiosities of Literature."

The Anagram, although a language puzzle, partakes somewhat less of the riddle element than do the foregoing. It involves the construction of a significant word or phrase from the letters of a given name. Originally oriental, it became known to the Hebrews, who classed it among the cabalistic sciences. They believed occult properties to reside in proper names. Finally the anagram became current among the Greeks. "Plato had strange notions of the influence of anagrams, when drawn out of person's names, and later Platonists were full of the mysteries of the anagrammatic virtues of names."[1] Anagrams thus constructed from letters of the name of a given person, often even influenced his choice of vocation. This mystic significance of the anagram thus almost eclipses its puzzle element. Its later use as a puzzle, however, entitles it to some notice in this sketch.

The above seems to represent the more fundamental types, out of which most of the later forms of language puzzles have grown.

Revivals of Interest in Language Puzzles.

At certain later epochs there are traces of renewed interest in language puzzles, and especially in riddles and enigmas. Such periods seem to coincide with seasons of intellectual awakening. In the latter half of the 7th century, Adhelm, Bishop of Sherbourne, left a number of enigmas in Latin hexameter which have been repeatedly printed. Before his time there was a collection of Latin enigmas, each containing three hexameter lines. The revival thus begun propagated itself throughout the remainder of the Anglo-Saxon period. There were eighty riddles and enigmas in English before the Norman conquest. In Protestant countries the Reformation put a stop, for a time, to the riddle-making.

In the 17th century, a great riddle era in France, there was considerable publication. At this time, Menestrier also wrote his "Philosophy of Enigmas." The taste spread to England. Swift, Cowper, Fox and others wrote a number. One of the famous prose riddles of this period was that by Fox, on a "Watch." "I went to the Crimea; I stopped there, and I never went there, and I came back again." More than a score of Swift's enigmas are printed.[2] Some are of considerable length, notably these: "On a Pen," "On a Corkscrew," "The Gulf of all Human Possessions," "An Echo," "On a Shadow in a Glass." One of the best of the briefer ones—that "On Time"—is as follows:

> "Ever eating, never cloying,
> All-devouring, all-destroying,
> Never finding full repast,
> Till I eat the world at last."

Again, in the 18th century, notably in France, the interest in riddles and enigmas became marked, Voltaire and Rousseau writing, among others. "*Mercure de France*" became a repository of riddles and enigmas, the solution of which was sufficient to make a reputation in society.[3] To such exuberance of mental energy, and especially the delight in playing with language, is to be ascribed the invention of other intricate word puzzles, as the acrostic, word-square, charade, and the like. Boccaccio wrote a giant acrostic of fifty cantos.[4] During the Elizabethan age, words and verses were tortured into the most fantastic forms. Acrostics and chronograms were much in vogue.

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[1] D'Israeli: "Curiosities of Literature."
[2] Works of Jonathan Swift; edited by Sir Walter Scott, Vol. XV, London, 1883.
[3] Art. "Riddles," Chambers' Encyc.
[4] D'Israeli: *ibid.*

Summary. Language puzzles, and especially riddles, arising from the same soil that produces literature and mythology, seriously engage the mind of peoples of relatively low degree of intellectual advancement. They depend upon perception of analogies, which is the predominant characteristic of the thinking of early peoples and of children.[1] The riddle probably plays a serious rôle in education among lower races. But later, when perception of analogies becomes sufficiently easy, these puzzles lose their soberer aspects and serve merely as amusements. The later development of language puzzles shows the influence of growing culture. The riddle makes way for the enigma, with its regard for literary form; for the conundrum, which savors of the three R's; and finally for the acrostic, word-square and charade, which take one farther and farther from the natural objects that were the original theme of riddles.

Mathematical Puzzles.

The germs of mathematical puzzles must have appeared early in the development of mathematics, but the first works devoted to them date from the 16th century. The list of works since that time, containing either a general collection of these, or special consideration of single problems, numbers upwards of 120. De Bouvelle's "*Propositions arithmeticæ ad acuendos juvenes*," printed 1543, (credited at different times to Bede or Alcuin) is said by Lucas to be the first known beginnings of mathematical recreations. Perhaps the best known and most popular works of this class, however, are Bachet's[2] "*Problemes plaisans et délectables*," Paris, 1612, which has gone through several editions, the last two in 1874 and 1879 respectively; and Ozanam's "*Récréations mathématiques*," Paris, 1694, of which also a good many editions have been sold, and which has been much revised and popularized by Montucla. A translation into English of Montucla's edition was published by Charles Hutton early in this century. A later edition bears the date of 1840. These works of Bachet and Ozanam are the chief sources of the modern mathematical puzzles which appear in popular works on the subject, and in juvenile periodicals. Two recent works deserve mention: Ball's "Mathematical Recreations and Problems"[3] and Lucas' *Récréations mathématiques*,"[4] in five volumes. A long line of distinguished mathematicians, including Cardan, Tartaglia, Fermat, Leibnitz, Euler, Listing, Plateau, Thompson, Sylvester, Story and Ch. Henry, have interested themselves in problems in this field. Several histories of the attempts at the "Quadrature of the Circle" and of the forms of "Magic Squares," bear abundant testimony to the fascination which these problems possess for the mathematical mind. "Magic Squares," moreover, were invested with a mystic signification which long endured. Albrecht Dürer, in his famous "Melancholy," engraved in 1514, has represented a magic square, showing that even in his day, it retained at least a symbolic meaning.

The 14-15-16 puzzle, so much in vogue within comparatively recent years in this country, is said to have been invented by an Englishman 200 years ago. It has been mathematically treated by Story and others. Puzzles of the labyrinthine and maze types, so

[1] Cf. Jastrow: "Natural History of Analogy." Proceedings Am. Ass'n Advancement of Science, 1891.
[2] Cf. Bibliography in Lucas' work.
[3] London, 1892.
[4] Paris, 1882.

familiar in puzzle columns, have a history. These forms have always fascinated men. The famous labyrinths of ancient times — the Egyptian, Cretan and Samian—were reckoned among the wonders of the world, and were held to be unthreadable. The Egyptian labyrinth contained more than 3000 chambers. In the middle ages the custom of constructing in the walls and pavements of churches labyrinthine designs, is well known. The same pattern also came to be a feature of landscape gardening, and the labyrinth of Hampton court is one of the most famous in England. Mathematical interest in the labyrinth in all its varieties, and also its vogue as a puzzle, probably dates from the middle ages. Tremaux and others have published rules for threading such figures.

These instances illustrate sufficiently, perhaps, how many puzzles have from early times strongly appealed to the human mind. It is hardly a chance coincidence that so much of myth and mystic meaning has clustered about them, in view of their peculiarly baffling quality.[1] On the other hand we have seen how some problems (as the 14-15-16 puzzle), although originally invented to amuse, may by competent mathematical treatment be lifted to the plane of a real and perhaps important problem, and thus contribute in a direct way something to the enrichment of science.

Mechanical Puzzles.

The history of this group is even more meagre than that of the preceding. Aside from those mechanical puzzles whose mathematical tractment has been exploited, very little account is obtainable. It may be expected, however, that anthropological investigation will show the same wide distribution and similarity of origin that have been found in the case of games. The University of Pennsylvania's exhibit at the Columbian Exposition contained 129 mechanical puzzles, most of which are of oriental origin.[2] The larger number are not, as commonly believed, invented in China and Japan, but rather in India. Sporadic invention of puzzles has indeed occurred in modern times in Europe, while America has made something of a name for the ingenuity of its inventors in this line. But few are entirely original, and the usual *modus operandi* of the puzzle maker is to graft onto an old type enough slight modifications to give the appearance of novelty, and commend the whole to the public by a fetching name. The distinct types of puzzles are few in number.[3]

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[1] To illustrate how myth and legend tend to cluster about puzzles, the following concerning the familiar mechanical problem, the Tower of Hanöi, is in point. M. De Parville gives an account of the origin of the toy, "In the great temple of Benares, beneath the dome which marks the centre of the world, rests a brass plate in which are fixed three diamond needles, each a cubit high and as thick as the body of a bee. On one of these needles, at the creation, God placed sixty-four discs of pure gold, the largest disc resting on the brass plate, and the others getting smaller and smaller up to the top one. This is the tower of Bramah. Day and night, unceasingly, the priests transfer the discs from one diamond needle to another, according to the fixed and immutable laws of Bramah, which require that the priest must not move more than one disc at a time and that he must place this disc on a needle so that there is not a smaller disc below it. When the sixty-four discs shall have been thus transferred from the needle on which, at the creation, God placed them, to one of the other needles, tower, temple and Brahmins alike will crumble into dust, and with a thunder-clap the world will vanish . . . ."—Ball, "Mathematical Recreations," p. 78.

[2] Stewart Culin, *A. J. Folk Lore*, VI, 22.

[3] Perhaps nowhere are some of the characteristics of the problem-solving instinct more clearly exemplified, and the essential unity of the human mind, in spite of the differences of time, nationality or race, more clearly indicated, than in the history of attempts to solve a peculiar group of problems whose insolvability has called down upon them the opprobrious epithet of "Follies of Science." Prominent among these

Logical and Philosophical Puzzles.

Although Zeno of Elea, the "father of dialectic," is indirectly perhaps the first important source of puzzle material of this sort, its chief development falls in two later epochs, one ancient, the other mediæval, namely, among the sophists and the schoolmen. Both agree in exalting the formal aspect of thought, and acquired marvelous skill in the handling of phrase and proposition, which, as it degenerated, often sunk matter in method and made discussion a rhetorical swordplay.

Two of the minor sophists, Euthydemus and Dionysodorus, are of this sort. Plato draws a memorable picture of them in his "Euthydemus."[1] Claiming to be masters of the art of eristic, or fighting with words, they stand ready to teach for a consideration. A few of the questions which were put to the youth Cleinias give a fair idea of their expert word-juggling. "Cleinias," says Euthydemus, "who learn, the wise or the unwise?" "The wise," is the reply. . . . "And yet when you learned you did not know and were not wise." Again: "And do they learn what they know or what they do not know?" "The latter." "And dictation is a dictation of letters?" "Yes." "And you know letters?" "Yes." "Then you learn what you know." "But," says Dionysodorus, "is not learning acquiring knowledge?" "Yes." "And you acquire that which you have not got already?" "Yes." "Then you learn that which you do not know." And so it goes. If we wonder how any people should have taken such word-juggling seriously, we should remember the status of the Greek mind. Every philosophic idea was in a state of flux; contradictions were rife; logic was not yet written; there was no analysis of grammar. Language was first beginning to perplex human thought. The contribution of the sophists to the intellectual activity of the Greeks was genuinely important. It is now admitted that they led to the systematic study of grammer, rhetoric, philology, and were the necessary propædeutic for the logic of Aristotle.

The most interesting and ingenious arguments of the sophists survive in the logical treatises, but any attempt to classify the whole range of their puzzles would be futile. Many depend upon ambiguity of meaning of terms. Others are of more intricate logical form.

The puzzle interest in Greece did not die with the sophists. According to Diogenes Laertius, Chrysippus, the stoic, wrote six different treatises upon Eubulides' famous puzzle, "The Liar," and Philetas of Cos studied himself to death in attempting to solve it.[2]

Three illustrations will sufficiently exemplify the sources of the puzzles of this early period. Zeno's arguments against the reality of motion, of time, space, the manifold, and the veracity of sense perception, can be characterized, as to form, by a single one against motion. Motion cannot begin, because a body in motion cannot arrive at another place until it has passed through an unlimited number of intermediate places.[3] Of a later period the following are representative: — The Protagoras-Eualthus argument. Eual-

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are Duplication of the Cube, Trisection of the Angle, Quadrature of the Circle, Astrology, Alchemy, and Perpetual Motion. Most are of great antiquity and have a voluminous history, but Perpetual Motion has received little attention historically. No prolonged or systematic search for the origins of this problem seems to have been made. From data already gathered, there are evidences of a close relation of this mechanical idea to certain biological and philosophical concepts; and in yet other respects, it offers a field for profitable psychological study.

[1] Jowett's edition of Plato.

[2] Bowen's "Logic," p. 289.

[3] Ueberweg: "History of Philosophy," I, p. 57.

thus received lessons in rhetoric from Protagoras, it being agreed that a certain fee should be paid if the pupil were successful in the first cause he pleaded. Eualthus neglected to take any case and Protagoras sued for his fee. Eualthus defended himself in court and it was consequently his first case. Protagoras argued, "If I be successful in this case, O Eualthus, you will be compelled to pay by virtue of the sentence of these righteous judges; and should I be even unsuccessful you will then have to pay me in fulfillment of your original contract." Eualthus replied, "If I be successful, O master, I shall be free by the sentence of these righteous judges; and even if I be unsuccessful, I shall be free by virtue of the contract." The "Syllogismus Crocodilus," Eubulides' "Liar," "All rules have their exceptions," are a few of the numerous puzzles of this group. Finally, there is a group which plays upon the manner of asking questions, so bringing it about that either an affirmative or negative involves one in apparent admissions of a damaging nature. "Have you left off beating your father?" is obviously of this sort.

Among the schoolmen is seen the apotheosis of formal logic. The mission of scholasticism was to furnish a rational basis for the Christian faith. "They burden themselves with the weight of a logical instrument which Aristotle created for theory and not for practice, and which ought to have remained in a cabinet of philosophical curiosities without ever being carried into the field of action."[1]

Disputation was the great means of education. Dexterity in framing and solving sophisms was reckoned a scholarly accomplishment and one of the special fruits of a university training. In spite, however, of the indictment of Milman[2] and others, that these activities never had nor cared to have any bearings on the life and practical opinions of mankind; in spite of their failure to add directly a single new idea to science,—nevertheless the mind of semi-barbarous Europe was thereby trained for the vast work of the modern world.

This being as it may, there can be no doubt about the arid subtleties of its decadence. Even St. Thomas Aquinas—the "greatest giant between Aristotle and Newton" — is carried away by his devotion to logic. In his *Summa Theologiæ* — where everything is thrown into Aristotelian form—are found discussions and logical demonstrations of such propositions as these: "Angels are composed of action and potentiality." "Every angel differs from every other in species." "The bodies assumed by angels are of thick air." "Many angels cannot be in the same place." "The velocity of an angel is not according to the quantity of his strength, but according to his will." "The motion of the illumination of an angel is three-fold, or circular, straight and oblique." Others discussed whether the angel Gabriel appeared to the Virgin Mary in the shape of serpent, dove, man or woman. Young or old? In what dress? Garment white or of two colors? Linen clean or foul, etc.? What was the color of the Virgin Mary's hair? Was she acquainted with the mechanic or liberal arts?

Through more than a century thousands debated the problem, "When a hog is carried to the market with a rope about his neck, which is held at the other end by a man, whether the hog is carried to the market by the *rope* or by the *man*?" The "free-will" discussion gave rise to famous problems. One of these was invented

[1] Taine: "History of English Literature," I, pp. 214-15.
[2] Milman: "Latin Christianity," VIII, p. 267.

by J. Buridan[1] (died about 1358), and is widely known as "Buridan's Ass." "An ass is equally pressed by hunger and by thirst; a bundle of hay is on one side, a pail of water on the other. Will he die for want of both, or will he make a choice?"

Remembering that a puzzle is a problem whose solution is an end in itself—a problem attempted mainly for the pleasure derived from the activity — the question naturally rises, are the above fairly called puzzles? Were they not dealt with because they had application to real questions and principles of philosophy and morality? It cannot be denied that most were originally of that sort. Aquinas certainly cannot be charged with admitting to discussion any matter which does not bear directly upon the serious task in hand. Even the apparent trivialities were important in his logical arches. It is when torn from their setting and employed as theses at a later period, when logic had fallen to the plane of a mere gymnastic, that they degenerate into mere puzzles.

Logical puzzles of this sort find few devotees to-day, though some who have reached that stadium in the study of logic and metaphysics which brings a certain mastery, find a temporary pleasure in them. A more distinctly modern species of logical puzzle grows out of the study of logical theory. The following is quoted from the "Life of De Morgan": "(1) For every z there is an x which is not y. (2) Some y's are z's. Some x's are not z's."[2] Prof. Jastrow[3] has also recently published one of this sort: "Granted that A is B, to prove that B is A. B (like everything else) is either A or not A. If B is not A, then by our first premise we have the syllogism: A is B: B is not A: ∴ A is not A; which is absurd, therefore B is A."

Whether any of the larger present problems of philosophy, epistemology, ontology and metaphysics, often take on the puzzle *quale*, may well be doubted, but that they occasionally do so in some minds seems likely. That such problems are attempted at first simply for the pleasure of the activity, is hardly possible. As Kant says: "It is in vain to assume a kind of artificial indifferentism in respect to inquiries, the subject of which cannot be indifferent to human nature."[4]

But what shall be said of the fascination which the antinomies exercise upon some minds? What of the devotees of ontology, who, refusing to accept the verdict of critical philosophies, press on by old and fruitless methods to the ultimate reality, to the absolute? It must be conceded that as the original impulse fails and as the solution of ultimate questions seems more and more remote, there appears to come in some minds a tendency to manipulate the cherished formulæ, just as the mathematicians often do theirs, to see what will "come of them," or to keep the dialectic muscles in the top of condition.

Dilemmas of Etiquette, Law, Strategy, Ethics, Etc.

To the majority of mankind the supremely interesting problems are those dealing with practical life. But for the very reason that they have a practical focus, they are not strictly classifiable as puzzles. Hence little more can be done than to suggest in the briefest and most fragmentary way a few lines along which are discoverable cases, which seem to possess a modicum, at least, of puzzle quality.

[1] De Morgan: "Budget of Paradoxes," p. 28.
[2] *Knowledge*, III, p. 7.
[3] *Science*, N. S., V, p. 105.
[4] "Critique of Pure Reason," Introduction, Trans. by Müller, p. XXI.

Mason[1] quotes the observation of a whaling captain, that the Eskimo often go out, in sport, to difficult places, and having imagined themselves in certain straits, compare notes as to what each one would do. Fifteen years ago the puzzle mania in England, after a long vogue of acrostics and the like, finally went over to personal dilemma puzzles, not unlike those of the Eskimo. They ran like this: "A certain man does so and so, and in consequence finds himself in such and such a delicate moral situation, what shall he do?" The popularity of certain stories which pose a dilemma, as the "Lady or the Tiger?"; and so-called mystery stories, a device of modern newspaperdom, wherein the culmination of the plot is left to the ingenuity of the reader, are further illustrations in point. The correspondence columns of many periodicals to-day also show the almost morbid degree of interest, on the part of some, in questions of etiquette. How many of these problems belong strictly to the puzzle field cannot be determined.

In the field of strategy the puzzles are perhaps few, but of exceeding interest to some minds. One of the writer's friends occasionally whiles away a tedious quarter of an hour by planning an impenetrable fort, and then attempts to make his way in.

From the very nature of Casuistry as an application of reason to particular cases where conflicting or apparently conflicting duties are involved, it became the source no less than scholasticism of formal distinctions, of logical subtleties, which are the rich soil for the possible growth of puzzle material. But, as in the case of philosophy, it is only in its degenerate states, and not always then that its problems are fairly to be called puzzles, having in general entirely practical ends. The later works on casuistry (up to 1700) contain such problems as these, "Does a man who steals four shillings commit a mortal sin, or only a venial one?" "Does a man who blasphemes twenty saints at once, commit twenty sins, or only one?" The culmination of this rank development is perhaps in the doctrine of Probabilism, which rested on the theory that the moral law does not bind in cases where it is doubtful, and that it may be considered doubtful if theologians of name have denied that it binds in particular cases. This was an obvious opportunity for endless discussion, and the moral laxity which the principle permitted was so effectively branded by Pascal in his "Provincial Letters" as to lead to the condemnation of the doctrine and the temporary overthrow of the Jesuits in France.

Civil law also furnishes nearly the same favorable conditions for subtle distinctions, and most of the decisions of courts are often difficult applications of principles to particular cases, and hence a form of casuistry in the original meaning of the term. The development of Roman law, with its necessarily great emphasis on definition and fine shades of meaning, must have been also especially responsible for that love of logic-chopping which is supposed to survive to-day in the law courts.

Enough has been said, perhaps, to make it patent that questions of law, strategy and ethics may degenerate into mere puzzles, and when they do so, belong to the Logical and Philosophical groups.

It remains to speak of the abnormal and genuinely morbid aspects of the mental state of puzzle. Nowhere is an abnormal turn so likely as in the field of the ethical and practical. The type of man or woman constantly brooding over fine distinctions of motives and conduct, full of forebodings as to the outcome of simple acts, which, at most, are of little real consequence, and which

[1] "Origin of Inventions."

should have been relegated to automatism, is too sad and too familiar in literature and in life to need illustration. The perspective of life is lost, and the painful unrest tends to color in sombre hue the whole stream of thought.

In distinctly morbid cases also (*Grübelsucht*, or Insanity of Doubt), the matters over which the patients ponder are those discussed in the last two sections. "One patient doubts everything, even his own existence, and is totally unable to arrive at any definite conclusion on any subject. Another cannot discuss a subject without indulging in the tiresome process of hair-splitting, and in so doing exhausting all the subtleties of scholasticism concerning matters more or less familiar or hackneyed." On the basis of the ideas which prevail in the minds of these unfortunates the following classification has been made: The *Metaphysicians*, who ponder abstruse questions. Who created God? What is the origin of language? What is immortality? and the like. The *Realists*, who think of more trivial questions. A Russian prince, for instance, wonders "why men are not as tall as houses." Another wonders why there is only one moon, and not two. The *Scrupulous*, who constantly struggle for precision in statement. They weigh fine distinctions in order to be truthful. The *Timid*, who speculate about personal or bodily accidents and their consequences. The *Reckoners*, full of anxiety to know the numbers of things, who count buttons, windows and every conceivable object.[1] Like the normal philosophical and ethical examples, these questionings, in so far as they are undertaken for supposed ends of conduct, would be excluded by a rigid definition of puzzles, but in so far as they are undertaken merely from an undefined impulse to reach a solution, they would come fairly within.

[1] Ball: "Insanity of Doubt," Tuke's *Dictionary Psych. Med.*

THE VALIDITY OF THE PSYCHOPHYSICAL LAW FOR THE ESTIMATION OF SURFACE MAGNITUDES.

By J. McCrea, B. A., and H. J. Pritchard, B. A. (Toronto).

The Psychophysical Law has been tested as to its application, for linear magnitudes, but hitherto little has been done to find out to what extent it may be applied to the estimation of surfaces. This paper gives the results of a series of experiments which have been made for the purpose of testing the validity of the law when applied to the estimation of surface magnitudes. The experiments have been performed in the Psychological Laboratory of the University of Toronto, during the session of 1896-97.

The apparatus used, constructed under the direction of Dr. Kirschmann, is essentially that used by Mr. J. O. Quantz, B. A., when experimenting on a problem akin to the present investigation during the session of 1893-94. For a description of this apparatus the readers are referred to Vol. VII, No. 1, of this Journal, to the article on "The Influence of the Color of Surfaces on our Estimation of their Magnitudes." Except for one or two minor changes the arrangement was the same as in Mr. Quantz' experiments. In the present investigation the colored surfaces were replaced by white, which were obtained by simply leaving the surface in the diaphragm open and covering the open end of the apparatus with white tissue papers in addition to the ground glass of the window.

The objects used in our case were taken from a set of 180 brass diaphragms, varying in diameter from 6 to 50 mm., which were constructed according to the device of Dr. Kirschmann, by means of a conical drill which bored through the above stated number of thin sheets of brass, which were tightly clasped together. By this means the necessity of any further finishing, such as grinding or filing, which would have spoiled the continuity of the transitions, was prevented. In order to secure a constant distance of the periphery of the circular diaphragm from one of the margins of the brass plate, the plates were set in such a way that one surface of the parallelopipedon, which they formed, was parallel to the cutting edge of the conical drill.

From this set of diaphragms we selected for each experiment two discs of different size. This was done in order to eliminate the error which might arise from knowing the posi-

tion in which the discs had actually the same visual angle. The difference between their diameters which was most convenient for us to use was about one millimeter. The measurement of the diameters of these was made with a micrometer caliper, by which it was possible to measure distances to $\frac{1}{50}$ of a millimeter. Each observer measured each disc 10 times, and the average of the 20 trials was taken.

As the discs were made with a conical drill, the diameter of the aperture on one side was somewhat smaller than that on the other. The side on which the diameter was the smaller was blackened, so as to prevent the reflection of light as much as possible. Then the diaphragms were placed on the screens, with the blackened side toward the eye of the observer.

With the same micrometer caliper also was ascertained the distance between the two discs when in the same plane. This distance remained approximately constant for all the series. The distance between the fixed or normal disc and the eye of the observer was 1230 mm., and this remained constant throughout.

In the observations, the mode of operation was the same as that described by Mr. Quantz in his paper. Each observer made 100 observations with each eye in every series of experiments, but they were not made consecutively. Only 20 or 30 observations with each eye were made by an observer in succession, and in these he made 10 observations with each eye alternately. This change was made so that the eye would not become wearied by too prolonged use. These 100 observations with each eye are called a series.

After each observer had made 100 observations with each eye, the discs were interchanged and the same mode of procedure was followed. These observations are called the second series and these two series of observation are called a set. As will be seen from the accompanying table, six such sets of experiments have been performed.

Although the intention was to apply the Method of Average Errors, the ordinary course of procedure in the calculation was not followed; for, instead of the pure average error, on the advice of the director of the laboratory, we computed the Mean Variation. The Mean Variation has the advantage of being entirely independent of the normal magnitude, thus giving only the average deviation from an ideal normal magnitude, represented by the average value of the observations. If, to the determination of the normal magnitude, an error of $\frac{1}{10000}$ would adhere, this error would be implied in each observation, and if the observations were all in one direction, either positive or negative, the error would enter the last result multiplied by the number of cases. Further, by using the Mean Variation, one escapes the ambiguity which is

involved in the ordinary use of the Average Error Method, viz.: in the Method of Pure Average Errors, we can change, without detriment to the pure average error, one observation of a series (*e. g.*, from the positive to the negative) without changing any other. This is not possible if we take the mean variation.

In employing this method, it was applied to the distances of the variable stimulus from the normal stimulus. First, the average distance between them was found and the mean variation in the 100 observations computed. Then the average distance was added to, or subtracted from, the 1230 mm., according to the direction from the normal stimulus in which the average distance was found to be. The result thus obtained was called r. The mean variation was added to r, and the result called r^{m}; it was likewise subtracted from r, and the result called r_{1}. Then by means of a trigonometrical solution, the value of the visual angles, subtended by the diameter of the disc at each of these three distances, was ascertained. The computation is exactly the same as in the case of Mr. Quantz, to whose geometrical representations the reader is referred. Then, having found the difference between the angle subtended by the disc at the distance r and each of the other two angles, the average of these two differences was taken, and this average is regarded in our tables as the mean variation. The relation between this variation and the visual angle of the diameter of the disc at the distance r was expressed in percentage; and the averages were taken of the per cent. for both of the eyes in both series of the set.

From this percentage of the mean variation of the diameter, the percentage of the mean variation of the surface magnitude may be deduced. By means of the following algebraic process, it was ascertained that the relation between these two percentages remained constant.

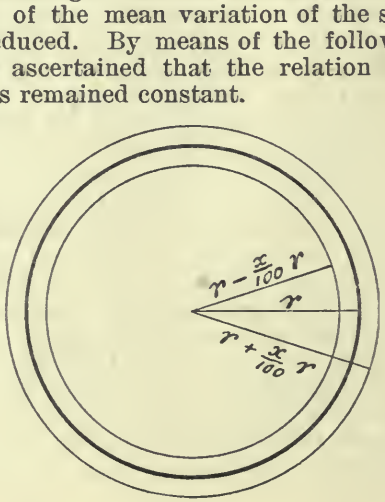

FIG. 1.

r = radius of circle, which represents the estimated value.
x = the % of r, which represents the mean variation.
$(r+\frac{x}{100}\,r)$ and $r-(\frac{x}{100}\,.\,r)$ = the radii of the circles between which the variations of the circle have play.

1. Area of Estimated Value $= \pi r^2$
2. Area of inc. circle $= \pi (r+\frac{x}{100}.r)^2 = \pi r^2 (1+\frac{2x}{100}+\frac{x^2}{10000})$
3. Area of dec. circle $= \pi (r-\frac{x}{100}.r)^2 = \pi r^2 (1-\frac{2x}{100}+\frac{x^2}{10000})$

Diff. of 2 from estim'd value $= \pi r^2 (1+\frac{2x}{100}+\frac{x^2}{10000}) - \pi r^2$
$= \pi r^2 (\frac{2x}{100}+\frac{x^2}{10000})$

Diff. of 3 from estim'd value $= \pi r^2 - \pi r^2 (1-\frac{2x}{100}+\frac{x^2}{10000})$
$= \pi r^2 (\frac{2x}{100}-\frac{x^2}{10000})$

Av. of these var't'ns $= \frac{\pi r^2 (\frac{2x}{100}+\frac{x^2}{10000}) + \pi r^2 (\frac{2x}{100}-\frac{x^2}{10000})}{2}$
$= \pi r^2 (\frac{2x}{100})$

$\therefore$ the per cent. of the variation to the estimated value (πr^2) is $2x\%$, *i. e.*, the per cent. of the mean variation of the surface magnitude is always double the per cent. of the mean variation of the diameter of estimated value of the circle.

In the tables which we give with this paper, we refer only to the diameter, but if we wish to ascertain the variation of the area, we merely require to multiply the former percentage by 2, as we have seen from the foregoing calculation.

In the experiments which have been performed, six different pairs of discs have been taken. The sizes of these discs are shown in the diagram (Fig. 2) and the results of the experiments are given in the table below.

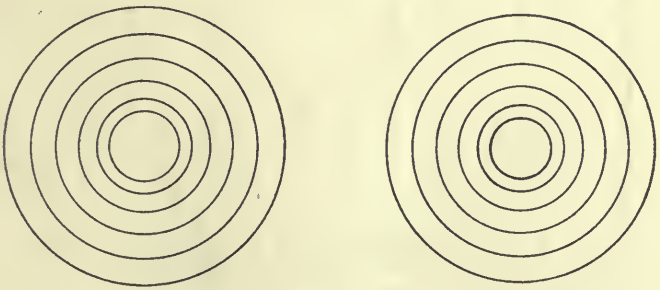

FIG. 2.

The first four columns of the table explain themselves. In the 5th is given the measurement of the diameter of the normal stimulus, *i. e.*, of the disc which remains fixed throughout the series. In the 6th column is given the visual angle

TABLE I.

Set.	Observer.	Series.	Eye.	Measurement of Normal Stimulus.	Visual Angle of Normal Stimulus.	Estimated Value.	Mean Variation.	% of Estimated Value.	Average %.	Constant Error.	Average of Constant Errors
I	McC.	1	Left	35.902 mm.	1° 40′ 14.01″	1° 36′ 34.73″	1′ 18.2″	1.34%		−3′ 39.28″	
			Right			1 36 13.62	1 12.92	1.26	1.3125%	−4 0.39	−1′ 29.1275″
		2	Left	37.306 mm.	1 44 9.26	1 45 14.95	1 28.31	1.24		+1 5.69	
			Right			1 44 46.73	1 28.76	1.41		+0 37.47	
	P.	1	Left	35.902 mm.	1 40 14.01	1 39 35.63	1 1.265	1.02		−0 38.38	
			Right			1 39 23.05	1 2.715	1.05	1.0975	−0 50.96	+1 0.1825
		2	Left	37.306 mm.	1 44 9.26	1 47 37.63	1 22.375	1.27		+3 28.37	
			Right			1 46 10.96	1 7.18	1.05		+2 1.70	
II	McC.	1	Left	30.155 mm.	1° 24′ 12.3 ″	1° 27′ 30.66″	1′ 11.67″	1.36%		+3′ 18.36″	
			Right			1 26 50.98	1 7.18	1.29	1.2975%	+2 38.68	+0′ 33.3525″
		2	Left	28.958 mm.	1 20 51.67	1 19 10.14	0 56.98	1.19		−1 41.53	
			Right			1 18 49.57	1 4.18	1.35		−2 2.10	
	P.	1	Left	30.155 mm.	1 24 12.3	1 26 56.53	0 56.09	1.07		+2 44.23	
			Right			1 26 7.88	0 51.325	0.99	0.975	+1 55.58	+1 5.5275
		2	Left	28.958 mm.	1 20 51.67	1 20 35.6	0 43.24	0.89		−0 16.07	
			Right			1 20 53.3	0 46.095	0.95		+0 1.63	

TABLE II.

Set.	Observer.	Series.	Eye.	Measurement of Normal Stimulus.	Visual Angle of Normal Stimulus.	Estimated Value.	Mean Variation.	% of Estimated Value.	Average %.	Constant Error.	Average of Constant Errors
III	McC.	1	Left	22.73 mm.	1° 3′ 30.66″	1° 1′ 28.2 ″	0′ 43.4 ″	1.17%		—2′ 2.46″	
			Right			1 1 25.72	0 50.88	1.38		—2 4.94	
		2	Left	23.923 mm.	1 6 48.58	1 9 6.08	1 6.40	1.60	1.3925%	+2 17.50	—0′ 3.6075″
			Right			1 8 24.05	0 58.53	1.42		+1 35.47	
	P.	1	Left	22.73 mm.	1 3 30.66	1 3 2.37	0 43.55	1.15		—0 28.29	
			Right			1 2 53.81	0 43.96	1.16	1.1775	—0 36.85	+0 45.4075
		2	Left	23.923 mm.	1 6 48.58	1 9 24.66	0 54.06	1.29		+2 36.08	
			Right			1 8 19.27	0 45.78	1.11		+1 30.69	
IV	McC.	1	Left	16.245 mm.	0° 45′ 22.68″	0° 45′ 9.71″	0′ 47.89″	1.76%		—0′ 12.97″	
			Right			0 45 20.87	0 41.77	1.53		—0 1.81	
		2	Left	17.521 mm.	0 48 56.39	0 53 20.74	1 21.33	2.54	2.135%	+4 24.35	+2′ 2.2875″
			Right			0 52 55.97	1 26.10	2.71		+3 59.58	
	P.	1	Left	16.245 mm.	0 45 22.68	0 45 47.6	0 47.525	1.72		+0 24.92	
			Right			0 45 34.28	0 45.31	1.66		+0 11.60	
		2	Left	17.521 mm.	0 48 56.39	0 50 33.89	0 50.515	1.66	1.7325	+1 37.50	+0 51.04
			Right			0 50 6.53	0 56.93	1.89		+1 10.14	

TABLE III.

Set.	Observer.	Series.	Eye.	Measurement of Normal Stimulus.	Visual Angle of Normal Stimulus.	Estimated Value.	Mean Variation.	% of Estimated Value.	Average %.	Constant Error.	Average of Constant Errors
V	McC.	1	Left	12.6 mm.	35′ 11.92″	36′ 2.29″	55.57″	2.57%		+0′ 50.37″	
			Right			36 16.07	43.35	1.99		+1 4.15	
		2	Left	11.601 mm.	32 24.53	32 11.99	37.78	1.96	2.105%	−0 12.54	+23.615″
			Right			32 17.01	36.90	1.90		−0 7.52	
	P.	1	Left	12.6 mm.	35 11.92	36 13.83	40.845	1.88		+1 1.91	
			Right			35 43.92	40.205	1.88		+0 32.00	
		2	Left	11.601 mm.	32 24.53	32 40.38	27.22	1.38	1.5775	+0 15.85	+25.2375
			Right			32 17.42	22.545	1.17		−0 9.31	
VI	McC.	1	Left	8.289 mm.	23′ 9.44″	22′ 26.27″	17.02″	1.26%		−0′ 43.17″	
			Right			22 31.08	17.37	1.29		−0 38.36	
		2	Left	9.291 mm.	25 57.38	27 42.59	42.81	2.58	2.1125%	+1 45.21	+37.7975″
			Right			28 4.89	55.94	3.32		+2 7.51	
	P.	1	Left	8.289 mm.	23 9.44	22 47.84	18.725	1.37		−0 21.60	
			Right			22 52.48	18.665	1.36		−0 16.96	
		2	Left	9.291 mm.	25 57.38	27 55.69	43.12	2.57	1.985	+1 58.31	+46.0175
			Right			27 41.7	43.89	2.64		+1 44.32	

SUMMARY TABLE.

Set.	Series.	Measurement of Normal Discs.	Average.	Average %.	
				J. McCrea.	H.J.Pritch'd.
I	1	35.902 mm.			
	2	37.306 mm.	36.604 mm.	1.3125	1.0975
II	1	30.155 mm.			
	2	28.958 mm.	29.5565 mm.	1.2975	.975
III	1	22.73 mm.			
	2	23.923 mm.	23.3265 mm.	1.3925	1.1775
IV	1	16.245 mm.			
	2	17.521 mm.	16.883 mm.	2.135	1.7325
V	1	12.6 mm.			
	2	11.601 mm.	12.1005 mm.	2.105	1.5775
VI	1	8.289 mm.			
	2	9.291 mm.	8.79 mm.	2.1125	1.985

The order in which these sets were observed is as follows: IV, V, III, II, VI, I.

subtended by that diameter. In the 7th appears the value of the visual angle, when it was judged to be equal to the normal stimulus. The 8th and 9th columns will be understood from what has already been said in this paper. By Constant Error is meant the difference between the estimated value and the normal magnitude.

The sets in the table are arranged according to the relative sizes of the discs used, beginning at the largest, and not according to the order in which the observations were made.

In a comparison of the results which are given in the Summary Table, it will be noticed that the percentages, although not nearly equal, still show a certain approximation to constancy. Whilst the normal magnitudes vary between extremes, which are to each other about 1:4, the per cent. of the average error varies for Observer M. only between the limits of 1:1$\frac{2}{3}$ and for Observer P., 1:2. Thus the Law of Weber does not seem to hold exactly for surface magnitudes; but the results show a decided approach towards it. It will be observed, however, that with a certain degree of

regularity the percentage increases as the magnitude of the object decreases. But we see that the percentage of the mean variation in Set IV is greater than this regularity of increase would demand. This may be accounted for by the fact that this was the first set of observations made, and the accuracy of judging has probably increased with a year's practice. In Set II, where the average stimulus had a visual angle of about 1° 20′, the mean variation was the smallest; and as the visual angle decreased in size from that magnitude, the mean variation increased, as is shown in the results obtained from Sets III, IV, V, and VI. It was noticed, during the course of the observations, that as the size of the disc decreased, the irradiation of light became greater. The irradiation was so great in Set VI, where the visual angle of the normal stimulus was about 0° 24′, that it was found necessary to put two additional sheets of tissue paper over the open end of the case; and even then the irradiation had a disturbing influence upon the judgments. This increase in the irradiation of light may account in whole or in part for the increase of the mean variation as the magnitude of the stimulus decreases.

Only one set of experiments was made in which the normal stimulus was greater than 1° 20′, and in this set the mean variation was greater than the mean variation in Set II. There has not been a sufficient number of experiments performed to warrant one in coming to any definite conclusion as to the cause of this irregularity. It may, however, be due to the fact that the visual angle is so large that the eye in observing is inclined to make movements which are so great as to interfere with accuracy in judging. Beyond this suggestion nothing further can be stated at present as to the cause of this irregularity.

In examining the Summary Table one will notice a marked correspondence between the results obtained by the two observers. With the exception of Set IV, which was the first made, when the mean variation increases for the one it also increases for the other. Throughout the whole six sets the mean variation for Observer P. has been considerably less than for Observer M.; but on comparison it is found that they bear a comparatively constant relation to each other. In Set I the mean variation for Observer P. is 83.6% of the mean variation for Observer M.; in Set II, 75.1%; in Set III, 84.5%; in Set IV, 81.1%; in Set V, 72.08%, and in Set VI, 93.9%; the average of these is 81.7%.

In addition to what has been said, it is of interest to consider the Constant Error, as seen in the tables. One of the results of Mr. Quantz's experiments was that the movable

disc was always underestimated. This fact, which as yet cannot be accounted for, is decidedly confirmed by these trials. A glance over the last column of the tables, which contains the total averages of the Constant Errors for the different sets, will show that there is, in nearly all cases, a *positive* deviation. This means that, in general, the moved disc was decidedly underestimated.

Nevertheless, on examining the different series of each set separately, it is found that when the variable stimulus is closer to the observer than the normal stimulus, it is judged to be equal to the normal when its visual angle is greater than that of the normal, *i. e.*, it is underestimated. But when the variable stimulus is farther away from the observer than the normal stimulus, it is judged to be equal to the normal when its visual angle is less than that of the normal, *i. e.*, it is overestimated. As may be seen by an examination of the tables, this is constant for both observers throughout almost the whole of the six sets. We may, therefore, conclude, with a considerable degree of certainty, that when we compare the size of two objects lying at different distances, the nearer object is underestimated or the more distant one is overestimated. Although it was the desire in these experiments to take no account of distance and to attend only to the size of the objects observed, it is evident that the observers' knowledge of the distance has had a slight influence on their judgment. Probably the underestimation of the nearer object may be accounted for by the fact that since it is known to be nearer to the eye of the observer than the normal stimulus, it is expected that it will appear larger, and hence it is judged to be smaller than it really is. And in the same way, when the variable is at a greater distance from the observer than the normal, it is expected that it will appear smaller, and hence it is judged to be larger than it really is. It may be mentioned here that these results do not correspond with those obtained by Goetz Martius.[1]

However, the discrepancy may rest upon unforeseen circumstances, which may be ascertained by future research. In the experiments of Goetz Martius, the objects were seen successively, thus making necessary a change of the convergence and accommodation (all of the observations of Goetz Martius were made binocularly, while in these experiments the observations were made monocularly, and one of the objects was always at rest at the same normal distance). In all likelihood the regularity with which the positive and nega-

[1] *Philos. Stud.*, V, p. 601 ff.

tive errors appear in these trials has something to do with the incongruence of the visual angle and the angle of regard ; the so-called Parallax of Indirect Vision, to which Kirschmann attributes so great a significance for the monocular depth perception. However, at present the connection is not clearly seen, but the reader, who is interested in the matter, is referred to the articles of this author on "The Parallax of Indirect Vision and the Slit-formed Pupil of the Cat"[1] and "The Metallic Lustre."[2]

It must be remembered that the trials of Goetz Martius, which were concerned with linear magnitudes, had entirely different aims and methods ; and, therefore, the results must, to a certain extent, be incomparable with ours. His method was adapted chiefly to the problem whether there is overestimation or underestimation in different distances, and not to find out the accuracy of our judgment for the magnitudes themselves.

How great the accuracy of the judgment for surface magnitudes is may be recognized by regarding the diagrams of Figure 2, in which are given the magnitudes of the discs used as nearly as they can be reproduced in a drawing. The left ones represent the larger, and the right ones represent the smaller of each of the six pairs. (They are arranged concentrically in order to save space.) Before the diagram was drawn it was proposed to represent the accuracy of the judgment, *i. e.*, the mean variation, by the thickness of the stroke representing the circumference ; but a simple calculation from the tables will show that the thickness of the stroke would have to vary between about $\frac{1}{5}$ mm. (0.234 for M. and 0.198 for P.) for the greatest circle, and about $\frac{1}{10}$ mm. (0.098 for M. and 0.092 for P.) for the smallest circle. These magnitudes are too small to be well represented in a drawing, and certainly they cannot be represented in a cut. Thus the accuracy of the judgment in these trials on surface magnitudes is too great to be indicated by the thickness of the stroke.

The results of these experiments could be summarized in the following propositions :—

1. The accuracy of our judgment of surface magnitudes is astonishingly great. The mean variation for visual angles of 1° or less was always below 1′ in magnitude, and for angles up to 1° 45′ in magnitude, it never exceeded 1′ 20″.

2. Although the results do not entirely fulfill the demands of the Psychophysical Law, yet they show a certain approximation towards it.

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[1] *Philos. Stud.*, Vol. IX, pp. 447-495.
[2] *Ibid.*, Vol. XI, pp. 147-189.

3. In the comparison of a fixed object with one which is moved towards or from the eye, the latter is overestimated when it is at a greater distance from the eye, and underestimated when it is at a lesser distance. Taking all of the results together, the moved object is decidedly underestimated. This latter fact confirms fully the results of the earlier investigation of Mr. Quantz.

GENESIS OF NUMBER-FORMS.

By D. E. Phillips, Clark University.

Before entering into the results of this inquiry it may be well to make clear the nature of these forms and to give a short account of former investigations. The first is a very difficult task, for psychological phenomena that appear foreign to us are hard to comprehend, especially when so strange. The reader will be greatly assisted in what follows by first examining carefully the drawings given on pages 512 and 513.

The general character of a number-form is such that whenever a number is thought of, it appears in the same place on a visual diagram which is invariably called up, viewed by the mental eye, often definitely located, and which usually consists of an irregular composition of lines on which the figures appear either written or printed. These diagrams are often enormously large in comparison with the drawings here presented. "Sometimes," says Galton, "a form has twists as well as bends, sometimes it is turned upside down, sometimes it plunges into an abyss of immeasurable depth, or rises and disappears in the sky."[1] In some instances the line does not appear; nevertheless, the numbers occur in a fixed order, but are usually less complicated. Galton says the most common way is to see only two or three figures of the diagram at once, but in my investigation, that depends upon whether the mind is performing mental calculations, or the form is viewed as a whole. The entire form can usually be seen, and, by many, as distinctly as if viewed by the natural eye.

"Number-forms," says Galton, "are in each case absolutely unchangeable except through a gradual development in complexity. Their diversity is endless, and the number-forms of different persons are mutually unintelligible. These strange 'visions,' for such they must be called, are extremely vivid in most cases, but almost incredible to the vast majority of mankind, who would set them down as fantastic nonsense;

[1] "Inquiries into Human Faculty," p. 123.

nevertheless, they are familiar parts of the mental furniture of the rest, in whose imaginations they have been unconsciously formed, and where they remain unmodified and unmodifiable by teaching."[1]

The number of individuals possessing such visual schemes depends upon what limitation is put upon the term "Number-Form." For example, some persons have a diagram for the days of the week, days of the month, or months of the year, etc., who have no number diagram. These are evidently of the same nature, and if they be included in our estimate of forms the ratio is much changed. Again we find all degrees of clearness, and some number-forms appear as all other mental imagery, or fade away until classification becomes difficult. So here, as in most fields of investigation, differences on many points result largely from the differences in the extent given to the subject by the various investigators. Surely this will to a great degree account for the variations found in the reports of those who have investigated this subject.

Galton, who published the first article on these forms in *Nature* and afterwards in "Inquiries into Human Faculty," states that "the peculiarity in question is found, roughly speaking, in about one out of every thirty adult males, or every fifteen females."[2] But he considers only clear number-forms and the estimate is on adults. The next work was done by G. T. W. Patrick of the University of Iowa, and appeared in The *Popular Science Monthly*, Feb., 1893. He is inclined to think that one out of every six adults would be a more accurate proportion, that the proportion among children is greater, and that it is perhaps a little more common among women than among men.[3] It is to be observed, however, that among the diagrams which he gives are diagrams for the months, days of the week, seasons, and alphabet; no mention is made of whether they are counted in the estimate of one in six.

The same year Flournoy published his *Des Phénomènes de Synopsie*, in which he includes number-forms. He informs us that he received returns from 370 persons between 18 and 40 years, and found that in childhood colored-hearing or *photisme* is much more frequent and gradually diminishes, while on the other hand schemes are much more stable and endure through life from the time they first exist. At 20, 1 in 6 have colored-hearing; 1 in 9 have visual schemes, and

[1] "Inquiries into Human Faculty," p. 156.
[2] "Inquiries into Human Faculty," p. 119.
[3] *Pop. Science Monthly*, Feb., 1893, p. 506.

1 in 15 have both.[1] About the same time Miss Calkins published in THE AMERICAN JOURNAL OF PSYCHOLOGY her examination of 543 students, all girls, of whom 78 have forms, 32 colored-hearing, and 14 have both.[2] In the fall of the same year she examined 203 new students, finding 32 with colored-hearing, 61, or 30%, with forms, and 17 with both.[3] In the first case about 1 in 7 have forms, and in the last nearly 1 in 3. Here all of the various diagrams mentioned are counted. Out of 300 children, from 10 to 12 years of age, Binet found only 3% with number-forms, but attributed the result to his inability to make them understand what he desired and to their indifference.[4] These variations are largely due to the different limits given to these psychological phenomena, the difference in age and sex of subjects investigated, and the manner of investigation.

The present writer's interest in this subject was first aroused by some strange and complicated answers to the following questions in a syllabus on Number and Mathematics: (*f.*) Cases of number-forms, *e. g.*, the first 12 numbers being habitually associated with a dial or clock-face, the first ten on a line, straight or curved, systems of dots, colors, etc. Do odd seem to you different from even numbers? Draw any number-forms. How do you arrange days of the week or month, the musical scale?" As this section did not cover the points of greatest interest, and as each seemed to have great difficulty in explaining these mental forms in writing, I began a personal examination of 332 Normal School students. Still some questions of importance were overlooked in the early part of the work. The following questions were finally formulated and the investigation extended to 974 school children of Worcester, Mass., and 343 miscellaneous adults personally interrogated: 1. At what age did it appear? 2. How did it originate? 3. Is it useful, or troublesome? 4. Do you see the figures on a line? 5. How large does it appear to be? 6. Where is it located? 7. Are you left-handed? 8. Do you know of any forms in your family? 9. State any peculiarities about your form or its use. 10. Do you like mathematics? 11. Give name, age, and sex.

The following table shows the sources of the material for this article, number of forms collected, the per cent. having some form, and the per cent. having number-forms.

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[1] "*Synopsie*," p. 15.
[2] AMERICAN JOURNAL OF PSYCHOLOGY, Vol. V, p. 265.
[3] *Ibid.*, p. 439.
[4] "*Synopsie*," p. 16.

TABLE I.

SOURCES OF MATERIAL.	No. Examined.	Number-Forms.	Month-Forms.	Week-Forms.	Alphabet-Forms.	Lord's Prayer, Songs, etc.	Total Forms.	Total Having Forms.	Per cent. Having some Form.	Per cent. Having Number-Forms.
Normal School,	332	20	45	13	3	—	81	59	18—	6
Miscellaneous,	343	23	20	8	7	4	62	45	13+	7—
Returns on General Syllabi,	360	25	31	2	4	—	62	50	14—	7
School Children of Worcester, 10-16 y.	974	79	118	11	9	—	217	167	18—	8+
Total,	2009	147	214	34	23	4	422	321	16—	7+
Males,	969	67	74	19	13	4	177	145	15—	7—
Females,	1040	80	140	15	10	—	245	176	17+	8—

The 332 Normal students I examined personally, and had opportunity to see some of them a year later, but found no change of any note. Fully 80% of this class are teachers. The 343 miscellaneous are also cases personally investigated. Nearly all of them are adults over 25 years old; 92 are teachers; 41 Clark University men; the remaining persons are, generally speaking, uneducated. A few cases were obtained by correspondence. Many answering the syllabi omitted points of importance, and some not included here simply spoke of the direction numbers take in their minds. The returns from the Worcester schools were collected from the 7th, 8th and 9th grades, from children of 10 to 16 years old. After a short explanation the children were asked to draw whatever form, or forms, they had. In all the rooms, except five, an effort was made to keep them from obtaining an imaginary form for the occasion, and in only a few cases was there reason to think the forms were not genuine; each pupil giving a form was, as a rule, questioned privately. In

the five rooms fair opportunity to copy or devise a form was offered pupils by presenting drawings and entering into detailed explanation; but the forms collected there show no signs of fraud. The percentage of forms was not quite as large in three rooms as is usually found. After giving the slightest explanation, a close observer will hardly fail to distinguish every one having distinct number-forms. Those who have no form have no idea of what you are speaking of, and are often slow to comprehend any explanation, appear surprised or treat indifferently what you say. Those having a form show an entirely different attitude. In a room of 44 children the mere mention of forms showed four who comprehended my meaning, and they were afterwards found to be the only ones having forms. Six men in a shop were asked if any of them had a number-form. One asked, "What do you mean?" On a word of explanation he exclaimed, "I have the craziest thing you ever saw," and proceeded to outline No. 12, Plate II. While at their play I asked two girls, about five or six years old, if they could count one hundred. Each replied that she could. When asked which way the numbers go, one replied, "They go round and round, then up to the clouds," making a circling motion with her hand. In the first grade I examined 23 children privately, finding two clear number-forms. The first boy was a little over six and had just learned to read. While he was counting 100 I observed that at certain points there was considerable struggle, as if he had lost sight of something. When asked if the numbers went down, he shyly said, "They go up and turn," and then drew on the board Form 17, Plate I. I tried to deceive him by placing numbers on the turns to suit myself; five different numbers were placed where 17 is, but each time he shook his head; finally he told me to put 17. He located all the others with the same certainty. Later the form was slightly changed; the boy was called and asked if it were correct. He is very shy and slow, but soon proceeded to correct it even to the length of the lines, which he was not tall enough to draw himself. The clearness and persistency of such a form are not to be doubted.

Some will be inclined to mistrust results obtained from children from 10 to 16 years, and while every precaution was taken to avoid error, I do not consider that this part of the study is free from such. But it cannot be far wrong, for almost the same ratio exists among adults, none of whom remembers a time when his form did not exist. The ratio, however, is, as we shall see, of little importance, and the culminating point of this work lacks no reliable evidence.

A few things in Table I are worthy of attention. The ratio

for number-forms remains much more constant than for other forms, while children have more week and month forms than adults. The total number of forms is nearly one-third larger than the number of persons having forms. This shows that several have more than one form of some kind. Where a distinct number-form is found, the individual often has other forms, but many that have a month-form, week-form, etc., have no number-form. The last two columns show that the per cent. having some form is more than twice as large as for those having only number-forms, that the per cent. decreases a little with age, being about 1 in 12 for children and about 1 in 15 for adults. The proportion seems to be a little greater among females than among males; especially is this true for month-forms. Omitting these there is by no means so great a difference as Galton found. As a rule men think such things very trivial and are not as willing to respond as women. As we hope to show later, unless an arbitrary definition and limit be given to forms, a table of this kind can be no accurate guide. The records here are based upon comparatively distinct forms. Since completing this table several returns have been received that might change the ratios somewhat. Prof. Barnes, Fairmount Normal, W. Va., states that on examining 118 boys and 136 girls, he found that 69 boys and 53 girls had some form. But there was no personal examination and no forms drawn.

TABLE II.

General Direction, First Turns, and Endings.

	No. of Forms.	Turn.					End.		
		To Left.	To Right.	At 10	At 12	At 20	Below 100	At 100	Above 100
Galton,	65	23	38	15	27	5	16	26	22
Flournoy,	37	4	29	14	5	5	10	14	12
Patrick,	14	2	9	2	0	0	5	1	5
Present Collection,	147	18	91	60	32	11	78	53	16
Total,	263	47	167	91	64	21	109	94	55

Table II gives a classification of the principal direction,

Plate 1.

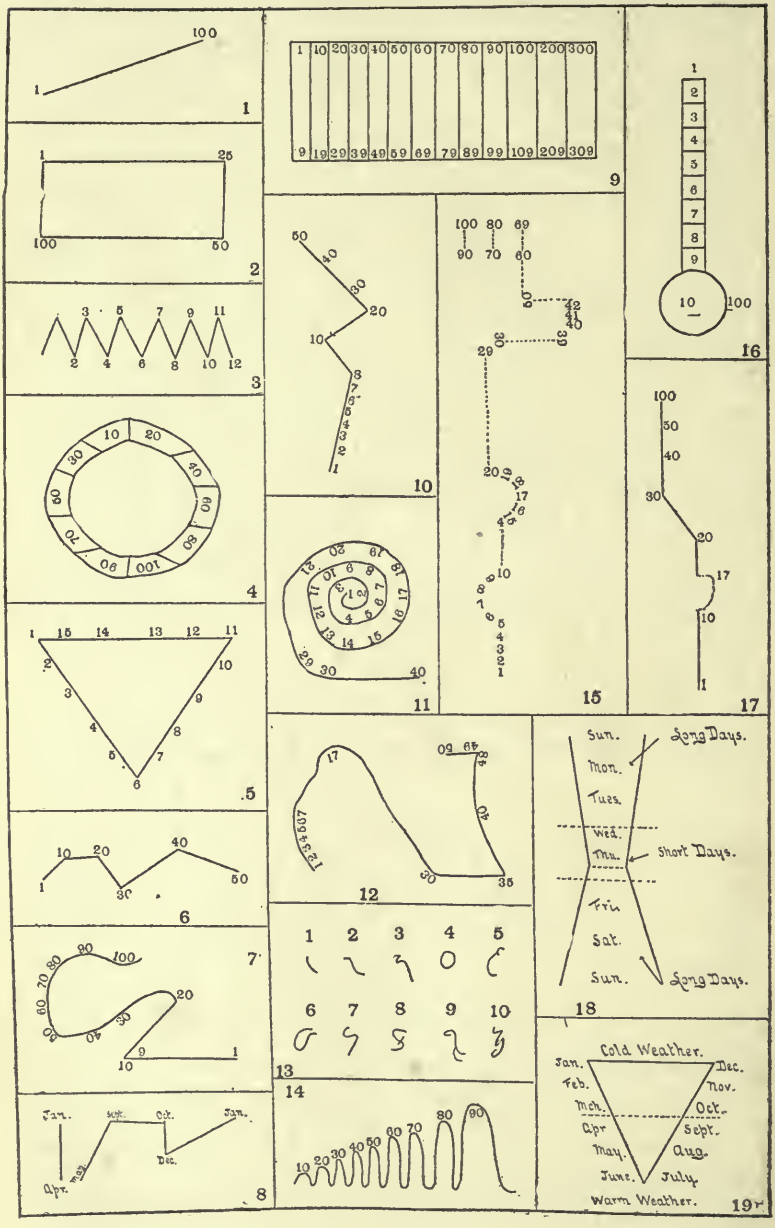
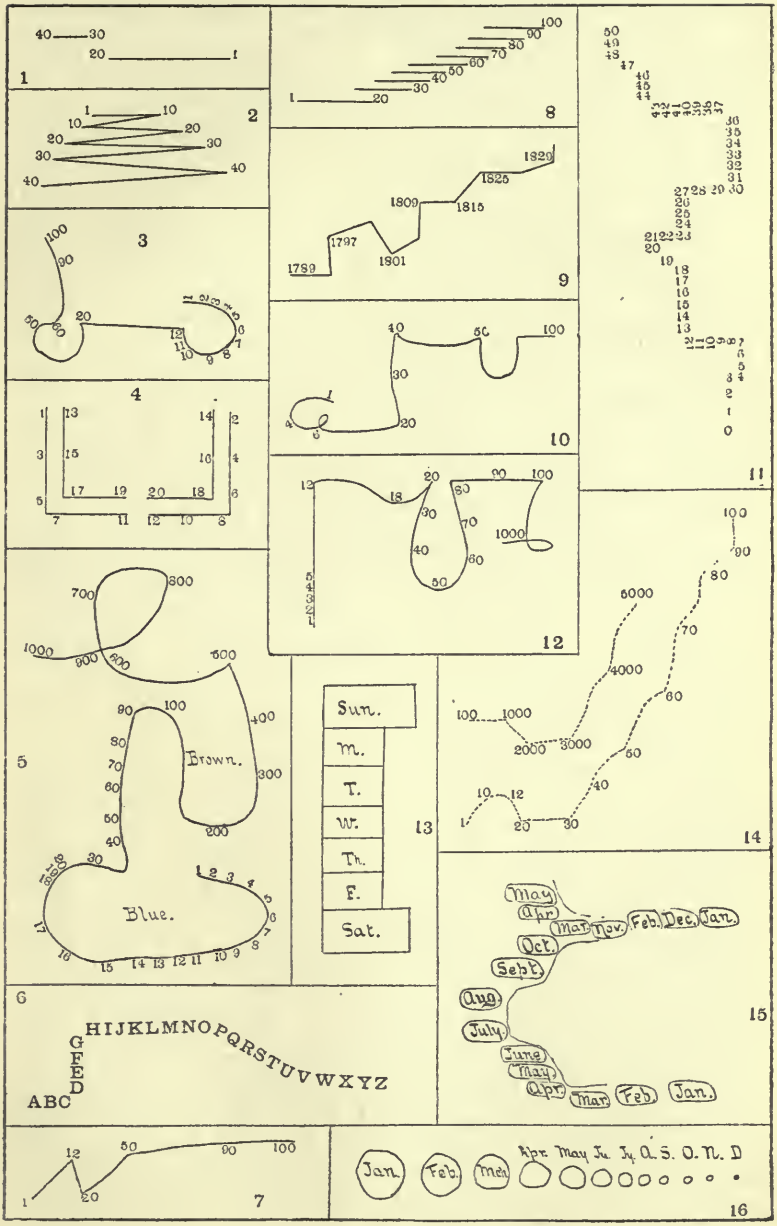

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Sun.
Mon.
Tues.
Wed.
Thu.
Fri.
Sat.
Sun.
Long Days.
Short Days.
Long Days.
Cold Weather.
Jan.
Feb.
Mch.
Apr
May.
June.
July
Aug.
Sept.
Oct.
Nov.
Dec.
Warm Weather.

Plate 2.


1
2
3
4
5
Brown.
Blue.
6
HIJKLMNOPQRSTUVWXYZ
ABC
7
8
9
1789
1797
1801
1809
1815
1825
1829
10
11
12
13
Sun.
M.
T.
W.
Th.
F.
Sat.
14
15
May
Apr
Mar
Nov.
Feb.
Dec.
Jan.
Oct.
Sept.
Aug.
July.
June
May.
Apr.
Mar.
Feb.
Jan.
16
Jan.
Feb.
Mar.
Apr.
May
Ju.
Ju.
A.
S.
O.
N.
D

first turn, and ending, of all the number-forms I have been able to find published, including my 147. The direction and first turn have been referred to by others, but no definite summary made except that Miss Calkins directs attention to an outline of turns. Her work is not included here because information on other points was wanting and few forms were published. Out of 68 forms she gives 17 turning at 10, 8 at 12, and 5 at 20.[1] The above table is but a rough classification, but it shows some tendencies in number-forms for which the psychologist may be puzzled to find an explanation. A glance at the total directions and turns shows that these do not include all the forms, for a numeral scheme may take any direction and make its first turn at *any* number, but these show such majority as to point to some general laws. Very few forms go down, but some are so complicated in direction that classification is impossible. The endings are only approximately correct, for many do not draw the entire form, and some forms are capable of almost indefinite extension according to the series in mind. We shall have occasion to refer to the lines here indicated later.

Plate I shows the leading types and some of the most highly developed forms of persons under eighteen; Plate II contains only adult forms. These two plates indicate that number-forms develop in complexity, and perhaps change somewhat in shape, notwithstanding that most individuals think that their form has always been substantially the same. This contrast and the three leading types, to be mentioned presently, would appear more striking if the entire collection could be published.

It seems almost impossible to classify these number-diagrams. Such a classification is perhaps of not very much value, and must be based upon other points as well as on the drawings. The variety and complexity of forms are wonderful. Month-forms are frequently alike, but I have found no two number-forms exactly the same. Still, taking several points into consideration, we may note three rough types which include nearly all number-forms. Nos. 1, 2, 5, 9 and 16, Plate I, and Nos. 1, 4, 8, Plate II, represent the simplest that it seemed advisable to include, although there is really no line of demarcation. The chief characteristic of this class is the evidence of conscious construction, or of deduction from, or alteration of, some form or object more or less frequently before the eye. Of 19 who have suggested an orgin for their number-form, 15 belong to this class. As regards localization, vividness, etc., these individuals are, as

[1] AMERICAN JOURNAL OF PSYCHOLOGY, Vol. V, p. 449.

a rule, most uncertain. The fact that they frequently locate the forms on blackboards, charts, books, blocks, etc., is evidence of such an origin, and of the fact that they are slightly modified mental images. One lady says she is conscious of taking hers from blocks on which the numbers were stamped; and she is the only one who has complained of a form being troublesome. Another is conscious of arranging the numbers on the edge of a chart and ever afterward having the form. This will explain many that take a real geometrical form. As a rule this class does not exist to any great extent among adults, and since adult forms can hardly be modifications of these, it is probable that they drop out early in life and that those formed most unconsciously are most persistent. They are never so striking to the individual nor used with half as much freedom and elasticity as those that seem more spontaneous and to others more unmanageable.

Nos. 3, 6, 8, 10, 15 and 17, Plate I, and Nos. 2, 7, 9, 11 and 14, Plate II, furnish examples of the largest class of forms. They are usually pronounced useful, but not so vivid as the more complex ones. To this belongs Diamandi's mentioned later. More than half the forms collected belong to this class, and the similarity between them is sometimes considerable.

Nos. 7, 11 and 12, Plate I, and Nos. 3, 5, 10 and 12, Plate II, show a decided tendency to take a circular or curved direction. They are usually exceedingly vivid, strangely located, and generally said to be useful in a manner and to a degree wholly unintelligible to any one except the possessor. There are but few of these and they usually extend beyond 100.

Besides these three classes there are some very exceptional forms. C. C. S. and L. B. have forms of three dimensions. Mr. L. of Clark University tried several times to draw his, but could not. He finally described it as resembling the threads of a screw about four feet in diameter, the threads enlarging on the far side, and after the first round running almost parallel. The first one hundred completes a round, and each succeeding hundred a little more than a round, ending directly over 2, 3, 4, 5, etc., respectively. If two thousand is thought of as twenty hundred, it appears on its proper round over twenty, but if as two thousand, it is located on the same round, but over two. The form as a whole is located on a plain in front, goes to the left, and sometimes seems to extend behind him. It is very definite and clear, and highly useful in all numerical calculations. No. 13, Plate I, was obtained from a Swede boy of 17. I

could not understand the peculiar characters under the numerals; two personal interviews gave no information except that these are directions which the numbers take when he hears them, and that the same feeling is received when he sees them, unless they are passed over rapidly. The boy is timid and slow to learn. The characters are reduced to about one-eighth of their original size. Later a girl of fifteen presented a similar case. Her characters do not resemble those of the boy, and are somewhat larger. She gives the same explanation, except the power to receive such a sensation from sight is gradually diminishing. She is an American girl of average intelligence.[1] These two cases are peculiar, and call to mind an observation made some ten years ago, on a boy about 12, in my school, who said that each note had a peculiar swing to him when spoken, and when singing he had an impulse to follow the same.

Let us now examine the answers to the questions asked. Of 321 giving forms, 280 answered the question: "At what age did it appear?" 241 do not remember a time when it did not exist; 17 feel sure that their number-form originated about the age of 6; 22 place their month-form after 12 years; 11 say they learned to add and multiply on their scheme. Prof. Patrick gives quite an extensive form of a girl 9 years old; No. 7, Plate I, is from a girl only 6, and No. 17 has already been mentioned. Nothing is more marked than the very early period at which these schemes are developed. Probably number-forms begin with the naming of numbers, and go on as the child learns to count one hundred. There are several things in the forms that point to this fact. Most children can count one hundred before they learn to recognize anything written or printed. This begins at a period when, of all others, the largest part of our knowledge comes through sight; it is only natural that they should try to visualize the abstract and to cast it into some concrete form or space relation. Table II shows that of 263 forms 91 make their first turn at 10; 64 at 12, and only 55 extend beyond 100. There is at least a suggestion that both the first turning points and the limits of these forms may be related to the manner of counting, and indicate that their formation begins with the earliest counting. A child is generally taught to count 10 on its fingers, yet this is quite different from its previous knowledge, which chiefly consists in learning the names of things. It by no means recognizes the numbers as the names of its fingers. Generally there is

[1] Cf. the somewhat similar diagrams given by Miss Calkins,—AMERICAN JOURNAL OF PSYCHOLOGY, Vol. V, Fig. 7, Plate I, facing p. 464.

a pause in the counting process when ten or a dozen is reached, then it is again taken up only to plunge the child into pure abstraction, and continued until 100 is reached. A friend writes, "F., 4 years old, does not know his letters, but he can count 100." Learning to count before learning characters of any kind is the rule, almost without exception, among country children. Of 1160 individuals, including 660 children, 280 high school students, and 220 adults, 92% learned to count first; over 80% assert that they could count 100 before they could read.

In this connection I wish to add some testimony on a point that will doubtless seem mystical and incomprehensible, but I cannot forbear to state the facts. When my work was presented at the seminary, the question was raised whether these forms could precede the power to recognize the written or printed figures. To my astonishment two possessing forms immediately declared that they were confident that their forms existed before they knew written or printed characters of any kind. After this I talked the subject over with Dr. Story, Professor of Mathematics at Clark University, who thought this impossible, and attributed it to their inability to remember accurately the period of absence of a thing so long and continuously in the stream of consciousness. However, since that time I have reached as many persons having forms as I could conveniently, and many who profess an early recollection of their forms give the same testimony. Besides this there are cases of individuals having forms for certain anthems, the Lord's Prayer, and Doxology. These are not mental images of a printed page, but a projection of an indiscernible something into space. Dr. S. sees the first phrases of the Lord's Prayer nearest; the remainder gradually recedes. This was learned early, while the creed, learned from a book, is reversed. In a like manner early number-forms do not give a visual image of any characters at first, but, so far as I can understand, simply a division of space in these pecular directions. Mr. T. states that his form existed as early as the fifth or sixth year, yet he did not know figures and was unable to read until he was ten. Mathematical prodigies have exhibited a great power to visualize numbers, yet in most cases the power was well developed before learning to recognize printed characters. It is here, as we hope to show later, that the best approach to the genesis of number-forms is to be found.

As already stated only 19 offered any explanation of the origin of their numeral scheme, and in most cases the explanation is not satisfactory even to the giver. Twenty-four give an explanation of their month-form. "Brother, 5 years

old, cannot add when not in a room with a clock. He counted by the hour spaces; he is now 7, and uses the clock face mentally." Lady of 26 years says, "I learned to count when 5 years old, but could not remember 11 and 12. My grandfather told me to count two 6's, and that made a dozen. For some time I calculated time and objects by 6's; never how many 12's, but so many clock-faces. I used to arrange pebbles in the sand as on a dial. I can't explain to anyone how I can count faster that way, but I can." Such a description may safely be trusted.

Is it useful, or troublesome? To this point particular attention was given because some investigators have considered such forms a hindrance to abstract thought. But only those who have no diagram make such an objection.

Mrs. Hornbrook has given in the *Educational Review* a review of some work in which she attempted to show the utility of number-forms. She gives there her own form, which has been of so much service to her. The numbers up to 100 were arranged in the form of a square. In some tables the 10's were put in very heavy type; in others the multiples of 5, 6, 8, 9, etc. These tables were always kept where they could be seen, with the hope of producing a form in the child's mind. She states that they were not able to discover any permanent forms, but that forms were developed and used while learning the multiplication table.[1] I am inclined to think that such forms were only localized memory of the tables, such as anyone can form, by a voluntary effort, of objects often seen, and doubtless closely related to the first division of forms already given. As to the utility of number-forms in many cases, I have no doubt. Of those having some form 211 answered this; 97 are sure of its utility; only one finds it troublesome; 113 say it is neither useful nor troublesome. From many I receive such replies as, "very useful," "could not add without it," "use it every day," "yes, I shut my eyes and count." Mr. B. says he cannot see how mathematical calculations can be performed without such. A girl of 18 states, "I could not add 7 and 9 without mine." Another, whose form appears on Plate I, No. 6, informed me that she put herself to sleep counting on it. Girl, 20: "In rapid counting I know at every notch on the line just what figure belongs there." "My form," says Mr. L., "is as necessary as bread and meat." In Miss Calkins' analysis of this point, about one-half do not think them useful, but she mentions no cases where they are considered detrimental. Now, those who are neutral are doubt-

[1] Vol. V, p. 479.

less more nearly correct. They perhaps use their form just as we use language, without ever thinking that it is useful as a medium of thought. In fact, several who have said they did not use their form, have later corrected this statement by saying that they found themselves continually using it. In using this complex machine they always speak of "jumping" from place to place. The best way to understand this is to look at a surface, and then fixate the eye first on one point, then on another. This doubtless explains why in calculating many see only parts of the diagram. Fig. 3, Plate II, is a carpenter's. In telling how he used it he said: "When I reach 20 the horizontal parallel lines turn upright; the space between 10's is divided into equal parts, except the middle is larger for 5. If 9 were to be added to 37, which is now written in its place, I jump to 46."

With the exception of Diamandi, who sees his on the convolutions of his brain, the rule is to locate in space near the head, when located at all. Several did not answer this question, and many were not conscious of any localization; but the most common replies were, "right in front of my eyes," "it is not located, but just stands out by itself," "I can see it hanging in the air right in front of me," "it always goes to the ceiling," "I can see it on the wall." Four localized their forms to the left about three feet, three overhead; some said it went up in front until they could hardly see it. When drawing his form one man found an ordinary sheet of paper too small, saying, "It ought to lengthen out," giving his hand a swing to the right. Flournoy gives the following cases: "M. Y.'s number-form, composed of parallel lines representing the hundreds, occupies the right half of the space in front of him. In the left half floats his diagram of the week in the form of a horizontal rectangular figure divided into seven bands, something like a leaf of ruled paper, floating in the air about a metre from him, opposite his left thigh. Still more to the left, and at the height of his head, is situated his year-form, an ellipse of small eccentricity presented in nearly a vertical plane. Whenever M. Y. thinks of a date of the year, of a day past or future of the current week, or of a number, he perceives it in its proper place on the corresponding scheme. I have often had occasion to make him write down rapidly a series of figures at random. He follows what he is writing only with an indirect vision, like a hurried copyist who lets his hand work of itself, and will not lose sight of the page he is copying."[1] He gives also an account of a girl, 11 years old, who had a diagram for

[1] "Society for Psychical Research," Vol. VIII, p. 146.

the months situated directly over her head, entirely out of the field of vision, so high that she could not reach it by 6 to 8 centimeters. It always kept the same distance from her head. Another sees the future in front and the past behind him. In order to see into the past he must place himself back in his imagination beyond the event, saying it is impossible to visualize time which is behind him.[1]

The space in the forms between the turns after 20 are not usually filled out, but the numbers when thought of take their places in order. As a rule near the end the numbers seem to be very much crowded, but those who describe their form as extending up into the sky, or far away in the dim distance, have no such trouble. In some no line appears; in others the line followed is a dotted line which the individual is conscious of tracing; but in the majority the line is somewhat distinct.

From Table II it is evident that about four times as many go to the right as to the left. Having found two left-handed persons with forms running to the left, it was suggested that this might have something to do with the direction. Miss Calkins kindly re-examined her subjects for me on this point, but found nothing to substantiate it. In my further investigations I have met with the same result. So the direction must have some other explanation.

Galton thinks these forms hereditary, with even sometimes a strong tendency to reproduce the form.[2] But as strong a similarity of forms is seen in many not in any wise related. An examination shows two or three general types, no matter where they are collected. Miss Calkins' result is much in favor of heredity. Flournoy says all that can possibly be attributed to heredity is a *predisposition*.[3] My answers on this question were, children not included, 128. Six were sure of relatives having a number-form; 17, of relatives having other diagrams. I find no more signs of, nor reasons to look for, heredity here than in any highly developed power of imagination, memory, art, music, etc., all of which are much questioned since Weismann's theory of heredity has become prominent. Two in the same family may have like forms by mere coincidence.

Ninety-four of those having number-forms assert that they are fond of mathematics. "I worked at odd times," says one, "for two years on a geometrical puzzle, and finally got it." "I like mathematics," says another, "but think my

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[1] "*Synopsie*," p. 183.
[2] "Inquiries into Human Faculty," p. 140.
[3] "*Synopsie*," p. 203.

form has nothing to do with it." "I love to solve problems mentally," is a common reply. Twenty-eight "hate" mathematics. There are so many things to modify one's likes or dislikes for mathematics that it seems to me this proves nothing one way or the other. In my work I have tried to ascertain whether they are more general among dull persons, or the more intellectually active, but so far I have been unable to detect a stronger tendency in the one class than in the other. Neither does it appear that they are more general with the imaginative. This differs from Galton's statement that "it is found among most imaginative persons."[1] More number-forms have been found among forty-one persons in Clark University than in any equal number elsewhere, eight well defined forms having been found. There are three of three dimensions. My observation among higher mathematicians has been too limited to draw any conclusions. No one can say that one would be better without a form, for, as it appears only when numbers are thought of, it does not influence the ordinary thought processes.

In this connection it will be interesting to *résumé* the comparison which Binet makes between Inaudi and Diamandi, two mathematical prodigies.[2] Inaudi was born in 1867 of a poor family. During pregnancy his mother frequently saw the recklessness of her husband, and, pressed by poverty, she calculated in her head means of economy; her days were spent with figures until she acquired a mania for counting. This is the statement of his brother. At the age of six Inaudi acquired a passion for counting; never used fingers, pebbles, etc., but did all with words, learned the names to 100 from his brother and then demanded more. He entered Paris at thirteen; could neither read nor write. He was presented at the Academy of Sciences in 1892, and in 1892-3 was examined more than fifty times. When an infant his head was so large that it was thought that he could not live. He learned to read seven years ago, converses but little, yet shows good natural intelligence. In calculation or reproduction of figures he repeats the numbers three times, seems perfectly quiet, and can carry on a conversation on other subjects, the only effect being to prolong the time. Binet thinks that he must have over 300 figures in his mind at the same time.

Diamandi was born in Greece in 1868; entered school at seven; was at all times first in mathematics; left school at sixteen; became a grain merchant, and here his mathematical talent greatly developed. He had fourteen brothers and

[1] "Inquiries into Human Faculty," p. 114.
[2] "*Psychologie des grands calculateurs et joueurs d'échecs.*"

sisters; only one brother and one sister possessed a similar aptitude. His mother had a wonderful memory for everything. He has abandoned commerce; reads much; everything written on mental calculations; composes verse and romances, and knows five languages. In 1893 he presented himself at the Academy of Sciences, and was examined by the same commission that examined Inaudi. Binet has experimented with him fifty times, from three to five hours each time. He came to contest with Inaudi, and it is this that makes the account of Inaudi of value here. Inaudi is an exception among mathematical prodigies. He is, so far as understood, of the purely auditory type, while Diamandi is of the visual type. For some time Diamandi denied having a number-form and kept it concealed for more than two months. Once he said that the figures appeared to him on one of his cerebral convolutions placed to the front and left.

"The form and location of this image in relation to the individual, are the elements which volition can scarcely modify." His number-form is of the usual type, extending from left to right, of broken lines, and space more occupied at the beginning. Besides this, Diamandi sees all objects in the centre of a complex figure formed by a grayish-colored mass, enclosing a lighter spot. The thought of a house, a dog, etc., brings the image of such into the lighter space. He first presented to Binet a roll of paper with 2,000 figures on it, any one of which he could reproduce and locate without difficulty, or read them diagonally or otherwise. When hearing figures in French he encounters great difficulty, being obliged to translate them into his native Greek, and often makes many errors, but never fails when they are presented on paper. After a first look at the figures on paper, he closes his fists; puts them against his temple; bows his head; soon takes another look at the paper, then closes his eyes and begins the operation. With him the making of a visual image is the important thing, while Inaudi appears to make no mental representation. Diamandi desires the figures written in a square, and he always begins at the left, no matter how they are written. The multiplication of 65,879x2537 was accomplished in 3 min. 10 sec.

If interrupted by noise or questions, Diamandi loses the image then in mind and is obliged to reproduce it. No matter how many of the figures are variously colored, he reproduces them with their proper color. With a small number of figures Inaudi is more rapid than Diamandi, otherwise Diamandi surpasses him in rapidity and in extent of reproduction and calculation. Whether this difference is due to other causes than the existence of Diamandi's num-

ber-form, Binet does not consider; although it is certain that he in some way makes use of it, always locating the figures in their proper places in his form in a manner which only those who have such diagrams can comprehend. Then they are as plain as if written before the natural eye. I give these two cases here because of their bearing on forms and on mathematical prodigies in general. Unfortunately number-forms did not gain attention early enough to be studied in former mathematical prodigies. A few are known to have possessed true number-forms. Dr. Scripture says the great peculiarity of mathematical prodigies is the visual images of numbers which they always carry about in their minds. And among general returns there is mention of three children extraordinarily rapid in use of numbers and each has a well defined form.

Flournoy *résumés* several thories which have been held as to the explanation of the whole matter of *Synopsie* as follows: All are analyzable into two great classes. The first seeks the explanation in psychological association. The other declares it outside of ordinary association and seeks its explanation in physiological conditions, holding that the continuity of the central cortex permits excitations to radiate to different centres of localization. It is an exceptional anastomosis uniting nerve fibres or cells ordinarily separated. Flournoy holds that the principle of psychophysic parallelism will harmonize both theories. He classes all the phenomena of *Synopsie* under affective, habitual, and privileged psychical associations. Affective association is the general coloring which each sensation gives to every other sensation received at the same time, no matter how heterogeneous. This is only natural from the unity of the nervous system. Habitual association is the continual association of two things until they become an indissoluble whole, such as months and days in columns of an almanac, etc. Privileged association plays an enormous rôle. Things become indissolubly fixed in our memory and thought, not because they are often in the field of reality, but because of a time, perhaps an only time, when the thing struck us and left an indelible trace in our nervous tissue. Such are the visions of our early childhood which have submerged the other memories of the same period, and no reason can be assigned why such remained in preference to a thousand other scenes. Krohn gives quite an extensive review of the theories concerning Pseudo-Chromesthesia, or colored-hearing. He claims that none of the many physical explanations nor the psychical association is comprehensive enough to explain all of the facts. However, we infer that he does not consider number-forms a closely allied

phenomenon, styling them *automatic* associations. He considers such explainable by psychic associations.[1]

Having presented the main body of facts, we may well ask, what does all this mean? Have we an exceptional phenomenon, unrelated to any other psychic activity, for which some special explanation must be given? Concerning the general explanations of *Synopsie* above presented, we have little to say, but it appears certain that these visual diagrams are only less ordinary examples from a much wider field of mental phenomena.

One of the most striking things about number-forms is their extremely early origin, yet that they have a period of gradual formation and development is also evident. Forms for the Greek alphabet, historic dates, the years that one has lived, months, and in a few cases, numbers, have been developed late in life. As a rule they are not so vivid and enduring, but there are striking exceptions. Mr. G. says, "My form resulted from an evening reverie while looking in the fire; and after studying higher mathematics, I added minus and plus infinity. I was about 14 when it originated." We must then conclude that forms may originate late in life, and that they certainly become more elaborate by use and time.

There is no more reason for isolating these mental activities from a much larger field than there is for isolating exceptional cases of memory or imagination from these general powers of the mind. In any new line of investigation, the exceptional always receives attention first. This seems to have been the case with Galton, and most of the others mentioned have followed largely in the same path. Beside the more complicated cases which we have been treating, we find more than as many persons in whose minds the numbers simply take a distinct direction. Sometimes the numbers are seen on a straight line running only to the right, left, or up, etc. Sometimes only the numbers appear. Again there is only the sensation of following in some particular direction whenever numbers are thought of; sometimes only a feeling that large numbers are far off. Prof. Story, in conversation with the writer, denied that he had a number-form, but finally remarked that large numbers appeared far off, although he saw nothing, and had no feeling of any particular direction; yet if 7 and 69 were thought of, there would appear to be room between for the other numbers. I felt sure that investigation on this point would throw light upon the subject, and at once began a re-examination of those who had denied

[1] American Jour. Psy., Vol. V, p. 20.

having a form, and others who thought they had none. Two hundred and fifty adults have been reached, and two hundred and ten have a feeling that numbers in some way recede from them. Many report that they have an upward movement. Mr. F. said he could not resist thinking of numbers as going up, the large ones getting very high. With others they appear to go straight in front, or at angle of 45 degrees. To many, large numbers simply appear to be far away, and they are unable to designate any direction. Mr. B., a man of mathematical ability, said he had no number-form, but his number series contracted. Beginning with zero it is more than twice as far to 100 as it is from 100 to 200, and so on towards infinity. This is exactly the law that can be seen in every number-form, though not in any fixed ratio. I believe *that nearly all persons possess some idea of extension of numbers, more or less indefinite.* At first I had no idea that any similar phenomenon could be found in my mental activity, but when I think of 99 in its relation to 1, the form appears about two yards in front of me at an angle of about 45°; and I have never been able by an effort to think of it otherwise except for a moment. I find that but few have even noticed how they cast numerical thought into space relations. Out of 480, above the 7th grade, 74% visualize all mental operations with numbers in some way; and but few had thought it could be otherwise. The suggestions in former studies led us to an examination of children. In the 1st, 2nd and 3rd grades 785 children were asked to count and then to tell if the numbers take any direction. The most unexpected directions were asked for first. Thirty-four said they went down; 60, to the right; 29, to the left; 74, right forward; 470, some upward movement. Of course none of these were considered with the number-forms, but we evidently have the same material here and many of these are probably as distinct as the complex forms.[1]

Here we see the dominance of the eye over the other senses. In most of the forms it appears that there is a tendency to keep within the field of vision; only in a few cases are the forms located outside of that field, and many seem to turn in order to avoid getting out of it.

The number series is a succession, the rudimentary concept of which dates back further than the actual numeration of objects. When children begin to count they usually represent this series by nods or movements of some kind. Many adults unconsciously make these movements. A girl, 17,

[1] It would be extremely interesting to know whether those blind from birth make use of any such space imagery.

always moves her great toe. She says it is irresistible. If these movements are suppressed we might still find them represented in thought in the form of a space series. Without doubt children tend to connect some movement or extension in space with numbers, and it is here that we are to find the genesis of number-forms. Back of any visual image seen by the mind's eye is the motor element in thought, which must have space as a back-ground. Some say they cannot think of any series of objects, as man, dog, cow, horse, etc., without some idea of succession in space. Infinity usually suggests a never-ending line, the direction of which is often definitely located. Many, in thinking of the distance between two places as so many miles, see it in space.

Can early association explain this general tendency to cast the number series into spatial form? Is there anything inherent in the number concept which in any way determines the association? What is the relation of geometry and numbers? Numbers are generally defined as a series of successions, and a number is said to have no relations except that it comes after, and is followed by another, while a geometrical figure may have several relations.

Euclid did not make that wide separation of geometry and arithmetic now so commonly practiced, but there is a general tendency to base primary mathematics again more and more on geometry. Sylvester said, "Every time I go deep enough I find a geometrical bottom."[1] Again we may ask: Are the facts herein set forth to be traced to the general fusion of sensations received through different senses? If so, then this subject is a part of a still larger one, including Pseudo-Chromesthesia, dramatization of numbers (that is, the giving to certain numbers the characteristics of certain persons, animals, or objects), and the whole range of facts which Wundt includes in *complicative association*. The more we attempt to trace any set of sensations or perceptions to their ultimate origin, the more this confusion or mingling is encountered. But it hardly seems best to class these phenomena under the same head. It is better to seek the explanation in the motor and space elements in thought. If I have succeeded in showing that number-forms and others are not such isolated phenomena as they have been considered, and that they have their genesis in simpler mental activity, the object of this short paper is accomplished. Local relationship is very dominant in all thought, and when we suppose we think abstractly, as a rule, we use, either consciously or unconsciously, some substitute. Such thoughts are at bottom symbolic, and in so far concrete.

[1] "Address before the British Association."

I desire to acknowledge my indebtedness to Drs. Hall, Sanford, Burnham and Story for suggestions, to the authorities of the Worcester schools, to Supt. Carroll and the teachers of Worcester for coöperation, and to Profs. Luckey, Barnes and Deahl for the sending in of valuable material.

THE PSYCHO-PHYSIOLOGY OF THE MORAL IMPERATIVE.

By James H. Leuba, Ph. D.

Among the many experiences of the ethico-religious consciousness, there is one of such exalted mien and striking distinctness, announcing so loftily a mysterious will and playing such a remarkable rôle in the higher life of man, that it has long since been singled out by name among ethical races. Kant has baptized it: "*the Categorical Imperative.*" It would be difficult to overestimate either the practical or the theoretical rôle played by this ever-ready monitor. Theologians and naturalists alike have recognized in it the highest and most distinctive endowment of man; "I fully subscribe to the judgment of those writers who maintain that, of all the differences between man and the lower animals, the moral sense or conscience is by far the most important," says Darwin, in the chapter on the Moral Sense in the "Descent of Man."

It is after this inward pattern that the ethico-religious seers and prophets have drawn the features of the objective universal Moral Order. In the past no attempt has been made to analyze the Moral Imperative[1]; it has been considered a simple, ultimate fact and it has moreover been supposed to be, somehow, of another order than the rest of the psychic life. Currently, it has stood for the "divine" in man. Kant himself accepted the fact uncritically as the inscrutable expression of 'universal reason,' as "the absolute dictator of its own laws," and bestowed upon it sundry distinguished appellations, such as "it is an *a priori* synthetic-practical proposition." He was not anxious to discover the *deus ex machina*, but rather, conformably with his general psychological dualism of sense and reason, to make out by repeated affirmations and by appeals to experience an independence of the Categorical Imperative "of any particular tendency proper to human reason, and which need not necessarily hold for the will of every rational being."[2] "From what has

[1] For a summary and discussion of the theories of the Nature and Origin of Conscience, see Chap VI and VII of Hyslop's "Elements of Ethics."

[2] These quotations are taken from the "Fundamental Principles of the Metaphysics of Morals," tr. by Theo. Kingsmill Abbott.

been said it is clear that all moral conceptions have their seat and origin completely *a priori* in the reason. . . . ."

Although to-day the old-fashioned dualism of sense and reason has been set aside in the higher scientific circles, and although psycho-physiological science is now in condition to provide the necessary data for a detailed psycho-physiology of the Moral Imperative, the men of acknowledged authority have not directly addressed themselves to the consideration of this problem, and the superannuated Kantian metaphysical psychology of ethics has not yet been formally superseded by a psycho-physiology of the Moral Imperative in harmony with modern science. Unfortunately for ethics, it has remained chiefly in the hands of those who were not able to launch it in the new current; it still continues to waste its energy in the quest of the *summum bonum*, of the *criterion of conduct*. Whether this criterion be conceived of as a sort of Platonic archetype, the vision of which is to serve as a pattern of right living, or whether it is untranscendentalized and derived in Aristotelian fashion from a "thorough-going and exhaustive cross-examination of men's actual moral judgments," as if it was the centre of the complete circle formed by these judgments,[1] it is, in our opinion, an equally profitless chase with regard to practical ethics: profitless in the first instance because our cosmological concepts do not allow us to believe that there are such archetypes to be discovered; profitless in the second, though theoretically attainable, because it can not be the "ultimate standard" of our judgments about conduct, inasmuch as life is not best represented by a circle, but by a spiral or some such curve, expressive of the guiding modern belief in evolution, in growth. That opinions, such as the one quoted, should still be entertained and acted upon by some of our younger moralists, is a regrettable proof that the evolutionary view of life, if theoretically accepted, has not yet leavened our mental habits thoroughly enough to guide our thinking efficaciously.

Evolutionary ethics has, in its way, accounted for the genesis of the feeling of obligation. But as its method is not psycho-physiological, but rather historical, it cannot be expected to furnish us with the psycho-physiology of the Moral Imperative. When Spencer writes in the broad, undifferentiating manner, characteristic of first attempts in a new field: "We see that where the consciousness of authority, of coercion, and of public opinion, combined in different pro-

[1] James Seth: "The Standpoint and Method of Ethics," *Phil. Review*, Vol. VI, No. 3.

portions, result in an idea and a feeling of obligation, we must class these as ethical, irrespective of the kind of action to which they refer,"[1] we answer, yes, it is probably as you say, but, as psycho-physiologists, we should like to know more about that "consciousness of authority;" we should also like to understand better how the combination of certain consciousnesses brings about a feeling of obligation, and the well-deserved criticism by Prof. Dewey comes to our mind: "Their great defect is that they do not give us any method of differentiating moral coercion (or obligation) from the action of mere superior physical force." "The theories [of Bain and Spencer] must logically commit us to the doctrine that 'might makes right' in its boldest form."[2]

In the following essay we attempt to demonstrate the psychological parentage of the Moral Imperative and its physiological mechanism. We shall be led to set down the thesis that *the Moral Imperative is the psychic correlate of a reflective, cerebro-spinal, ideo-motor process, the efferent end of which is organized into motor tracts coördinated for a specific action.* And we shall endeavor to show how the particular qualities of this experience are—on the generally accepted principles of psycho-physiology—satisfactorily accounted for by this physiological mechanism. In closing we shall direct the reader's attention to the most important practical deductions to be drawn from the advocated conception.

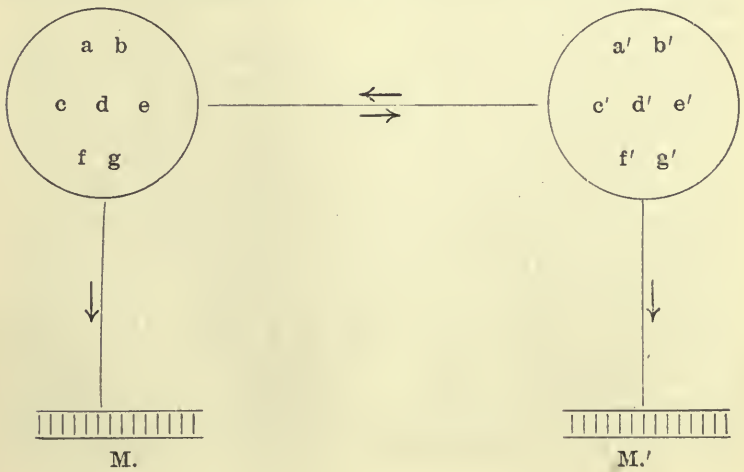
Most of the experiences of the mature man do not have as physiological counterpart the unit of biological activity, the reflex arc, but rather groups of associated processes of the reflex arc type combined in a system of antagonistic forces. The Moral Imperative belongs to such a class of complex experiences. The famous dilemma of Buridan's ass might serve as an illustration, if there were need of one for such a familiar occurrence. Whenever he turned his head towards the water and was about to move, the hay caught his mind's eye and made him look to the bunch, but before decisive steps had been taken, the water was present again. The tilting equilibrium was so perfect in this instance that it never broke.

Moral obligation is never felt but as a member of such an antagonistic system. When an action is performed reflexly or when, being anticipated, it follows smoothly without any conscious inner obstruction or hesitation, without entering into conflict with another end, there is no room for a

[1] "Inductions of Ethics," p. 337.
[2] "Ethics," p. 144.

categorical imperative. If, for instance, I see a person in imminent danger of being run over by a street car and I exclaim suddenly, "Look out!" my behavior does not imply the knowledge of the Moral Imperative. Similarly, if I learn by the morning mail that my dear friend X has fallen grievously ill, and, in a wave of compassionate feeling, I say, "I shall take the first train to him and try to soothe his suffering," the categorical imperative has not been heard. But if, in the first illustration, be it from sheer inertia or from unwillingness to cry out in a public street, I wait a few seconds to see if the person becomes aware of the danger, and then, not automatically, but after a more or less clear knowledge of the unworthiness of my reticence, I direct his attention to the danger; or if, to make the case plainer still, the person happens to be my great enemy and the thought flashes through my mind, "Let him be killed!" while the second after better motives prompt me to interfere, then I may properly be said to have heard the "voice of conscience" in the form of the categorical command. The value of the result of my conduct measured in pleasure or utility is here irrelevant, since we are not discussing the worth of action, but a peculiar consciousness.

The antagonism of these dynamic systems is a *motor* antagonism known in consciousness as an antagonism of intentions, or of ends; *i. e.*, the reflex arc processes are combined in two groups and end respectively in muscles, coördinated for contrary actions; there is consequently a reciprocal defeat of purposes. Schematically the experience may be represented by the accompanying diagram, in which *a*, *b*, *c*, *d*, *e*, etc.,



stand for cortex processes discharging concurrently into the muscles M; and a', b', c', d', e', etc., stand for cortex processes discharging in the antagonistic muscles M'.

As immediately known, experiences of this kind may be compared to that of a man witnessing a kinetoscopic exhibition. On the projection screen he sees a developing tableau; let us say a man at the beach, walking along the spring-board, reaching the end, swinging two or three times and then plunging. Suddenly everything goes out; there is darkness for the space of a second. Then, again, a tableau is thrown on the canvas and is recognized as the continuation of the first; the man is now pulling himself out of the water, etc. The blanks between the tableaux correspond to the apparently empty breaks which we observe between the series of developing apprehensions of an antagonistic ideo-motor system. It feels like a break and a blank, because the apprehensions have a sort of *light* quality, due, no doubt, to their predominantly visual origin; when the cortex processes discharge into motor tracts and the chain of apprehensions is thereby interrupted, the inward panorama darkens and the change in the quality of the experience is naturally felt as a break and an extinguishment: a break, because of the sudden change in the kind of experience, and an extinguishment, because of the absence of representations of visual origin, since motor and visceral sensations now fill the mind. The break between the tableaux is more or less accentuated according as the motor discharge is more or less intense.

So much in the way of a rough psycho-physiological description of the antagonistic reflex arc combinations to which the Moral Imperative belongs.

It is evident that all the experiences of that class do not have the Moral Imperative *quale*; very far from it. Whether I shall, or shall not, go to see my friend may be a matter of simple convenience, there need not be any moral compulsoriness about it. So it is with the protracted dilemma in which Mrs. Smith gets when considering whether she had better put on her magenta or lavender gown. One essential element—the Moral Imperativeness, the sense of obligation—is lacking. Prof. Sidgwick says, in speaking of the subject of the present paper, that he calls such cognitions "dictates or imperatives because in so far as they relate to conduct on which one is deliberating, they are accompanied by a certain impulse to do the act recognized as right." The too broad term "impulse" is not very felicitous in this place, inasmuch as the experience in question is a very specific kind of impulse. Kant aptly described it as a categorical imperative. In order to sepa-

rate that awe-striking experience from others, like it in some respects, we shall have to limit our antagonistic ideo-motor cognitions to such as contain an "Imperative," and not an impulse only. But even this will not be sufficient, because there are cognitions which may well be called imperative and which, nevertheless, are clearly not moral. For instance, the insistent impulse of a sane, or insane, mind to get up at night and see for the second or third time whether the gas is turned out when *feeling quite sure*, as we say, that it is out.

But before endeavoring to differentiate on psycho-physiological grounds the non-moral from the moral-imperatives, it will be useful to single out certain traits of the cognitions having the imperative *quale*, whether it be moral or not.

The illustration just used will serve us well as a concrete case. Suppose, on the one hand, that having gone to bed it occurs to me that the gas in the hall is still burning and that I should go and put it out, but that immediately there comes the rejoinder, "No, it is not burning, I remember very clearly putting it out when I came back from town," the whole matter being thus given its quietus. Or let us imagine, on the other hand, that although I think I have turned it out, the motor-idea to get up for the purpose of extinguishing it recurs again and again, in spite of the momentary assurance I have that it is all right, until weary of the conflict I yield to the persistent "It is burning; go and put it out!" In the former instance, there is no imperative prompting to action, while in the second the impulse is described, in ordinary parlance, as "Imperative." It would be better to use the expression insistent or imperious motor-idea to characterize this class of experience, reserving the term imperative for the *moral* insistent ideas, for the reason that the urgency of the latter differs in a very specific manner from that of the former, as we shall see in the sequel. Nevertheless we shall conform here to a loose usage and avail ourselves of the adjective moral to differentiate the two kinds of insistent motor-ideas. The question before us now is, what is the differentia of an imperative experience?

Two points are in special evidence: the recurrence of the cognition and the definite apprehension of the action to which it prompts. A feeling of unrest and discomfort growing out of the conflict generally accompanies the experience as a derivative. It is worthy of remark that the imperative process need not be characterized by great motor intensity, although it always has a clear efferent conclusion. Oftentimes the calm, ineffective way—ineffective, because it does not have in itself the power to carry out its orders—in which it makes itself known, seems to be out of all proportion with the motor

energy with which it is resisted, and yet its teasing persistency may compel obedience. This point will assume a considerable importance when we come to consider the Moral Imperative.

The reader may have noticed that thus far we have had nothing to say regarding the will. As our problem is neither action, nor the relation of the ego to the Moral Imperative, but the psycho-physiology of the Moral Imperative itself, we shall not have to take the will into consideration at all. Whether we deal with a simple impulse, or with an insistent idea, or with a Moral Imperative, the will is excluded, for all these experiences are involuntary activities of which we find ourselves possessed and upon which we may react, but which we do not will into existence.

And now let us address ourselves in earnest to the consideration of the problem already mentioned and for which we have prepared the way in the preceding pages. In what do the consciousness and the physiological mechanism of the moral law differ from that of a "physical" or "external" compulsion, or from that of an imperious idea?

Ready common sense is not long held in suspense by such a query; it answers, "it is the object of duty, the things that are right, that we feel as morally binding, just as red things are seen red." Unfortunately for our peace of mind we do not believe that this *petitio principii* is the final word of science; we want to know what it is that makes a course of conduct to be felt as a duty, as morally binding. The feeling in itself is evidently an ultimate datum, but we may point out its qualitative relations to other feelings, and we may legitimately seek to do that which has already been done in the psycho-physics of the simpler sensations, of tone for instance, by Helmholtz, and even in the case of such complex experiences as the emotions,[1] *i. e.*, we may seek for the specific mechanism which is the necessary counterpart of the "Stern Daughter of the Voice of God." To do this is properly the business of psycho-physiology.

Our end will be more safely reached through a critical examination and comparison of typical cases of moral and non-moral imperative experiences. We shall choose illustrations as similar as possible.

I. Being in bed, I am suddenly made aware of an impulse to go and put my watch, which against my habit I have left in my waistcoat pocket, in its accustomed place under my pillow. As soon as I have realized the meaning of the

[1] See Darwin, Wm. James, Lange, Dumas, etc.

prompting, a counter impulse sets in, vaguely preceded by the apprehension of the comfort of the bed and discomfort of leaving it. For an instant I remain relatively quiescent; meanwhile, the apprehension "watch-in-my-pocket-not-under-pillow" develops; I see the usefulness or the uselessness of its being under my pillow and the danger of its remaining in my pocket, etc. Suddenly a break happens in the mental scenery and I say to myself, "The watch is safe where it is; I do not need it under my pillow; it is just as well where it is." But this has hardly crossed my mind before the first impulse is present again. For the second time, as soon as I have realized its meaning, I veto the getting-up tendency, judging that there is no need of my leaving my comfortable bed for such a purpose. But no amount of considering and reasoning prevents the impulse from recurring again and again, until exasperated I jump up and execute the order.

In this experience, we must notice three "movements" of the reflex arc type: (1) the impulse to get up following immediately, quite involuntarily, upon the apprehension of watch-in-my-pocket-not-under-pillow. Whenever that thought pops up, the impulse to get up follows mechanically as its efferent conclusion. The action is known through the impulse and not before it. (2) As soon as the meaning of the felt impulse is realized, an antagonistic movement occurs, the afferent part of which is more or less dimly known as an apprehension of discomfort, of cold, etc., that would be experienced were we to get up, and the efferent side of which is the innervation of muscles antagonistic to those stimulated in 1. This second reflex arc is, like the first, involuntary. (3) When impulse 1 has been neutralized by innervation 2, the necessity, usefulness, consequence, etc., of 1 and 2 cross my mind and, in a motor tendency antagonistic to getting up, I say, "I need not get up; it is a matter of indifference whether the watch is here or there." This third movement differs from processes 1 and 2 in that it is *reflective*, *i. e.*, while in movements 1 and 2 the action was not known before the impulse to perform it, here the apprehension itself gets its cue from, or starts with, the cognition of the deed; the action is, as we say, *under consideration*. In the present instance, the motor conclusion of the third process is antagonistic to getting up, the imperative impulse is not approved of.

A group of three reflex arc processes—the first two involuntary, reflex, ending in antagonistic motor tendencies; the third one reflective, ending in the disapproval of the insistent impulse—linked together by associative connections and repeated an indefinite number of times, makes up the

experience we are now analyzing. To say that this triune process remains the same throughout its repetitions does not mean that the same apprehensions are repeated, but rather that the motor results are similar and that although the apprehensions may differ somewhat in vividness and in contents, they are, nevertheless, recognized as referring to the same objects and to the same action.

II. In the middle of the night I am awakened by the coughing of my brother lying sick in the next room. My first movement is to go to him and see whether I may do something for his comfort. Before this action is carried out an antagonistic impulse arises, following upon a more or less obscure apprehension of bed-comforts, etc. But this shrinking from getting out of bed has hardly subsided before a chain of considerations passes before my mind: the pain my brother might be enduring, which I might relieve; the meanness of my aversion to move, etc.,[1] a chain of apprehensions ending in a motor tendency in harmony with the first, and which I may express to myself in the words, "Yes, you *ought* to get up; it is your duty, it is right that you should do so." But somehow or other I remain inert until another fit, or the memory of the first fit, of coughing, or the thought of my brother, starts up again an abortive attempt to get up, etc.

Here, again, we have three coördinated arcs which may go on repeating themselves indefinitely. The first two are in every respect similar to the corresponding processes of the preceding instance. They are both involuntary, impulsive. The third movement, like the corresponding one of instance No. I, is reflective, but it differs from it in its direction; instead of opposing the motor conclusion of the insistent idea (the first reflex arc), it coincides with it.

III. Let us suppose that instead of being sick, my brother is in health, and that violent coughing from him still determined in me an impulse to go to him. The deterrent reflex arc process takes place as in illustration 2. Instead of imperatively urging me to attend upon my brother, the third process now leaves me free to do what I may choose; I express myself mentally in the words, "I need not get up;

[1] Before going further we desire to draw the attention of the reader to the fact recently pointed out by Prof. Dewey in his article on "The Reflex Arc Concept," *Psychological Review*, Vol. III, No. 4. That which is usually taken as a reflex arc is generally a coördination, or combination, of a number of reflex arcs. The apprehension side of our reflective processes is in fact composed of a lot of afferent-efferent processes; but they are so combined that we may consider them as one resultant reflex arc movement.

there is no urgency; he does not need me; I may remain in bed if I like it best," etc.

IV. Fourthly, let us imagine, that, again in bed, I suddenly remember having neglected to write a letter recommending some one for a position. My first movement is to get up. Then comes an antagonistic innervation following upon the apprehension of the discomfort involved in getting out of bed to sit at the writing-desk, etc. Presently I become clearly aware that I have promised to write the letter, that the young man trusts in my word, and many unnamable, ominous shadows hover past my field of mental vision, and I say to myself, "Get up; you ought to." This experience is in every essential point similar to II.

The reader has no doubt noticed that the reflective motor-apprehension of II and IV was categorical, no alternate was left, "You ought to get up" was the conclusion; while that of I and III is best described as disjunctive with regard to the action suggested by the first impulse: "There is no need of your placing that watch under your pillow," I said to myself; and, if I had fully expressed my attitude at that instant, I should have added, "There is also no necessity for leaving that watch where it is, it is a matter of indifference," *i. e.*, the experience II (the sick brother), and IV (the promised letter), include the moral categorical imperative, the voice of duty; while I (the watch), and III (the brother in health), are morally indifferent. All four experiences are similarly composed of groups of three coördinated processes of the reflex arc type; two of them being reflex and the third reflective. If our analysis is right, it must be in the reflective process that we must look for the "moral" differentia, inasmuch as a reflex movement cannot be fraught with the feeling of moral oughtness. The words, "You ought or ought not to do this," and, "Do what you please about it," designate like every other word or group of words, by means of sensory signs, certain experiences, sensations, presentations, representations, apprehensions, feelings, emotions, etc., *i. e.*, certain irreducible, immediate consciousnesses. In the instances in question, these expressions are the names given to the motor conclusions of the reflective apprehensions. When those specific processes are felt in the described relations, we say either that we feel the oughtness, the duty; or that we feel the action to be in itself indifferent. What the difference thus expressed is can be brought out only by a careful examination of the reflective motor-apprehensions themselves. As the process is of the reflex arc type, we shall consider it under two heads: the afferent and the efferent side.

As to its afferent side it is similar in the moral and in the non-moral movements; in both cases, it is a reflective as opposed to a reflex apprehension, *i. e.*, it takes its cue from the cognition of the action of which we have become aware through the reflex movements 1 and 2. Thus we know, as we say, that we are considering the advisability of a certain action, hence the name *reflective*. The efferent conclusions of these reflective arcs end in the muscles that would be needed to carry out, or resist, the execution of the action, or in their speech substitutes. We may call the reflex movements *blind impulses* because consciousness lights up only the way that has been already traveled; and bestow upon the reflective processes the name *intelligent impulses* because the lamp is turned forward and lights up the end at stake.

We have used the term *reflective* and not *voluntary*, for the evident reason that a voluntary activity does not only include the prevision of the possible motor conclusion, but also a something else, for which we have no better name than the ill-understood word "effort." The motor conclusive of the reflective process with which we are dealing comes not unannounced, but unasked for; be it desired, willed against, or unwilled, it imposes itself upon us just as much as the reflex process. This unwilled experience may very well be followed by a voluntary activity striving either for the suppression or the fulfilment of one or the other of the recurring movements, or yet by deliberate efforts to consider the question thoroughly from all sides; but this is not at all necessary to a reflective process of any kind, and especially not to a moral-imperative experience.

A second and far-reaching characteristic of the afferent side of the reflective arc, belonging also to both moral and non-moral experiences, is its independence of passions, emotions and sentiments; or to express this physiologically, its independence of the sympathetic nervous system. It appears to be an activity limited to the cerebro-spinal system. For the sake of convenience we shall anticipate a little, and, before having brought in all the evidence, shall make the statement that whenever the Moral Imperative is felt, it is the correlate of a purely cerebro-spinal reflective motor-process. Let the reader accept the statement on probation and keep it in mind through the rest of the paper; we trust that he will be finally convinced of its truth. We say that the third movements in our illustrations develop passively, dispassionately, coldly. Emotion and strong feeling may well develop after the motor-conclusion has been reached; it is this occurrence which often veils the fact we are trying to

bring out. Let the reader recall, for instance, the shame which will follow the realization of the command, "You ought to get up," when alongside of it creeps the consciousness, "You are too mean, or too lazy to obey," or when the command is looked upon as from God, and in consequence a mass of ethico-religious feelings is stirred. The exclusive cerebro-spinal dependence of the Moral Imperative has been also obscured because other experiences dependent in part upon the sympathetic nervous system have vaguely been identified with it under the general name of "moral-feeling." If, for instance, I recoil in shame and disgust from a lascivious piece of art, just as I push away a sour beverage, the turning away from and the being ashamed and disgusted do not imply the experience of the Moral Imperative, although a tendency to turning away might be its conclusion.

We pass now to the consideration of the efferent part of the reflective movement. Thus far we have found nothing differentiating the non-moral from the moral reflective process. In illustrations II and IV, the reflective motor conclusion was expressed by the words, "You ought to get up, there is no other alternative." In I and III, on the contrary, the motor side was not felt as a necessity of performing a particular act. I felt, "You need not get up unless you choose; do what you please." These expressions indicate, it seems, that, whereas concerning the first, the cortex activities corresponding to the reflective apprehensions pool their forces and discharge harmoniously in coördinated motor channels, concerning the second, the cortex stimulus either loses itself in many non-coördinated motor tracts or divides itself along two antagonistic lines of discharge, with the result that in the former case there is a clear, definite apprehension of the action, together with an impulse; while in the latter, the representation of the action is usually less vivid and there is no discernible tendency either to perform or resist it. The very definite aversion to getting up felt, for instance in illustration I, must not be mistaken for the motor side of the reflective arc process. A careful introspection will reveal that it is rather due to a repetition of the second reflex arc, occurring so quickly after the reflective arc that it may be thought to belong to it.

From the foregoing analyses, we conclude that experiences II and IV, *i. e.*, those including moral obligation, differ from the non-moral ones, I and III, in that the third, or reflective process, is imperative, which means in physiological terms that its efferent discharge is definitely organized along coördinated motor tracts. The "Moral" arc in these cases is: (1) reflective; (2) wholly cerebro-spinal; (3) it has a clean-

cut, coördinated motor conclusion prompting to an action. While the corresponding reflective arc of the non-moral experiences, if identical in regard to points 1 and 2, differs in the manner above stated with respect of its efferent termination.

The illustrations from which we draw the foregoing conclusions were expressly chosen in order to differentiate the Moral from the non-Moral Imperatives; we shall therefore have to extend the range of analysis before we may legitimately generalize our findings and affirm that these three characteristics belong exclusively, and always, to the Moral Imperative experience. Let us consider rapidly other typical experiences and see whether they do or do not fall in line with the preceding ones.

a. The thought of my friend X flits through my mind and I am prompted to go and see him. Then comes a string of apprehensions developing around "my friend:" some pleasant moment I spent with him not long ago, the attractive look of his study, his good cigars, his cordial greeting, and the warm pleasure he took in the conversation. Here a little wave of pleasurable feeling or emotion interrupts the chain of apprehensions and I feel an impulse to go; "I shall go and see him," I say. Presently another series of tableaux passes before my mind: he gave me three months ago an essay of his which I have not yet read; at our last meeting he inquired what I thought of it. He looked a bit ruffled that I had so long postponed the reading of it. I see him now betraying his displeasure at hearing that I have not yet found time to read the paper. Another wave moves me and I recoil, thinking, "I shall not go."

We may imagine the process coming to an end after the first or after the second ideo-motor movement; or yet continuing after the third along similar lines of associations, and ending now in a "going" and now in a "not-going" motor feeling. The first afferent-efferent process is automatic; the second and third are reflective, but neither one is free from the influence of the organs of the vegetative life; the chain of apprehensions is cut short by an influx of stimulus from the sympathetic nervous system. This experience does not contain the Moral Imperative.

Let now the circumstances be changed; suppose that X is of a humble station in life. He has called upon me long ago and I have not yet returned his call; he must feel slighted, etc. The motor conclusion comes and is expressed by the words I pronounce mentally, "That is wrong; you ought to go; it is your duty." It might be that the thought of having failed in civility from such a mean motive towards

a man I esteem shames me, and that I decide to go on the spur of this emotion. If such is the case, I do not feel under moral obligation; for acting simply because we should be ashamed to have people know that we had not acted, does not, according to general experience, fall within the field of the morally obligatory. But, and this must neither be overlooked nor misinterpreted, I may feel both the shame and the moral obligation. As a matter of fact shame often follows the feeling of oughtness, but it never precedes it as its *determinant*. Even when emotions or feelings precede or follow immediately the "voice of conscience," we are fully aware that it would be heard just as imperatively without them; this is due to the fact just stated that emotions form no part of the "*moral*" arc. In an experience like this, after the first realization of "oughtness" and of shame, these two psychic states generally recur both in representation and in presentation. In representation they "feel" at times as if they penetrated each other and made one more or less homogeneous state. This apparent fusion easily confuses the experiencer in the belief that "oughtness" and shame are here inseparable from each other.

In this last case, the process is reflective, free from feelings and emotions, and its efferent conclusion brings before the mind definitely and urgently an action. Just as in the previously considered cases, this ideo-motor Moral Imperative does not stand alone, it is correlated with other ideo-motor processes.

b. We hardly need dissect Moral Imperative experiences starting with the sting of the grosser passions, hunger, lust, etc. They would be found to be analogous to the preceding cases. We should find first a reflex impulse tending to the gratification of the passion; then, possibly, a chain of apprehensions including sentiments and emotions, such as fear of discovery, shame at our weakness, etc., ending in an assent to, or a dissent from, the deed. If moral obligation is felt at all, it would be found again to be the return feeling of the efferent conclusion of a reflective non-vaso-motor arc.

c. I have been publicly criticised in a spirit of jealousy by some one, who, to reach his end, has not shrunk from false and calumnious representations. In my anger and indignation, I resolved to answer in a withering letter. I may feel violently impelled to write, without at all being conscious of moral obligation. If I cool down for a length of time sufficient to allow the undisturbed development of the cortex processes—and that is a very short time indeed,—it might be that the motor conclusion of the corresponding chain of apprehensions points nowhere, leaves me indifferent. If it be

so, I shall not know the Moral Imperative. But if it ends roundly in coördinated motor channels, filling my mind with the cognition of one specific action, then I shall feel moral obligation.

d. There are cases in which moral obligation is felt, but is not accompanied by the apprehension of a specific action. A general on the field of battle, for instance, may feel it morally imperative to make some move, although no particular movement seems best. Here the apprehension of the certain destruction which, under any conceivable possibilities, will overtake the army in its present position has a clear, powerful, motor conclusion tending to action again, but not to any highly specialized action. It is a discharge along the motor tracts coördinated for general bodily activity, turning about, running away, etc., or for the substitutes of these motions. Here again the spirit of the description we have given of the moral imperative process is not at fault; the motor discharge is not a random one, it does not reach as well the flexors as the extensors; it is coördinated for general action. The commander may subsequently consider a number of possible movements, find them all destructive and recoil from them all, until perplexed and confounded, he may grow cold and stupid,—but this has naught to do with the Moral Imperative.

e. The cases of so-called *external compulsion*, be it psychical or physical, do not differ from the preceding ones as far as the psycho-physiology of moral obligation is concerned. We need not consider the instances in which the habit of implicit obedience is so deeply ingrained that any order whatsoever is immediately executed or accepted without first awakening opposition or reflection. Such an automatic obedience as that of the old soldier at the Invalides who dropped his dinner which he was carrying in a tray on hearing a practical joker order "Shoulder arms!" evidently falls outside of our study. There is another sort of external compulsion affecting those who have learned the uselessness of resistance to certain commands coming from certain persons, or to certain despotic passions, or to the force of circumstances. Here the awareness of the compulsion does not always prevent the anticipation of the consequences of complying, and at times there is a recoil from them. When this recoil proceeds from a desire to avoid the pain or displeasure that obedience would occasion, the moral command is not heard. If we are aware of the Moral Imperative at any stage of an experience of this kind, whether we try to resist, or give up in despair without attempting resistance, we shall find on investigation that it is the conclusion of a reflective cerebro-spinal motor process, exactly as in the preceding cases.

f. The "logical" activity through which we arrive at scientific knowledge presents many of the characteristics belonging to the Moral Imperative. It is a reflective activity independent of the sympathetic nervous system and its conclusion has a finality, a "categoricalness," akin to that of moral obligation. Galileo would have been glad to persuade himself that the earth is motionless, but the logical imperative protested and affirmed, "yet, it *does* revolve around the sun!" Despite these similarities, people find no difficulty in practically differentiating between these two classes of experiences. The conclusion of the Moral Imperative process urges to a specific action, affecting some being, while the other pronounces upon the existence, past, present, or future, of an object of thought. Physiologically this means that in the logical process the efferent side of the reflective arc does not discharge in muscles coördinated for an action *that would modify the experiencer's relation to some existence*, although, to be sure, it has also a definite motor conclusion.

We have said of the reflective non-sympathetic process that it is impulsive, that it prompts to action. But its impulsiveness is peculiar; it differs from that of the reflex and of the sympathetic experience in that it does not seem to be due to the putting in incipient activity of the muscles involved in carrying out the action. Close introspection reveals, it seems to us, that the moral imperative process ends efferently, not in the muscles of the action itself, but in those of the speech organs which stand as their representatives. It happens thus that the urgency is not to perform the deed, but rather *to state that fact in speech signs :* we are not incipiently performing the deed, but, instead, we utter or hear mentally, "You ought to do this," or words to that effect. We shall postpone to another part of our paper a fuller discussion of this very interesting point. Let us add only that this impulsiveness is generally followed by an innervation of the represented muscles themselves and, on that account, we usually have, coming after and not belonging to the knowledge of the Moral Imperative, a genuine impulse to perform the action itself.

We may now go back to the provisory differentiation on page 539 and, on the strength of the agreement of cases *a*, *b*, *c*, *d*, *e* and *f*, with I, II, III and IV, we shall set down our thesis in the following general terms, referring the reader to the sequel for additional confirmation :—

The Moral Imperativeis the psychic correlate of a reflective, cerebro-spinal, ideo-motor process, the efferent part of which is organized into motor tracts coördinated for a specific action. No Moral Imperative can be known in the absence of such a

physiological activity; and whenever an activity of this kind is known in consciousness, it is known as a Moral Imperative. This reflective arc stands in dynamic inter-relation with one or more arcs that are either non-reflective cerebro-spinal, or sympathetic reflective, or non-reflective sympathetic. These associated processes vary widely in number, vividness and compulsoriness; the only necessary thing is that there be at least one such process preceding the "Moral" arc and forming with it a dynamic system.

The four diagrams on the opposite page may help to give definiteness to our thesis.

Explanation of Diagrams. In every diagram the dotted line *C.* stands for the cortex layers of the brain, and the dotted line *Md.* for the midbrain and the medulla. *M.* stands for the voluntary muscle system, exclusive of the speech organs; *V.* for the organs of vegetative life generally; *a. b. c.* for those parts of the brain concerned in the apprehension of the action, and 1, 2, 3, 4, 5, 6, for the apprehensions developing from, or ending in that of the action; *vs. c.* for visceral sensation centres; *s. c., s'. c'.* for speech centres, and *s. o.* for speech organs.

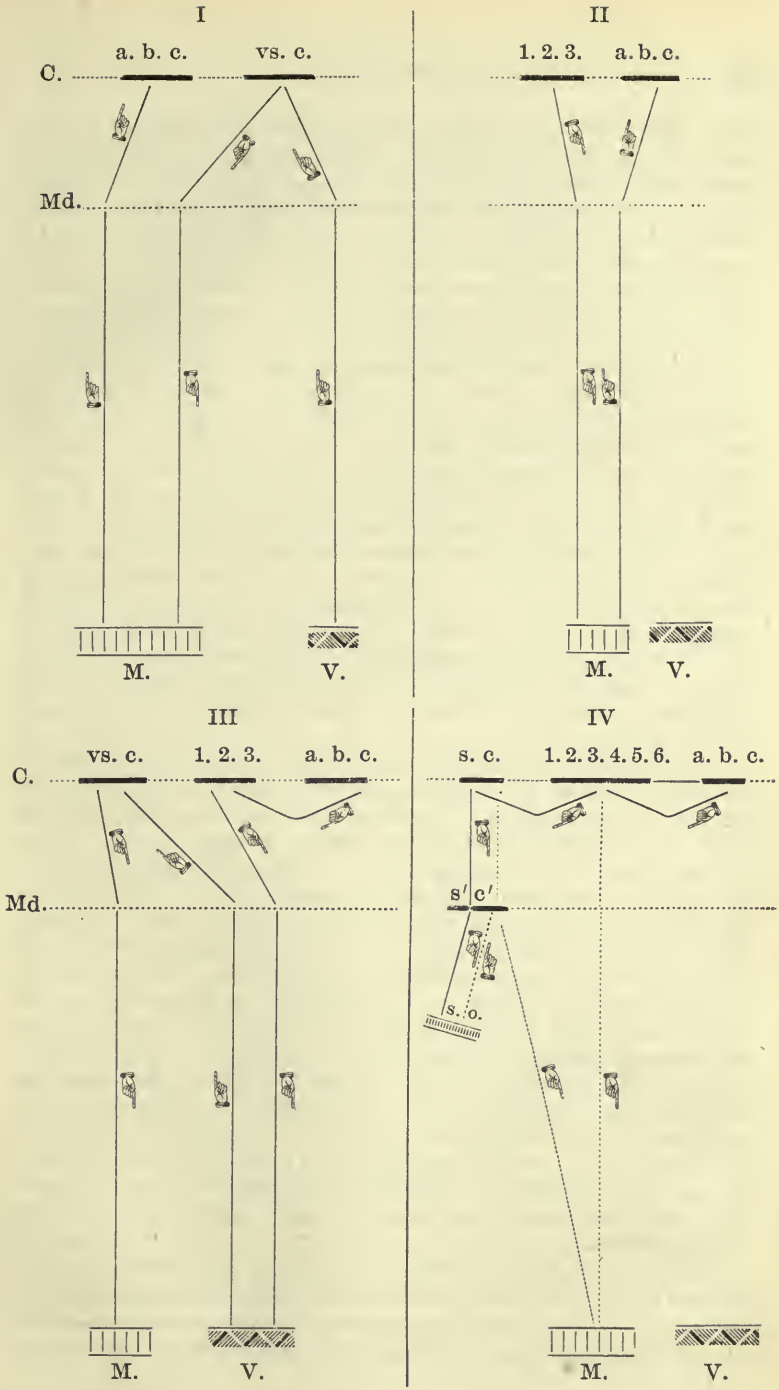
I. *A sympathetic reflex process*, starting in *V.* The action, to which the efferent discharge to *M.* prompts, is known only after the return motor sensations.

II. *A cerebro-spinal reflex process.* It may stand for the non-moral imperative processes we have instanced. It starts with 1, 2, 3, 4, the processes corresponding, for instance, to the apprehension of "watch-in-pocket-not-under-pillow," and ends with *a. b. c.*, which stand for knowledge of action towards which an impulse has just been felt.

III. *A sympathetic reflective process.* Sequence of events: (1) *a. b. c.*, (2) followed by a series of associated apprehensions. 1. 2. 3. (3) Discharge along visceral motor tracts, into viscera *V.* (4) Return visceral sensations in *V. S.* (5) Motor discharge in cerebro-spinal system reflexedly felt as impulse to act.

IV. *A reflective cerebro-spinal process.* Sequence of events: (1) *a. b. c.* (2) 1. 2. 3. 4. 5. 6. (3) Discharge into the so-called speech centres *S. C. and S'. C'.* (4) Sensory return.

Remarks on Diagrams III and IV. The class of experiences represented by schema No. III is the one with which we are most familiar; it is the "natural" experience *par excellence;* the only kind of experience possible until the sympathetic nervous system has been differentiated to a high degree from the cerebro-spinal system. We must take especial notice in this class of experiences of the influx of stim-


I
a. b. c.
vs. c.
C.
Md.
M.
V.
II
1. 2. 3.
a. b. c.
M.
V.
III
vs. c.
1. 2. 3.
a. b. c.
C.
Md.
M.
V.
IV
s. c.
1. 2. 3. 4. 5. 6.
a. b. c.
s′
c′
s.
o.
M.
V.

ulus due to visceral activity; it precedes the cerebro-spinal motor discharge which brings about the action, or the impulse to act, and constitutes a weighty factor in its determination. The intellectual consequence of this nervous influx through the sympathetic system is to shorten the string of reflective apprehensions, *i. e.*, to cut short the development of what may roughly be called the "reasons" for acting. There are occasions when the experiencer is gallingly aware of this arrest; for instance, when, in spite of vigorous dislike, we strive to be impartial towards some one, and again and again discover that the affecto-emotional wave has led to a judgment before we had taken into account this good point and that estimable trait. It even happens that under the influence of disdain, anger, impatience, pride, self-conceit, etc., we reach a conclusion-motor-impulse, all the while (as it seems) knowing that we have suppressed certain evidence, and distantly protesting against this unfairness. The blinding effect of passion has long ago, and in many lands, been turned into popular sayings. How this must be, and within what limits, can easily be understood from the point of view of dynamic physiology. How this state of things affects our general estimate of the worth and dignity of the judgments reached through processes of this class, we shall see later on.

It hardly need be said that the class of experiences represented by schema No. IV can belong only to beings whose cerebro-spinal nervous system has been so far differentiated from the nervous system of the life of nutrition and reproduction that it has isolated, closed, afferent-efferent channels. This schema represents all the higher purely "intellectual" operations; the calm deliberations of a man of science as well as the "voice of conscience." How the former differ from the latter we have attempted to say on p. 543, case *f*.

For the sake of brevity and simplicity we have spoken of 1, 2, 3, 4, 5, 6, as if they represented direct, successive associations of purely intellectual representations. We incline rather to the belief that every one of the links of the chain of apprehensions is made up of a "shortened" reflex-arc process,[1] and that it has frequently a well-marked affecto-emotional tone. But these reflex-arc processes get into dynamic unity and pool their efferent sides into coördinated channels, and so we may deal with them as if they made up one single reflex-arc.

Our use of the expression "purely intellectual" will probably have suggested an absolute independence of intel-

[1] See the paper of Prof. J. Dewey, already mentioned.

lectual knowledge from pain, pleasure and emotions. The observations made with the help of the sphygmograph, plethysmograph, pneumograph, dynamometer, and otherwise, have placed beyond doubt that which the anatomy of the nervous system had already suggested as highly probable, *viz.*, that even the mental activities which feel most purely intellectual, exercise a measurable influence on blood circulation and, generally, on visceral activity. But we may, legitimately, it seems, make use of the expression "purely intellectual" to name those cognitions in which the experiencer does not recognize an affective tone, or an emotion. The faint and unfelt, or rather undistinguished, general bodily echo of the felt intellectual process does not concern us here. Moreover, as introspective observation declares that the Moral Imperative is the purer, the more exclusively intellectual it feels, we need not in a study of this phenomenon take into account an element that is to it as the dross to the metal.

Another explanatory remark we must make concerning the efferent conclusion of this IV type of process. It is marked on the schema as ending in the speech organs, and not in *M.* as in the others. We have elsewhere had occasion to bring out a rather subtle difference in the "feel" of the Moral compared with the non-moral imperative process. We found that the being aware of the moral imperativeness of an action is not, strange as it may seem to the superficial observer, synonymous with the consciousness of a motor impulse to perform it; that, unfortunately for many of us, the knowledge of duty is not necessarily accompanied with an impulse to act. We are frequently, to use the words of the theologians of the 17th century, famous through the Letters of Pascal, in possession of the *grâce suffisante*, but we have not the *grâce efficace*. It lays down an absolute law, but it does not carry it into execution; it is a purely legislative and not an executive power. Hence it is that its imperativeness does not infringe upon our "freedom." This is to be physiologically interpreted, we believe, as meaning that whereas in the non-moral imperative processes the efferent discharge reaches the muscles that would carry out the deed itself, in the case of a Moral Imperative it is vicariously directed to the speech centres and thence to the speech organs, which act as substitutes, and therefore we have an impulse to *speak*, but not to do the deed. This substitution will appear more plausible, and its *modus operandi* more intelligible, if we glance at the psycho-physiological history of "consent," or "approbation."

Originally consenting to something is *doing* the thing consented to. The amœba either encloses and absorbs the parti-

cle that touches its body, or does not; the newborn infant sucks, or does not suck. But very soon substitute motions are developed, and take the place of the action itself: the turning away of the head gradually takes the place of the tight shutting of the mouth. Later, when speech makes its appearance, a sub-substitution occurs; the child instead of closing its mouth, or turning away its head, speaks the vicarious "no," and, henceforth, for the deed itself is substituted a representing deed of the speech centres and organs. To follow, with much detail, the reflex-arc mechanisms through their exceedingly complex schemes of substitutions would be a long and difficult task; what precedes may, perhaps, be adequate to our purpose. It will, at least, suffice for a correct understanding of the last clause of our definition of the Moral Imperative process.

Many will find it hard to admit that the less the Moral Imperative experience contains an impulse towards the execution of the command, the clearer it is. This difficulty is caused, we believe, by the fact that the substituted activity in *s. c.*, *s'. c'. and s. o.*, is probably always followed, according to the laws of association, by a motor discharge, more or less vigorous, into the represented muscles; this impulse is wrongly taken to be an intrinsic part, or a condition, of the consciousness of the Moral Imperative, although it is only an appendage.

The dotted line going from 1, 2, 3, 4, 5, 6 to *M.*, in Diagram IV, represents the possibly generally present survival of the primitive motor discharge going directly from the sensory realms to the deed-muscles themselves. We need not expect that the primitive sensory-motor course is absolutely obliterated in moral-imperative processes; they need not be pure.

We have all along proceeded on the assumption that the cognition of moral oughtness is the psychic side of certain particular processes of the reflex-arc type. We have said that the words "you ought to get up" or "do what you please, it is indifferent," are the names of the consciousness of such physiological activities. We shall probably be called to account by some for setting aside so unceremoniously the theory that used to reign supreme among ethical philosophers, and which is still in high honor in many quarters, not so much because of the satisfaction it gives as because no other theory, more in harmony with the conceptions of modern psychology, has been clearly set forth. The knowledge of duty, of oughtness, they will say, precedes and is the determining cause of the bodily activities which you put forward as the condition of the cognition of the Imperative.

This theory is an old acquaintance; it is the child of the now obsolete conception of the soul as an entity knowing, somehow, independently of bodily activity. Little by little it has had to give up some portion of the field of experience; at first the lower cognitions, those of the senses; more recently, the emotions were taken out of its realm by the Lange-James theory. In looking upon the moral feelings, as conditioned by specific physiological processes, we do no more than place this class of phenomena under the conception now generally accepted touching the relation of mind and body. We do not say that these bodily activities *cause* the "oughtness," neither do we say the reverse; we are content to state a parallelism and to affirm that, without these physiological phenomena, there is no possible knowledge of the Moral Imperative, just as—and for similar reasons — there can be no sight without the healthy activity of the optic nerve and of certain definite parts of the brain. Arguing on this point would be to enter upon a discussion of the most fundamental conception of modern psychology. To do this would be an impertinence unless we could show, or had sufficient reason to believe, that the facts of the moral life cannot, with reference to this conception, be classed together with the lower sensations, with the emotions and with the æsthetic feelings. But, of this, not only is there no evidence, but, moreover, all the facts known make it absolutely impossible to sever the moral from the rest of the psychic life.[1]

In so far as we call actions *right* or *wrong* according as they do, or do not, agree with the leadings of the Moral Imperative, and as we use the word *duty* to designate the actions morally binding upon us, in so far do these names *right*, *wrong*, *duty*, derive their meaning from the consciousness of the Moral Imperative, and are they applied solely under its guidance. We say "in so far" because we are not now prepared to affirm that right and wrong, in their moral meaning, as understood in civilized countries, never have another origin than the experience of the Moral Imperative.

The proposition that the knowledge of "oughtness" or of "duty" is the result of the described reflective arc is appar-

[1] For the rest let it be said that the parallelism doctrine is to our mind thoroughly unsatisfactory: it supposes a chasm between events we feel the need of relating in a sequence. The postulation of a causal relation between the two classes of events, in either direction, will remain unintelligible as long as our understanding of the nature of these two series of facts does not change. Let us hope that psycho-physiology will soon stand on a surer foundation.

ently controverted by innumerable experiences. The popular mind will be quick to poin tout the undeniable fact that we frequently know things to be objects of duty before having at all considered their consequences, purport, etc. (1, 2, 3, 4, 5, 6, in Diagram IV). If I think of stealing, I immediately know that it is my duty not to steal; and to say that this cognition follows upon a long series of apprehensions as before described, is most clearly a misrepresentation of the sequence of events. I know first that it is duty, and if I have the thoughts in question at all, it is only subsequently.

Psychology finds the answer to this criticism easy. Sensations are *signs* of objects, said Helmholtz. A sensation may stand for other sensations, and a feeling for other feelings. The wealth and complexity of our psychic life are largely due to the possibility of our knowing, on experiencing a sensation, or a feeling—if we may speak thus—that its object would under different circumstances give us other sensations and other feelings. Because of such substitutions we are enabled, on the perception of one quality, to apply to its object adjectives which were given to it to describe some other qualities. For instance, if on seeing an apple I know it to have an acid taste, a certain color has given me the knowledge of a taste. Similarly, because of the name of a famous painter on a canvas, or because a connoisseur declares it a work of high artistic merit, I "know" it is a beautiful painting, I believe it, I say so to my friends. I have neither tasted the acidity of the fruit, nor felt the beauty-thrill of the painting, and yet I know the one to be acid, and the other to be beautiful. It is evident that although I know, now, acidity and beauty without really experiencing them, it is only because some time ago, in my early experiences, I have tasted "acidity" and seen "beauty," and associated these complex verbal signs with other sensations, feelings or perceptions, due to the same object. Thanks to this association I am enabled, in subsequent experiences, to conclude immediately from the color to the taste name, without going through the long process of biting the apple and the physiological activity that follows. It is a similar vicarious substitution that makes it possible for me to-day, on the recognition of certain non-moral traits, to know that an action belongs to the class "*Moral Imperative.*"

We must not overlook the fact that not only do certain simpler, more convenient experiences substitute themselves for others in the same individual, but that, moreover, in the case of gregarious individuals, the experience of one of them often introduces among the others the name of that experience and certain forms of activities which were, in the orig-

inal experiencer, the reaction to it, although they may never have had the experience they name and under the influence of which they now act. Among the many who speak of the "awfulness of sin" and who live in fear of it, a comparatively small number have really experienced the "awfulness of sin." Shall we instance belief, faith, or the many virtues which we practice as the result of imitation? In its lowest, as in its highest regions, this vicarious world of ours is indebted to a few geniuses, blessed with exquisite sensitiveness and intelligence, and favored by circumstances, for the possession of substitutes—in the form of names or other sensations and feelings—for certain experiences that have never been their own, and for the habit of properly reacting to them. This is practically all that is necessary for the conservation of the individual and the progress of the race. These geniuses have bequeathed to the common herd their æsthetic and moral judgments and habits.

Frequently in the course of education, after having first learned the substitute and the reaction it calls for, we become acquainted with the substituted. This practically invaluable substitution, by which the original sequence of events is changed and links are dropped, is the great mystifier of those who attempt to unravel the mysteries of psychic life. As long as the representing is still able to call up the represented, the difficulty thrown in the way of the investigator is comparatively small; but when through long existence of the shortened connection and long disuse of the represented, the links are lost, then Nature, which seems to take pleasure in making safe her secrets, triumphs, and man struggles long in vain with problems many of the original features of which have completely faded out.

Let us now, changing our line of argumentation, search more closely for the psychic characteristics of the Moral Imperative as we find it in ourselves and as it has been described by those who have dealt with it in writing, and then ask ourselves what sort of physiological process might condition that experience. We shall thus discover the possible justifications of the current erroneous theories of Moral obligation, and show that, were we conscious of a reflective motor process of the kind described on page 543, it would necessarily be—according to our present knowledge of psycho-physiology—through the very qualities that we shall put down as characteristic of the Moral Imperative.

The poets speak of the Moral Imperative as the "Stern Daughter of the Voice of God" (Wordsworth). The ethical and religious philosophers define conscience 'the voice of a

conscious being external to me, to all men, who has made us and all the world" (Martineau); and the guiding genius of the metaphysical philosophy of this century cautions us against "allowing ourselves to think of deducing the reality of this principle from the particular attributes of human nature" (Kant). The Moral-Imperative, according to him, is to be clearly differentiated from "propensities," "inclinations," and everything else belonging to the individual. It transcends experience, it is a law, universal, categorical and imperative.

They all, poets and philosophers, struggle to express in the loftiest and the most uncompromising terms the universality, impersonality, finality, obligatoriness and imperativeness of this experience. After its imperativeness, it is its objectiveness, its independence of throbbing flesh which has attracted the special attention of the moralists. They have found a wealth of expression to picture that quality of the low but stern voice heard in the quiescence of the soul, in the stillness of the night; always there when we listen for it, but never heard in the din of passion. When the fever of jealousy, anger, or lust, surges on, or when vanity, distress or anguish thrills our souls, we feel the imperiousness of non-moral imperatives—of desires and cravings; but it is only when the wave has passed, when calm is reëstablished, be it only for a second, that we hear the proclamation of the moral law in that peculiar, impersonal, unemotional, toneless but autocratic voice that is taken for the voice of God.

Another quality of the Moral Imperative is best felt when it stands in antagonistic combination with processes containing elements from the sympathetic nervous system. It seems, then, to occupy the equilibrated, the stable, the rest position. To pass from it to the other processes feels like being jerked away from the resting attitude; and to come back to it seems like returning from an unstable to a stable position. To this peculiarity, we must add the fact that we tend to return to this calm, passionless state. It is, among the ideo-motor processes, as the tonic note of a melody; we are really satisfied only when it is the last "feel" of the complex experience. It would be more exact to say that when we return to equilibrium and stability—as we necessarily must—then is the time when the Moral Imperative looms up.

Finally, let us add to these traits the peculiar inefficacy which we have mentioned and accounted for as best we could, and we shall have a sufficiently complete description of the categorical imperative: *impersonality*, *universality*,

imperativeness, *obligatoriness*, *passionlessness*, *finality*, *stability*, *inefficacy*, are its essential characteristics.

Does the particular physiological process we have described as the condition of the Moral Imperative account satisfactorily for these qualities, on the basis of analogy and of accepted psycho-physiological theories?

Concerning the stability and the fact that the Moral Imperative recurs together with the consciousness of rest and equilibrium, it has no doubt occurred to the reader that it is a consequence of the absence of stimulus from the sympathetic nervous system. We can feel at rest, stable, only in the absence of emotions and feelings, because the affecto-emotional states in general are, in their very nature, movements. Cerebro-spinal processes, it is true, are in some respects just as much transient as affecto-emotional states, but their coming and going seems to be as in an horizontal plane, while the movements of affective cognitions are as in a vertical plane, *i. e.*, while in the latter case there are necessarily gradual changes in bodily tensions, in the former such tensions are either not present or unessential. It is not easy to find adequate words to describe such a quality as this; but every one able to turn his vision inward will readily apprehend our meaning and understand how this sense of stability helps to give to the moral cognition a finality-value which other experiences cannot have.

The so-called "universality" of the Moral Imperative is due to its impersonality and to the supposition that the dictates of the moral law are, or should be, universally valid. Concerning the latter we have nothing to say; to-day, the relativity of the moral conscience and its freaks, need no expositor. With regard to the former—its impersonality—we have to ask how comes this experience to be separated, in common judgment, from the individual self, and to be looked upon as transcending it? What, in its nature, made it possible for Kant to lift it up above those cognitions that *belong* to the *individual?* On the ground of its universality, he might as well have classed the liking for salt together with it as impersonal and universal. To this query we would give the same answer as to the preceding one: the absence of sensations from the external senses, and especially the absence of sensations from the internal organs is, together with its involuntariness and its relative universality, the justification of the expression "impersonal" when applied to the moral imperative or to "reason." It is evident that the independence of this cognition of the will would not, of itself, be sufficient to warrant its classification as "impersonal;" otherwise simple sensations would be just as much impersonal.

The difficulty vanishes when we realize that the great test of that part of our experiences usually called the "self" is, in non-voluntary experiences, pungency and localizability. Of two non-voluntary experiences, the one having the greatest sensational and emotional vividness and the most definite bodily localization is the one that we feel to be most our "own." The lessons of multiple personalities and anæsthesia are full of instruction on this point. Those which above all else seem most certainly ours in this narrow sense, are the sensations of touch, those of motion and those arising from the activity of the organs of the vegetative life. The latter form the great massive substance of the cœnesthesic self in which our supra-sensory cognitions, *i. e.*, our thoughts and judgments, are imbedded. It constitutes the incarnated self; everything is all right when our higher experiences are permeated by it, but let this background fall out and the self becomes a shadowy remembrance. Now, according to our theory, the Moral Imperative is conditioned by a reflective purely cerebro-spinal process, *i. e.*, it contains neither direct sensations from the external, nor sensations from the internal organs. Consequently it must feel as a disincarnated experience, as a disembodied unlocalized manifestation of spiritual life.

As regards the imperativeness of the phenomenon before us, we need not add much to what has already been said to make the assigned physiological counterpart satisfactory in this respect also. When an afferent process discharges through well defined motor paths, towards muscles coördinated for a specific action, we feel impelled to perform that action; if the process, for any reason whatsoever, recurs frequently, we have an insistent impulse which may well be called a non-moral imperative; and if such an imperative is the motor conclusion of a reflective process, free from sensations from the vegetative life, we have a moral imperative. It is moral because it follows upon a non-arrested, completed, reflective process, and is, on that account, accepted as final, approved as binding upon the subject. We are thus not only commanded to do a particular thing, but we also approve of it, and accept it; hence, its obligatoriness, its categoricalness. In the analysis of some of our illustrations we found reflex non-sympathetic processes that were imperious, but not morally imperative. In those cases the imperative was negated by the reflective process which came after, *i. e.*, in final resort, we did not approve the reflex imperative. *The motor conclusions of a reflective, non-sympathetic imperative ideo-motor experience are always approved of as final:* in the nature of the case, it cannot be otherwise, as we shall see presently.

"It is unqualifiedly true," says Prof. James, in his "Principles of Psychology," Vol. II, p. 568, "that if any thought does fill the mind exclusively, such filling is consent. . . . But it is not true that the thought need fill the mind exclusively for consent to be there." We cannot here attempt a discussion of this very difficult question of consent, but one thing we must try and make clear since our subject requires it. There are many kinds of "consent" of the filling-presence type. While I have in mind the first process of illustration No. I (the "watch" imperative idea), I may be said to consent to it, but the consent belonging to the reflective process of the same experience does not belong to the same family of consents. The former is an automatic, but the latter is a reflective approval, *i. e.*, an approval from a higher "self." A subdivision must, moreover, be made in the reflective consents according as the process having the consent *quale* does or not include elements from the vaso-motor system. We have, therefore, three different species of approvals representing not all the meanings the word assumes, but the most important ones. Each one has its particular grade of value: the reflex consent stands at the foot of the scale of values; we think better of the reflective-sympathetic consent, and for the reflective cerebro-spinal kind of consent we have a superlative regard; we may not know why it is so, but that it is so is the experience of everyone.[1] It is a sort of Supreme Court; its judgments are final and unrevisable, except by itself. Experience has taught us that the consents of the first class are liable to be withdrawn by the higher, reflective processes, and also that no judgment is final until it has been pronounced by the reflective cerebro-spinal court. These judgments of worth have the same origin as those which place sensations at the bottom and the higher mental processes on top; the same as those also which make us attribute greater worth to intelligence than to brute physical force.

Because this supreme approbation *quale* belongs only to experiences dignified by a sense of impersonality, it was granted the similar honor of being looked upon as a supra-personal, a divine approbation. *The imperativeness of the moral law is distinguished from the non-moral imperativeness by this highest kind of approbation accompanying its commands.*

Nothing need be added to what has already been said in explanation of the inefficacy of the Moral Imperative.

And now, when we put all these peculiar qualities to-

[1] For some explanatory hints we refer the reader to pp. 544 and 546.

gether, when we reflect that the Moral Imperative lacks the "feel" of the incarnated self, that its dictates are well nigh universal in the same society; that it comes and goes independently of our will; that its imperativeness is stamped with supreme, with categorical, approval, and yet does not coerce; that it utters its sentences in the quiet of relative passivity and is felt in antagonism to the fiery imperatives of the incarnated self, as well as in opposition to the blind promptings of reflex actions,—we wonder no more at the place assigned to it in the psychological schemes of philosophers who lived before, or who are ignorant of, the portentous reconstruction of the personality-concept at the hands of modern psychology and of the increased knowledge regarding the relation of mind and body.[1] They could not see the close bond of parentage existing between the Moral Imperative and the imperiousness of the vegetative life; still less could they understand the physiological mechanism underlying the various moral experiences and how it differs from that of non-moral cognitions. In the circumstances in which they were, the theories and concepts they evolved were the only ones apparently able to justify the psychic characteristics we have just reviewed.

The Moral Imperative, when looked upon as the psychic expression of a well-defined species of reflex-arc process, takes its natural and legitimate place in the unified psychic system of modern science. Thus viewed, it becomes the correlate of the latest and highest biological differentiation, since it requires, as a condition of its existence, the independence of the cerebro-spinal from the sympathetic nervous system.

This functional separation of the life of relation from the vegetative life marks the most basal and most important differentiation in the course of achievement in biological evolution. One need not be an anatomist or a physiologist to know that in the continuous "effort" of the organism to adjust itself to its environment, the life of relation has tended to become more and more independent of that of nutrition and reproduction. In the lower forms of animate beings,

[1] How quaint and obsolete seems the Kantian phraseology when looked at from the modern point of view. See, for instance, the characteristic passage ending with: "Here, then, we see philosophy brought to a critical position, since it has to be firmly fixed, notwithstanding that it has nothing to support it either in heaven or earth. Here it must show its purity as absolute dictator of its own laws, not the herald of those which are whispered to it by an implanted sense or who knows what tutelary nature."—"Fundamental Principles of the Metaphysics of Morals," tr. by Tho. Kingsmill Abbott, M. A., pp. 61 and 62.

where there is no specialized nervous system, the whole body responds to each and every stimulus. In some of the mollusks we find already two distinct nervous systems, considerably specialized, but still with large masses of nervous substance in common, in which stimuli of various origin unite and diffuse, so that such organisms cannot have experiences belonging exclusively to the life of relation.[1] In the grown man, the two systems, although inter-related, are largely independent; the visceral stimuli are largely confined to fixed channels, and there are numberless ideo-motor cerebro-spinal tracts, practically closed—so far, at least, as consciousness is concerned,—along which stimuli can travel without diffusing to a consciously appreciable extent in the sympathetic nervous system. In consequence of this high differentiation of functions, the various distinct types of processes Nos. II and IV are possible.

Individuals of different races, and those of the same race, differ widely with regard to emotionality and sentimentality. The recent neurological discoveries which show that the medullation of nervous fibres is far from complete at birth, but continues probably until late into middle life,[2] makes it easy to account on this ground for the general "emotional" difference existing between childhood and maturity. We may expect that a still more minute knowledge of neurology will bring to light the differences between races and sexes and individuals generally in the extent and completeness of the separation of the columns of fibres continuing the sympathetic system in the medulla and thence to the cortex of the cerebrum and cerebellum. Without stepping beyond legitimate deductions, we may well say that a history of the differentiation and isolation of the two nervous systems in man would give us, from the anatomo-physiological side, a parallel of the history of the antecedents, genesis and growth, of the moral sense, for reasons similar to those that show the anatomo-physiological history of the sense-organs to have moved step by step with the history of the "development" of the sensations.

Before closing we shall ask the readers' indulgence for a glittering generality, well worth considering, however. If the "endeavor" of the organism through its career of evolution is shown by comparative anatomy to have been towards the isolation of the sympathetic from the cerebro-spinal system, the greatest and most portentous *conscious* effort of the highest races during past millenniums has been to deliver the

[1] See plates in Gustav Retzius' "Biologische Untersuchungen."
[2] See especially Flechsig's work.

"soul" from the influences of the "body." Who has not been deeply impressed by the fury, or at least the penetrating intensity, with which the prophets of the ethico-religious consciousness of the Indo-European races have preached the subjugation, if not the annihilation of the body, abdication of self, renunciation; *i. e.*, indifference to humiliations, to the wounds of vanity and the cravings and pains of the flesh, that we may walk in the pure light of the uncarnated spirit? Hindoo, stoic and Christian sages have done battle under the same banner. It would be easy, but it is unnecessary, to quote in support of this statement the sayings of Gautama, of his disciples, those of Jesus or his immediate disciples, and especially of the saints of the middle ages. Translated into modern language this baleful "flesh" or "body" stands for the experiences dependent upon the sympathetic nervous system; it is the manifestations of that part of the self roughly denominated "the vegetative life," while the "soul" designates in the philosophy of the Church, as far as it stands for conscious realities, the experiences dependent upon the cerebro-spinal nervous system: it is the life of relation. And so it appears that the crusade of the ethico-religious consciousness, is a war of the cerebro-spinal Self against the cerebro-sympathetic Self: a war recorded not only in the literary annals of humanity, but also, and in a more lasting manner, in the neuro-physiological mechanism of the survivors of the Struggle for Life.

The common man is struck with a momentary joyful amazement when it dawns upon him that the deliverance after which humanity has been and is still yearning, is the self-same deliverance towards which these ill-treated bodies of ours have tended, and which they have already achieved in a large measure.

The biological conception of the Moral Imperative developed in these pages appears to us as one of the stones of the psycho-physiological foundation yet to come, upon which a truly scientific system of applied Ethics is to be built in the place of the practically useless "criterions of conduct" given us by ethical philosophers as the chief conclusion of their painstaking labors. When scientific answers have been given to the following queries: How are these Moral Imperative processes established? How is the passage made from the inefficacious command to the action?—a question involving the treatment of the will, in as far as it is a factor in the determination of action; and of algedonics, if it is to be considered in this connection. What is the value of Moral Imperatives, measured in their consequences with reference to pain and pleasure, or to character, or something else?—a

question upon which much light will be thrown by the investigation of the formation of the afferent side of the reflective arcs. When these and other questions have received a psycho-physiological answer, applied ethics will be in position to give the scientific instruction that humanity may rationally expect from it, but which it has thus far received only as the result of desultory empirical knowledge; *viz.*, methods of establishing clear moral imperative processes, of value, and of developing efficient motor connections between the knowledge of the dictates and their execution.

If the analysis of the Moral Imperative which has been made in this paper is correct, it obviously justifies a most far-reaching change of current conceptions with regard to the origin and nature of moral evil, of sin—and consequently of Regeneration—and of the relation of morality to belief in God and to many of the dogmas of theology.

DISCUSSION.

Professor Baldwin's Method of Studying the Color-Perception of Children.

A theory may be right or wrong, no matter whether there are many or few facts in support of it. On the other hand, a theory is right only when it can stand the brunt of a very large number of facts. If there are in the second case a few outlying 'facts,' the theory may still be right, because these facts may have been badly observed. If the facts on which the theory is based are very few or are equivocal, *i. e.*, differently interpreted by different observers, then the theory, though it may serve a man much in his own work, can take rank only as an individual hypothesis.

Professor Baldwin has lately published several theories in the domain of individual and child psychology. All of these theories have succeeded in getting themselves discussed; but no one of them, so far as I am aware, has got itself generally accepted. The general attitude of criticism seems to be that the theories are ingenious, and of the kind that would *a priori* carry conviction. But for this very reason they may be especially dangerous: first, because the uncritical mind may take for explanation what is only a working hypothesis; and secondly, because their schematic and suggestive exposition will make it very difficult for detailed criticism to reach them, the author being able to shift his ground and to modify his formulation at every attack. Still criticism must be passed, if only to check unconsidered acceptance; and serves its purpose if it rouses the author of the theory to a clearer, more definite and more comprehensive statement of his position.

Perhaps no theories are more likely to obtain credence than those which purport to lay a foundation for the science of education. While there are among educationalists some really careful thinkers, there are on the other hand, as one would naturally expect, thousands of industrious, thoroughly earnest and altogether untrained enthusiasts who have neither time, education, nor inclination carefully to weigh the multi-

tude of theories which are offered them, and which they eagerly desire to apply. Hence the fact that a psychologist in good standing has formulated and published a theory is not infrequently considered a sufficient evidence of its truth. Resulting from this comes a tendency to ignore all consideration of the theory itself, and to attempt at once its verification. But if theories are to be advanced with the abandon suggested by Prof. Baldwin, who says: "Give us theories, always theories! Let every man who has a theory pronounce his theory[1]!"—then surely the authors of these wholesale productions must expect them to receive especially critical examination, as theories, before their application is thought of.

Among other views that, it seems to me, must be expressed by his readers and considered by the author, before it can place itself on a practical working basis, I submit some of my own concerning Prof. Baldwin's theory of the law of suggestion or dynamogenesis as demonstrated in his experiments by the distance method upon the color perception of his child. They are the result of an honest study, undertaken primarily with the object of understanding the theory and its method.

The law of nervous dynamogenesis is briefly expressed in the statement that every state of consciousness tends to realize itself in an appropriate muscular development.[2] Suggestion in general is the tendency of a sensory or ideal state to be followed by a motor state.[3]

Prof. Baldwin has believed this for some time, and upon it has based the theory that the development of mind can be profitably studied. In 1890-1893 he published a series of articles in *Science* reporting observations on infants, and more recently (1895) in his book called "Mental Development in the Child and the Race: Methods and Processes," has gathered these together and attempted to synthetize his theory with that of the "current biological theory" of organic development. Along with the theory Prof. Baldwin has developed its application. In Chapter II of this book he explains his new method of child study, which is exceedingly attractive and very simple. He uses the color question to make clear his method, and says in this connection: "Only when we catch the motor response or a direct reflex, in its simplicity, is it a true index of the sensory stimulus in its simplicity." He thinks that hand movements are the most

[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 38.

[2] "Handbook of Psychology: Feeling and Will," p. 281.

[3] "Distance and Color-Perception by Infants," *Science*, XXI, pp. 231, 232.

nearly ideal in this respect. Sensations, he says, are stimuli to movement; and the child's efforts with its hands become indications of the relative degree of discrimination, attractiveness, etc., of the different sensations which call the efforts out.[1] Among others mentioned he thinks that the following questions might be taken up by this method:

(1) "The presence of different color sensations, as shown by the number and persistence of the child's efforts to grasp the color.

(2) The relative attractiveness of different colors, measured in the same way.

(3) The relative attractiveness of different color combinations.

(4) The relative exactness of distance estimation, as shown by the child's efforts to reach over distances for objects,"[2] etc., etc.

The first investigator to attempt any systematic experiments on children as to color sensation was Prof. Preyer, who, in his well-known work *Die Seele des Kindes*, published in 1881, gives the results of 1,486 judgments of color made by his child. The experiments began at the end of the second, and continued almost to the end of the third year. Prof. Preyer's problem was to ascertain what colors the child could distinguish and rightly name. It was an investigation of color discrimination. His method involved knowledge by the child of the names of the colors. This knowledge Prof. Preyer gave him by showing him a few colors and teaching him their names. Then with the colors still before the child, he asked him: Where is the red? Where is the green? etc., requiring the child to point out the color. Or—and this method he seems to have followed for the most part—Prof. Preyer would say: What color is this? requiring the child to name the color. From time to time during the course of the experiments new colors were added. At the end of the 34th month the results were as follows[3]:

[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 45.

[2] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., pp. 45, 46.

[3] *Die Seele des Kindes*, 4th ed., p. 121.

	Judgments.		Per Cents.	
	Right.	Wrong.	Right.	Wrong.
1. Yellow	232	8	96.7	3.3
2. Brown	79	8	90.8	9.2
3. Red	235	36	86.7	13.3
4. Violet	139	24	85.3	14.7
5. Black	39	7	84.8	15.2
6. Rose	76	29	72.4	27.6
7. Orange	47	23	67.1	32.9
8. Gray	35	33	51.5	48.5
9. Green	101	123	45.0	55.0
10. Blue	61	151	28.8	71.2
Total	1044	442	70.3	29.7

The next investigator to produce a new method was M. Alfred Binet. It is fitting, however, to speak, in the first place, of the experiments of Miss Milicent Shinn, who followed in the main Prof. Preyer's method, experimenting upon her niece in the third quarter of the child's second year. Here are her results:[1]

	Judgments.		Per Cent.	
	Right.	Wrong.	Right.	Wrong.
1. Pink	35	0	100	0
2. Orange	170	1	99.4	.6
3. Black	108	1	99.1	.9
4. Green	311	8	97.5	2.5
5. Yellow	240	7	97.2	2.8
6. Blue	309	22	93.4	6.6
7. Brown	11	1	91.7	8.3
8. White	117	11	91.4	8.6
9. Violet	63	10	86.3	13.7
10. Red	76	52	59.4	40.6
Total	1440	113	92.7	7.3

[1] "Notes on the Development of a Child" (University of California Studies), p. 49.

Prof. Preyer's child showed a tendency to confuse green and blue, which consequently appear at the end of his list; while the little girl subject of Miss Shinn became early uncertain regarding blue and red, with the result that red is tenth on her list. Yellow Preyer's child liked and discriminated best; and though it ranks fifth on her list, Miss Shinn is inclined to think it the favorite color of her niece. A comparison of the two tables, however, does not enlighten us to any great extent as to the probable tendency of color discrimination in young children. Much of the variation is probably due to word confusion.

M. Binet, realizing this, and also realizing that colors might be distinguished before word association is established, tried to obviate the difficulty by what he called the *méthode de reconnaissance.*[1] Preyer's method he calls the *méthode d'appellation.* Prof. Baldwin says that Binet, under the *méthode d'appellation*, "varied the conditions by naming a color and requiring the child to pick out the corresponding color," intimating that this was a new departure. Indeed, he says that "this gave results different not only from Preyer's, but also from those which Binet reached by Preyer's method."[2] But Preyer's method included *both* the naming of the color by the child *and* the pointing out of the color which was named. Sometimes he took the one way, sometimes the other. Binet's departure was the separation of the two. After carrying on both processes side by side for a while, as Preyer himself had done, Binet separated them, and kept a record of each. In one series he required the child to name the color; in the other to point out the color named. He made altogether by the *méthode d'appellation* 508 tests, which, arranged in percentages of right judgments, average as follows: red, 99; blue, 96; orange, 93; maroon, 86; rose, 74; violet, 71; green, 68; white, 54; yellow, 46. These results are obtained by averaging according to the number of tests given. Since these varied greatly (from 135 for red to 15 for orange), it would, perhaps, be fairer to find the percentage of right judgments in each of the three ways employed; *i. e.*, first, before the processes were separated; secondly, when the child named the color; thirdly, when she pointed to the color named: and to average these several results. The figures then are slightly different. Blue equals red and violet equals green; otherwise there is no change: red and blue, 99; orange, 93; maroon, 86; rose, 74; violet and green, 71; white, 54; yellow, 46. Binet's experiments

[1] *Revue philosophique*, Vol. XXX, pp. 583 ff.

[2] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 40.

were made upon his little girl, beginning when she was 32 months old, and continuing for a little over 6 months.

These, then, are the three tests made by Preyer's method, and they all differ widely. Yellow, so readily distinguished by Preyer's child, is by Binet's the least readily recognized. Red and blue, confused by Miss Shinn's niece, give almost no difficulty to Binet's little girl.

The results obtained by dividing Preyer's method are also interesting. When Binet's child said the name of the color, the order in percentages of right judgments is this: orange and blue, 100; red, 97; green, 83; maroon, 75; violet, 70; rose, 64; white, 33; yellow, 30. When the child indicated the color, the name being given her, the colors range themselves in this series: red, 100; maroon, 94; blue, 92; rose, 89; orange, 86; violet, 71; white, 68; green, 66; yellow, 58.[1] Binet by this clearly proves that the word element does affect the child's judgment. In order to test this still more closely, he carried on a series of experiments at the same time as the others by what he calls the *méthode de reconnaissance.* "I wanted to see," he says, "if this same child could find a color, which, after being shown to her, was mixed with several others. . . . . The *méthode d'appellation* places the child in rather artificial conditions. It is obliged to learn the names of the colors; it is forced to form a rational perception. It is evident that the child left to itself does not recognize colors by their names, but by visual memory; and the *méthode de reconnaissance* places it in more natural conditions than the other method."[2]

Prof. Baldwin, in discussing these methods, says: "It is, perhaps, a confirmation of Lehmann's position[3] that the

[1] In all calculations, .5 per cent. or more I have counted as 1 per cent.

[2] *Revue philosophique*, Vol. XXX, p. 589.

[3] Dr. Lehmann has an article in the *Philosophische Studien*, Vol. V, pp. 96-150, in which he shows that various grays upon rotating discs are recognized, if given names. Prof. Baldwin, in the "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 42, speaks of Lehmann as using "colored wools;" but gives no reference. In his "Hand-book of Psychology: Senses and Intellect," p. 177, he says: "As soon as some sign is made of a peculiar kind in connection with the image, it is recognized. Recent experiments by Lehmann on the recognition of differences of color strikingly confirm this view." The reader is referred to Lehmann, *Philosophische Studien*, Vol. VI. But Lehmann has no article in that volume. The volume referred to is probably V, in which appears Lehmann's *Ueber Wiedererkennen*. Dr. Burnham, in the AMERICAN JOURNAL OF PSYCHOLOGY, Vol. II, p. 610, referring to this article, says that Lehmann experimented with sensations of color, using different shades of gray produced by means of rotating discs. Both Prof. Baldwin and Dr. Burnham speak of Lehmann as

colors least recognized in Binet's list are shades whose names are less familiar to children; his list in order of certainty of recognition is red, blue, green, rose, maroon, violet and yellow, by the *méthode d'appellation*; and by both methods together, red, blue, orange, maroon, rose, violet, green, white and yellow."[1] In a footnote he says that the calculations were made from Binet's detailed results (*Revue philosophique*, 1890, pp. 582 ff.) by Mr. Tracy, and cites the latter's book, "The Psychology of Childhood."

It is not easy to see how Prof. Baldwin gets these results from Mr. Tracy's figures. For example, Mr. Tracy does not give any computations for the *méthode de reconnaissance*; and even if he had, there could have been no orange in the list of colors, as Binet did not make use of orange in the tests by this method. Prof. Baldwin, as will be seen, gets a certain order for the *méthode d'appellation*, in which orange is wrongly omitted: Mr. Tracy is probably responsible for this. But in the series Prof. Baldwin gives of both methods together, *i. e.*, the *méthode d'appellation* and the *méthode de reconnaissance*, the orange appears. Where he gets it, is not apparent. Mr. Tracy himself has interpreted Binet's tables for the *méthode d'appellation* very curiously, sub-dividing each series into a first and second series. The tables show no warrant for this. Mr. Tracy's results, therefore, wrought out in this peculiar manner, are confusing.

Prof. Baldwin criticises all of these methods and points out that even Binet's *méthode de reconnaissance* does not get rid of word association, since probably those colors are most easily recognized whose names are best known. It is here that he cites Binet's list. Taking the series that Prof. Baldwin gives of both methods together: red, blue, orange, maroon, rose, violet, green, white and yellow,—if we share his views we shall have to say that white is a less familiar name to a child than violet, and that green is a stranger word to him than maroon.

No other psychologist, I think, will agree with Prof. Baldwin in his position on the several points just discussed; but, on the other hand, none will fail to agree with him as to the general inadequacy of the methods so far advanced for the

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experimenting with colors; whereas, in reality, he worked only with *grays*. It may be that Prof. Baldwin, having made this first mistake, slipped naturally into the second one,—the use by Lehmann of wools. Neither in *Ueber Wiedererkennen*, nor in anything else that Lehmann has written, can I find any evidence of his having experimented with colored wools.

[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 42.

investigation of color perception in children, and the need for a better one.

Prof. Baldwin now comes forward with a new method, based on the law of dynamogenesis referred to above.[1] He thinks that the young child's reaching movements reflect its sensibility. The two variables to be considered in this method are the quality of the stimulus and its distance from the child. The drawing-out influence of the stimulus will vary with the quality and in inverse ratio with the distance of the colored object. While Prof. Preyer's experiments were directed upon color discrimination, and M. Binet's by the *méthode de reconnaissance* upon color recognition, Prof. Baldwin says: "I undertook at the beginning of my child H.'s ninth month to experiment with her with a view to arriving at the exact state of her color perception, employing this new method." Bits of colored blotting paper were placed at different distances from the child, one at a time. Account was kept of the number of times she reached out toward each. The colors were blue, red, white, green and brown. Newspaper (presumably cut to the same shape and size as the colored pieces of blotting paper) was used as "a relatively neutral object." Yellow unfortunately was not used, as Prof. Baldwin could not obtain a yellow in his neighborhood that suited him. Since the experiments extended over a period of six months, it is difficult to understand why he did not have recourse to some other neighborhood. Below are the tables showing the results of Prof. Baldwin's experiments, as they appear in the second edition of "Mental Development in the Child and the Race: Methods and Processes."[2]

R is the symbol for refusal, A for acceptance. N stands for the entire number of experiments with each color respectively, and n for the entire number with all the colors at each distance respectively.

$\frac{A}{N}$=the proportion of acceptances or efforts for any color, and

$\frac{R}{n}$=the proposition of refusals for each distance.[3]

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[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., Chap. II.

[2] See p. 52.

[3] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 54.

TABLE I.

DISTANCE, INCHES.	9	10	11	12	13	14	15	TOTALS.	RATIO $\frac{A}{N}$
	R. A.	R. A.	R. A.	R. A.	R. A.	R. A.	R. A.	R. A. N.	
Blue	0—1	0— 4	0—5	1— 3	2— 4	1— 5	3—1	7— 23— 30	.766
Red	0—1	0— 3	2—2	1— 4	1— 7	1— 7	5—1	10— 25— 35	.714
White	0—0	0— 0	0—0	0— 1	0— 5	1— 1	3—0	4— 7— 11	.633
Green	0—0	0— 1	0—1	2— 1	1— 4	1— 2	2—0	6— 9— 16	.60
Brown	0—1	0— 2	2—1	3— 2	0— 3	3— 1	2—0	10— 10— 20	.50
Totals	0—3	0—10	4—9	7—11	4—23	7—16	15—2	37— 74—111	.66
Ratio $\frac{R}{n}$	0	0	.30	.39	.15	.30	.90	Total, .33	

TABLE II.

DISTANCE, INCHES.	9	10	11	12	13	14	15	TOTALS.	RATIO $\frac{A}{N}$
	R. A.	R. A.	R. A.	R. A.	R. A.	R. A.	R. A.	R. A. N.	
Newspaper				0—17	0—28	1—33	25—2	26— 80—106	.76
Color	0—3	0—10	4—9	7—11	4—23	7—16	15—2	37— 74—111	.66
Totals	0—3	0—10	4—9	7—28	4—51	8—49	40—4	63—154—217	.71
Ratio $\frac{R}{n}$			.30	.20	.07	.14	.91	Total, .29	

Despite the fact that this is the third time of their printing, the tables still contain 7 errors in calculation. In Table I, under the sub-head *N* of column headed *Totals*, 16 should

read 15. Under *Ratio* $\frac{A}{N}$ for green .633 should read .636. *Ratio* $\frac{R}{n}$ for 11 inches should be .307, not .30. (It ought consistently to read .31, since in the next column .388 is made .39, and in that following .148 is put down as 1.5). Under 15 inches *Ratio* $\frac{R}{n}$ should be .882, not .90. In Table II *Ratio* $\frac{R}{n}$ for 11 inches, .30 again should read .307 or .31, not .30. *Ratio* $\frac{A}{N}$ for newspaper should be .754, not .76, and for colors .666, not 66.

As first printed in *Science*, April, 1893 (leaving out of account some less considerable inaccuracies of fractional percentages), the tables contain the following errors: In Table I under the sub-head *R* in the column *Totals* for green, 7 should be 6; under *N* 16 should be 15. Under the same headings for brown 11 should be 10, and 21 should be 20. Under column *Ratio* $\frac{R}{N}$ for green, .56$\frac{1}{3}$ should be .60, and for brown .47$\frac{1}{2}$ should be .50. In Table II *Ratio* $\frac{R}{n}$ for 11 inches should be .307, not .33$\frac{1}{3}$, and for 15 inches *Ratio* $\frac{R}{n}$ should be .882, not .89.

As printed in the first edition of "Mental Development in the Child and the Race: Methods and Processes," the tables contain 16 mistakes, ranging in error of percentage from 2 to 15. In the preface to the second edition, the author says: "The demand for a new edition of my book gives me the opportunity to make certain minor corrections throughout. The only important alteration is to be found in the tables (I and II) on p. 52, in which certain columns had been substituted from other tables which lie unpublished among my papers." Nevertheless, recalculation has disclosed the seven errors referred to above.

These facts are significant in themselves: for a writer who is careless in his presentment of facts we shall incline to suspect of being careless in his interpretation. Indeed, Prof. Baldwin's interpretation of these tables is as puzzling as the tables themselves. I have been able to understand it only on the assumption that *some of his statements in the second edition are based upon the figures of the first edition* of his book.

(1) His first statement is that "the colors range themselves in an order of attractiveness, *i. e.*, blue, white, red, green and brown." While this is a possible interpreta-

tion of the tables of the first edition, a glance at column *Ratio* $\frac{A}{N}$ shows that red should rank next to blue. In the *Science* article, "Distance and Color Perception by Infants," Apr., 1893, the interpretation is given correctly. It would seem, then, that Prof. Baldwin interpreted from the 'substituted' tables of the first edition, where *Ratio* $\frac{A}{N}$ reads: blue, .78; red, .75; white, .78; green, .68; brown, .50.

(2) White, he says, was more attractive than green, and slightly more so than red. But, according to the figures of the second edition, white is .08 *less* attractive than red. This misstatement also may have been caused by reading from the incorrect table.

(3) The next sentence says: "The newspaper was at reaching distance (9-10 inches) and a little more (up to 14 inches) as attractive as the average of the colors, and even as much so as the red."[1] We *are not given the figures* for newspaper at 9, 10 and 11 inches; but beginning at 12 inches and going up to and including 14 inches, we find that newspaper is *far more attractive* than any color tested, even than blue. The proof is obvious: *Ratio* $\frac{R}{n}$ (proportion of refusals) at 14 inches, for blue is .166, for red is .15, for white is .50, for green is .33⅓, for brown is .75, and for newspaper is .029; while *Ratio* $\frac{R}{n}$ for newspaper at 12 and 13 inches is 0.

(4) The attractiveness of the newspaper in these distances Prof. Baldwin accounts for by the fact that "the newspaper experiments came after a good deal of practice in reaching after colors, and a more exact association between the stimulus and its distance." Reaching distance, we are told, was 9 to 10 inches. If the child was improving in her estimation of distance, one would expect her, at a distance of 14 inches, to begin to refuse the newspaper, simply because she knew that she could not reach it; yet she does so in only 1 case out of 34, while the colors are refused at 14 inches in 7 out of 16 cases. The explanation, too, that these newspaper experiments came after a "good deal" of practice in reaching, is not altogether satisfying. Since a careful record was kept of each test, it would have been easy for Prof. Baldwin accurately to state just how much practice the child had received before the newspaper stimulus was offered her. Failure to state the conditions of his experiment on the part of an investigator must result in

[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 53.

failure to accept his conclusions on the part of his readers. Prof. Baldwin could and should have given this condition.

(5) While the *attractiveness* of the newspaper up to 14 inches is accounted for by the child's practice in reaching, the *refusal* of the newspaper at 15 inches is accounted for, curiously enough, in the same way. "At 15 inches and over, accordingly, the newspaper was refused in more than 92 per cent. of the cases, while blue was refused at that distance in only 75 per cent., and red in only 83 per cent." Since the child had had "a good deal of practice" in reaching, and had established a more exact association between the stimulus and its distance, it is hard to account for the use of the word 'accordingly' in the above quotation. One might better attribute the refusal of newspaper at this greater distance to the dynamogenic power of color (and this Prof. Baldwin seems to do in citing the smaller percentages of refusals of blue and red), were it not for the fact that green, white and brown, respectively, are refused at this distance in 100 per cent. of the cases!

(6) Prof. Baldwin then calls attention to the striking fact that the child refused persistently to reach for anything put at 16 inches or more away from her, and at 15 inches refused 91 per cent. of all the cases, 90 per cent. (the correct figures are 88.2 per cent.) of the color cases, and 92 per cent. of the newspaper cases. This shows, he thinks, the very accurate visual estimation of distance acquired by the child. "The child's interpretation of the distance inhibits all effort to reach across it." These interpretations result, we are told, from "associations of visual indications of distance with sensations of hand and arm movement."[1]

The inclination to accept this result and its explanation, were there no other reasons, would be destroyed by Prof. Baldwin's failure to state conditions and his vague use of terms. For example, after giving on page 54 the above figures for distances of 15 inches and over (the explanation for them being presented on pp. 76-77),[2] Prof. Baldwin says: "At nearer distances we find the remarkable uniformity with which the *safe-distance* association works at this early age. At 14 inches only 14 per cent. of all the cases were refused, and at 13 inches only about 7 per cent." The natural inference here is that 14 inches is included in the '*safe-distance.*' But on page 77 he speaks of the *safe-reaching dis-*

[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., pp. 76-77.

[2] The habit of later incidental explanation is characteristic of the book, and is very confusing.

tance; the *uncertain-reaching distance*, and the *impossible-to-reach* distance; and on page 49 he says that "in some cases the inhibition of *d* (distance) does not work, and the child oversteps all its experience in violent straining and tears." On page 53 he calls reaching distance 9 to 10 inches; and on page 54, again, says that there were no refusals to reach for anything exposed within reaching distance (10 inches). Such, then, are the various statements for us to attempt to reconcile.

If we include 14 inches within the *safe-reaching distance*, and put 15 inches in the category of *impossible-to-reach distance*, then *uncertain-to-reach distance* is excluded. Possibly 9 to 10 inches is intended to mean what we may term '*easy-reaching distance*,' and 14 inches that distance which calls forth "straining and tears;" but this does not explain *safe-distance*. If 9 to 10 inches is the distance beyond which the child cannot reach, and if this is also the *safe-distance*, then it is hard to see how the *safe-distance* association worked, as we are told it did, at 14 inches. If, on the other hand, 14 inches is the 'strain' limit of her reaching distance, and is included in the *safe-distance*, not only does Prof. Baldwin's *uncertain-reaching* distance disappear, but his use of the term "reaching distance" in other connections cannot be understood.

Leaving us in a state of uncertainty as to what he means by *safe-distance* association, Prof. Baldwin goes on to speak of the results obtained with objects displayed within 10 inches. He says: "The fact that there were no refusals to reach for anything exposed within reaching distance (10 inches)—other attractive objects being kept away—shows two things: (1) the very fine estimation visually of the distance represented by the arm-length, thus emphasizing the element of muscular sensations of arm-movement in the perception of distance generally; and (2) the great uniformity at this age of the phenomenon of 'sensori-motor suggestion' upon which this method of child study is based." Sensori-motor suggestion is here conditioned by three facts: (1) distance from the object, (2) its attainment or non-attainment, (3) its quality. That Prof. Baldwin is not unmindful of the second condition is shown by what he says in giving the formula of the dynamogenic method: "If the child reaches for a blue-*q* [q=quality] at 12 inches, and just gets it, he will then reach for a green-*q* with greater avidity at twelve inches than he would otherwise have reached for the same green-*q* at nine inches."[1] But

[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 48.

again we are left in the dark. We are not told whether the child at "reaching distance" really succeeded in grasping the object or not. How important this condition is, the above quotation plainly shows. The only information we are given relating to this point is on page 56, where Prof. Baldwin says: "Further, after each effort or two the child should be given the object reached for to hold or play with for a moment; otherwise he grows to apprehend that the whole affair is a case of Tantalus." "After each effort or two" is not as definite as the statement should have been made. Presumably, however, the child was given the object very frequently, whether she was able to reach it or not. In that case, condition (2) (attainment or non-attainment of the object) is almost, if not entirely, ruled out so far as the experiments are concerned, and the child's refusal to reach for objects at 15 inches and over is so much the more striking. On the other hand, any irregularity in giving the child the object would tend to affect her reaching. This would also influence her perception of color. Unless great care were taken that each color secured the privilege of being held or played with, "for a moment," an equal number of times, there would be danger that those colors receiving oftenest this closer contact would become the most readily recognised. Again, an object played with might be reached for, and yet not possess in its color quality enough dynamogenic power to call out movement.

(7) He says that the fact that there was a larger percentage of refusals at 11 and 12 inches than at 13 and 14 inches is due to the influence of brown, "which was consistently refused when more than 10 inches away." If brown was consistently refused when more than 10 inches away, then it must have been refused at 11, 12, 13, 14 and 15 inches respectively, and one cannot understand how that accounts for there being more refusals at 11 and 12 inches than at 13 and 14 inches. Clearly it does not. But even if this were a reason, it could not be advanced; for a glance at the tables shows that brown was *not* refused at 13 inches, but was accepted every time. If it had been refused as often at 13 inches as at 11 and 12 inches, the percentage of refusals for 13 inches would have been much higher. There is a valid reason, it seems to me, that Prof. Baldwin might have brought out, and that is the small number of tests given at 11 and 12 inches for green and white. The total number of tests for green at 11 and 12 inches is 4, for white 1; while the total number for green at 13 and 14 inches is 8, and for white is 7.

(8) Newspaper taken as a "neutral object"—and we are

not at all sure that it *is* neutral to the child—is not put on a fair basis of comparison. The tables give us no tests for the first three reaching lengths. If they did, newspaper would presumably rank ahead of the colors in attractiveness; for the nearer distances give a preponderance of acceptances. Ten out of the 23 acceptances for blue come within 9, 10 and 11 inches with no refusals; 6 out of the 25 for red with only 2 refusals; 2 out of the 9 for green with no refusals (green was not tested at 9 inches); and 4 out of the 10 for brown with 2 refusals. Putting it differently: at 9 and 10 inches there are no refusals for the colors, and at 11 inches the acceptances for the colors collectively are 70 per cent. It is safe to infer that had it been tested at this range the *Ratio* $\frac{A}{N}$ for newspaper would have exceeded even that of blue. There is one other way to place newspaper on an equal footing with the colors, and that is to exclude the first three distances. If we do so, the stimuli range themselves in the following order: newspaper, .754 (given in the table .76); red, .703; blue, .65; white, .636 (given in the table .633); green, .538; brown, .444. White, like newspaper, was not tested at all in the first three distances, and green but twice.

The relatively small number of tests made at the nearer distances, 9, 10 and 11 inches (none at all, as has been said, being given for white, only two for green and none for newspaper), the wide variation in number of tests (ranging from a totality of 3 experiments for all objects at 9 inches to 57 at 14 inches), added to the fact (which Prof. Baldwin himself recognises) of the absolutely small number of experiments represented by the tables,[1] forbid any accurate comparisons between stimulus and stimulus, or any safe conclusions upon the results as a whole. Yet Prof. Baldwin has not hesitated to make both.

In *Mind*, Apr., 1896, he says that he was not testing color discrimination or color preference, but color perception. It would seem, then, that he is illogical when he compares his results with those of Preyer and Binet, as he does on page 53 of his book. "Disregarding white, the difference between blue and red is very slight as compared with that between any other two. This confirms Binet as against Preyer, who puts blue last, and also fails to confirm Preyer in putting brown before red and green. Brown to my child—as tested in this way—seemed to be about as neutral as could well be." One would certainly infer from this that Prof. Baldwin

[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 57.

thought that the child not only perceived the colors, but *discriminated* between them; yet there is nothing in the experiments to tell us this. Moreover, Prof. Baldwin disclaims having investigated for discrimination. His comparisons, then, of his results with Preyer's, who did investigate for discrimination, are, to say the least, somewhat inconsistent.

He criticises Preyer because, he says, Preyer's results cannot be analysed; yet his own are open to the same objection. He tells us that he experimented with his child in order to arrive at "the exact state of her color perception."[1] The interpretation of the tables, instead of giving us any information about "color perception," begins with this statement: "The colors range themselves in an order of attractiveness." The natural inference is that Prof. Baldwin considers 'order of attractiveness' and 'order of perception' as synonymous expressions. But surely it does not necessarily follow that because the child reached out proportionately a greater number of times for blue than for red, she perceived blue better than red. It may have been that the child had a feeling for blue *plus* the sensation, and that to this feeling was due the greater 'attractiveness' of blue. Brown, on the other hand, may have produced in her a feeling of repulsion, or may not have been noticed as color at all, and the motor response have been called out simply by the form of the object.

Prof. Sully in *Mind*, Jan., 1896, reviews "Mental Development in the Child and the Race: Methods and Processes." He suggests that at first the objects grasped at be some sort of uncolored playthings, and then that they be colored and used as stimuli. In this way the last objection made would be to some extent avoided. The difficulty, however, would be in determining upon an 'uncolored' object. Prof. Sully also suggests that we do not know how soon children are biased in their preference by the colors of their environment, the mother's dress, for instance.[2]

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[1] "Mental Development in the Child and the Race: Methods and Processes," 2d ed., p. 50.

[2] Since writing this article I have found another reference to Prof. Baldwin's method in Prof. Sully's "Studies of Childhood," pp. 20-21. He repeats again the statement made in *Mind* that the method does not test color discrimination, but color preference, and adds that, even as a test of preference, it is likely to be misapplied: if the colors are not equally bright, if one color falls more often into the first or fresh period of the experiment, or if one color be brought in after longer intervals of time than another.

The first point has been discussed in this paper. Prof. Baldwin says he was not testing color discrimination. The necessity of equality of brightness he himself calls attention to on page 56 of his

The tables do not prove, again, that the child perceived blue, red, white, green and brown as separate colors, or that certain of these were (on account of their peculiar color qualities) more attractive than others; because newspaper, the 'neutral' object, even under its unfair conditions was as 'attractive' as any colored stimulus.

Prof. Baldwin's new dynamogenic method, then, ingenious as it is in its conception, and attractive as it is in its simplicity, has, nevertheless, been so carelessly carried out by its author that no reliance can be placed in the results obtained. True, the idea still remains; and it is left, possibly, for some less brilliant but more accurate experimenter to demonstrate its worth.

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book. As to how he met the fatigue factor, no statements are given except that experiments were stopped if the child showed signs of weariness. Whether or not Prof. Baldwin considered the attractive force of novelty which would result from the fact that one color is presented after a longer interval of time than another we do not know. As has been said, we are given no information as to the regularity or irregularity with which the various colors were presented.

BOOK NOTES.[1]

(G. S. H.)

De la Nature de l'Épilepsie. Dr. Fr. Hallager. 1897, pp. 181.

Epilepsy is anæmia. Lack of nutrition is a potent irritation. The attack may be more or less sudden and intense, according as the supply of blood is slowly or suddenly shut off. Some centres may be more excitable or exhausted than others, and so react differently to the same stimulus. The vessels may be constricted generally or locally. External irritation, as of a tumor, syphilis, decayed teeth, may cause it in otherwise sound brains by acting on the vaso-motor system. Vaso-motor irritability is thus a function. Ideopathic epilepsy is due to latent lesions. Cortical is really reflex epilepsy, for irritability can rarely be so great as to produce the results with no irritation.

Grundriss der Psychiatrie. Dr. C. Wernicke. 1894. Part I, pp. 80. Part II, pp. 97.

These interesting lectures base psycho-cerebral diseases on the distinction between projective and associative systems. Speech, vision, memory, organic somatic sensations, things and reality as a function of the projective system and spontaneous and reflex movements are described as neural functions. Ideas of movement and touch are originally organic sensations, consciousness, personality follow, and with the ninth lecture morbid psychology begins. Autopsychic, allopsychic, somatopsychic and autochthonous hallucinations are distinguished. Sejunction explains the disintegration of individuality. Phonemes are illusions of speech sounds. The illusion of retrospective explanation is described.

Anleitung beim Studien des Baues der nervösen Centralorgane im gesunden und kranken Zustande. Von Heinrich Obersteiner. 1896, pp. 572.

This third edition is much enlarged and rewritten, and now has 205 cuts.

Le Sommeil. Marie de Manacéïne. Translated from the Russian with the consent of the author by Ernest Jaubert. 1896, pp. 358.

This is a compendium on the pathology, physiology, hygiene and psychology of sleep and is provided with an excellent bibliography and index. It does not attempt new views, but is a very convenient and valuable *résumé*.

Hypnotism. Albert Moll. 1897, pp. 448.

This is revised and enlarged from the fourth German edition. With its excellent index of subjects and of authors, its bibliography,

[1] Notice under this heading does not preclude a fuller review later.

and its treating of the recent development of hypnotism, it is now probably the best general survey of the subject.

L'Évolution des Idées Générales. TH. RIBOT. Paris, 1897, pp. 260.

Animals abstracted before words and their logic of images is first described. Infants, deaf-mutes and gestures illustrate higher pre-verbal forms. Animal language, classification, the evolution of number, space, time, cause and law are each given a chapter. The two chief causes of abstracting and generalizing are utility and invention, and the power unfolds in three directions—the practical, speculative and scientific. Conscious and unconscious faculties coöperate throughout.

Grundzüge der Psychologie. HERMANN EBBINGHAUS. 1897. Erster Halbband, pp. 320.

The name, origin and seat of the soul, its relation to the body, consciousness and unconsciousness are discussed in the first half, and the second is devoted to structure and function of the nervous system. The book is an introduction to the study of these topics and not merely a general compendium, and hence the author tells us is both full and detailed. It is not limited to experiment and result. As it is to cover the entire literature of the individual soul from its lowest to its highest experience, it will require at least three more volumes the size of this to complete it.

Animals at Work and Play. C. J. CORNISH. Second edition. London, 1897, pp. 323.

Animals' beds, sleep, toilet, society and dislike of solitude, etiquette, tactics, humor, grief, play, in pageants, in rain, soaring, lost in storms, what they see, industries, in sickness, longevity, migration, their sanctuaries, the iced Arctic food of far north migrating birds, the invisible food of fishes,—these and many other topics are described in a most charming and novel way. All is based on a very long and careful study of many animals.

Psychologie der Naturvölker. JACOB ROBINSOHN. Pp. 176.

This work is a series of nine ethnographic parallels on the discovery of the soul, anthropophagy, character of the dead, modes of burial, life of the soul after death, human offerings and retribution. Soul is conceived at first as heart, blood and breath, and each may have several souls. Bodies are eaten where soul and body are nearly or quite identified. The eater inherits the soul. Among savages the love of life is measured by the evil and consequent fear of the souls of the dead. Burial gives the best of all revelation of views concerning the dead. Burning, *e. g.*, frees the soul quickest. From consecrated ground open spirit ways to heaven. The bibliography of each chapter is excellent.

The God-Idea of the Ancients, or Sex and Religion. ELIZA BURT GAMBLE. 1897, pp. 339.

This is an amplification of ideas, most of which were hinted at in the author's "Evolution of Woman." It will be an unwelcome conclusion to most, should the world have to accept an hermaphroditic conception of deity, or to tolerate the view that the gross idea of sex has played so large a part in the evolution of primitive theology. The author seems to grudge deity his predominance of virile elements.

La Psychologie dans L'Opéra Français. LIONEL DAURIAC. 1897, pp. 162.

This is devoted to Auber, Rossini and Meyerbeer, as illustrating a stage in the evolution of French taste. The tragic, pathetic and picturesque elements in the opera of *William Tell* and the musical qualities and dramatic style in *Robert le Diable* are the chief topics.

St. Augustine et le Néo-Platonisme. L. GRANDGEORGE. Paris, 1896, pp. 158.

Neo-platonism caused Augustine to break with Manicheism, aided to bring him to Christianity, and gave him arguments against heresies, but he transformed neo-platonism on many important points. He always subordinated his philosophy to his faith where they conflicted. His doctrine of God owed most to it.

Je Pense, donc je Suis. PAUL VIALLET. Paris, 1897, pp. 140.

This is a treatise on philosophic doubt. The Cartesian principle is defended against current criticism that it is sterile, uncertain, and illegitimate. It is in fact both a syllogism and an intuition, and not only valid against materialism and skepticism, but opens one of the best lines of training for the young.

Preuve Philosophique de l'Existence de Dieu. FERDINAND DRION. 1896, pp. 52.

Proof of God's existence must rest on science, which describes his works. Matter cannot exist by itself, but one can never know why God made the world. Order implies design; the contingent, the necessary; the finite, the infinite.

La Modalité du Jugement. LÉON BRUNSCHVICG. Paris, 1897, pp. 246.

The modality of judgment is one of the essential problems of philosophy and is bound up with the very notions of intellectual activity. In judgments of both the practical and theoretical order, the soul affirms its interiority, even over against the self, and in comprehending has already resolved. Truth in affirmation carries truth in action, and the possibility of one is bound up in that of the other.

Die Grundsätze der modernen Weltanschauung. Dr. ADOLF BRODBECK. 1896, pp. 80.

Ancient ideas were dualistic, ours monistic. Both are presented in a few pages each. Phenomena once thought, as the name suggests, mere appearances, are now considered by inductive minds the basis of all. Ground and appearance, God and world, now coincide, hence deduction is obsolete. Evolution, materialism, liberty, equality and fraternity are the watchwords.

The Opposites of the Universe. MARIE SANDS. 1897. Third part, pp. 87.

This work discusses the theological and nomological opposites and is really a discourse about God. Opposites are chemical, astronomical, electric, zoölogical, geological, philological, religious, etc. Of all these, that between God and man is the chief. The world prayer of mankind is, perhaps, the best of this somewhat anomalous work.

Schopenhauer's System in its Philosophical Significance. WILLIAM CALDWELL, M. A., D. Sc. 1896, pp. 538. Charles Scribner's Sons.

This is a book of class lectures and is an excellent digest of Schopenhauer's theory of knowledge, of art, morals, religion and metaphysics, with a final general discussion of the system as a whole. The author corrects the impression that his pessimism is the leading trait of Schopenhauer's philosophy. It is a convenient and valuable presentation.

Histoire de la Philosophie. ÉLIE BLANC. 1896. Tome I, pp. 656. Tome II, pp. 660. Tome III, pp. 656.

The author is a professor of philosophy in the Catholic University of Lyons. A hundred pages are devoted to oriental pre-Greek systems, and it is full in the scholastic period, epitomizing many systems not usually treated in standard histories. The systems of the last half of the present century are given more than half of the last volume. The modern revival of scholasticism is fully brought out. The work is a monument of erudition.

A Manual of Ethics. Sir JOHN S. MACKENZIE, M. A. 1894, pp. 355.

The scope of ethics, its relation to other sciences, the moral judgment, duty, will and desire, happiness, perfection, freedom, the moral life, virtue, the inner life and higher individualism, evil, progress, relation to religion,—these are the topics of the interesting and vigorous work, here presented in a second revised edition. This work, which is in the University Tutorial Series, is the best ethical primer known to us.

Misère de la Philosophie. KARL MARX. 1896, pp. 291.

This reply to Proudhon's philosophy of misery, and here reprinted from the work of 1847, is a treatise on the metaphysic of social and political economy and an argument for free trade; and against the misery which theories of restriction have caused.

La Cause Première. EMIL FERRIÈRE. 1897, pp. 462.

Substance is the basis of all. Its manifestations as mother-energy are twofold, inorganic and organic. From the standpoint of truth substance is the first cause, from that of reality it is the world. It is not only primary, but necessary, absolute, eternal, infinite and universal. The world is contingent, limited, relative and singular. The normal conclusion we want, on the other hand, cannot be drawn. To attempt to infer them plunges us in irreconcilable contradictions. We must therefore accept, doubt and resign ourselves to ignorance at least provisionally.

Nature et Moralité. CH. CHABOT. Paris, 1897, pp. 287.

The moral object is one form of the beautiful. The good, true and useful, which are the contents of morality and religion; metaphysics and social authority, which supply the objective principles of obligation as well as sensory motives, and the practical reason, which supplies its subjective principles, are all manifestations of the good will which nature manifests.

Précis de Logique Évolutionniste: L'Entendement dans ses rapports avec le langage. PAUL REGNAUD. Paris, 1897, pp. 211.

The author, who is well known as a professor of Sanscrit and comparative grammar, who has published many works in his field, holds that language and reason are as closely related as physics and

chemistry, and each is needed to understand the other. Language is applied logic and logic is only a codification of the laws of language. This is seen in genus and species, the parts of speech, metaphors and tropes, categories, amphibolies, sophistries, definition, cause, proof, etc.

The Will to Believe, and Other Essays in Popular Philosophy. WILLIAM JAMES. Longmans, Green & Co., 1895, pp. 333.

Professor James has done a service to his many friends by reprinting with little change these earlier and later papers. They are The Will to Believe, Is Life Worth Living? The Sentiment of Rationality, Reflex-action and Theism, The Dilemma of Determinism, The Moral Philosophy and the Moral Life, Great Men and their Environment, The Importance of Individuals, On some Hegelisms, What Psychic Research has Accomplished. The author's charm of style makes him one of the best essayists who now write in our language.

La Religion de la Science et de L'Esprit. J. STRADA. Paris, 1897, pp. 405.

This, we believe, is about the thirty-fifth volume by the author since 1865. This is only the first volume on the scientific constitution of religion, and is a part of the "Philosophy of Methodic Impersonalism." Religion is the unity toward which science tends, and its identity with science is the *ultimum organon.* The only religion is that of facts simply described, hence it is all verity and means indefinite research. There is no need of messiahs, saviours, incarnation, etc. God is not word, but fact, and his revelations are impersonal.

Des Origines Épidémiques. DR. H. BOUCHER.

Bacteriology and microbism this author thinks will in the future be regarded as a fantastic dream. In a single year nearly 200,000 people died in France of tuberculosis, and the only prevention medicine suggests is not to spit in public places. Despite all the proud claims of the bacteriologist, typhus, lupus, diphtheria, rabies, and the rest show little decrease. Pathogenic organisms are not differentiated to make the basis for even the chief morbid entities. Many wrong diagnoses are cited, and the theories are often vague, incomplete and even contradictory. The author prefers a "rational" method which conceives health as a balance of external and internal influences, and speaks of morbific agents, infectious principles. We must rest content with such general principles till bacteriology is more advanced, and is cured of its exaggerations.

Étude Clinique du Dynamisme Psychique. DR. HENRI AIMÉ. Paris, 1897, pp. 258.

Dynamism is a function, and not, as was once thought, independent of organic conditions. It is a science joining psychology and physiology, but distinct from either. Starting from Brown-Sequard's and Exner's idea of a power of certain parts of the nervous system to augment or diminish the activity of other parts, and defining dynamism as an abnormal nervous activity which corresponds to no apparent organic alteration, which may be effaced by another therapeutic dynamism, especially by suggestion, the author proceeds to describe with considerable fullness seventy-four cases, mostly for Bernheim's hospital, illustrating his thesis. Etiology, diagnosis and prognosis are briefly treated and a good bibliography appended.

Analysis of the Sensations. ERNST MACH. Translated by C. M. Williams. Pp. xii-208; 37 cuts. The Open Court Publishing Co., Chicago, 1897. Price, $1.25.

It is pleasant to welcome this excellent and well-known little book in English dress. The German text has been enlarged for this edition by a special preface, a number of additional notes, two appendices and a full index.

E. C. S.

On the Time of Reflex Winking. DAVID P. MAYHEW. Journal of Experimental Medicine,I, 1897, pp. 35-47; 5 plates.

Exner's measurements of this time, made more than twenty years ago, have remained until now practically the only ones. His figures gave averages of 0.0662 and 0.0578 seconds, depending on the strength of the stimulus—an electric shock applied to the other eye-lid. The measurements of Mayhew, executed with apparatus better suited to mark the exact beginning of the lid movement and with a light blow on the face as a stimulus, give an average of 0.0420 from 450 measurements on sixteen subjects, male and female. It was found further that there were considerable individual differences (0.0351-0.0491), but that each individual was tolerably concordant with himself. Sex made no certain difference, nor did natural winks occurring just before those in response to the stimulus, but the time appeared to be somewhat shortened by apprehension of the blow.

E. C. S.

The Statement of Stella Maberly. A Novel. F. ANSTEY. London: T. Fisher Unwin, 1896, pp. 250.

Novels dealing with psychological subjects usually make tiresome reading to a psychologist, but in this story Mr. Anstey has succeeded in grasping the method of the paranoiac mind so well as to furnish an interesting book. It can appeal only to a limited class of readers, since alienists and psychologists alone can appreciate the thread of heredity hallucination and delusion on which the narrative is based. It is to be regretted that this is the case, because the laity are much in need of education regarding the dangers to be apprehended from this class, and a popular work of fiction might do something toward awakening a healthy interest in this important subject. The reasoning of Stella Maberly is directly in line with the methods of paranoiacs, and the tragic consummation is not an uncommon sequel to such mental processes. While it will prove to be nothing more than a gruesome tale to the average reader, it will certainly interest psychologists who are not averse to seeing the domain of abnormal psychology invaded by the novelist.

J. W. WALKER, M. D.

NOTES AND NEWS.

Experimental Psychology in England.

There are signs that England is at last falling into line with other nations in the matter of Experimental Psychology. At Cambridge two rooms in the Cavendish Laboratory have for some time past been devoted to psycho-physical work; and it is now rumored that a modest laboratory is to be set up on an independent footing, and a University Lecturership established with a salary of $250. Efforts are also being made by Professor Sully and others to give the science independent status at University College, London. Lectures upon special departments of psycho-physics have been delivered for two or three years. Rooms are now offered for temporary use by Professor Carey Foster of the physical department; a sum of $350 has been contributed for the purchase of instruments; and it is hoped that sufficient funds may be raised to secure the services of a trained demonstrator for at least one term of the academic year. Subscriptions may be sent to the Hampstead Branch of the London & Southwestern Bank (account Psychological Laboratory, University College).

While this news must be welcome to experimental psychologists the world over, it is to be hoped that English men of science will not rest satisfied with the success of so limited a program. An efficient laboratory requires nowadays an initial endowment of at least $2,000, and a yearly income of at least $500 more. Moreover, though psychology owes a great debt of gratitude to physiology and physics for the hospitable reception accorded to it in these two cases, there can be no doubt that such affiliation, however temporary, tends to weaken its claim to independence in the minds of the non-elect. This is abundantly shown by the results of the hospitality offered to homeless psychologists by the Physiological Laboratory at Oxford. Experimental psychology is not physiology; it cannot be taught by a physiologist; its methods and much of its apparatus are peculiar to itself. The beginnings at Cambridge and London must, therefore, be regarded as the thin end of a wedge whose potential broadening is as considerable as that of, say, physical chemistry or bacteriology. May it be driven deeply and persistently!

Psychology in the College Curriculum.

The above remarks call to mind a statement made by Professor Jastrow in a recent number of *Science* (June 4, 1897), to the effect that "psychology has a very unfortunate reputation in the mind of the college student, as a study peculiarly difficult, to be pursued by methods unusual and intricate." It would be interesting to

know, first, whether this statement really holds; and secondly, whether, in cases where it does hold, its truth is not referable to the fact that psychology is taught along old-fashioned lines. The writer's experience is that when stress is laid upon the performance of introspective exercises by the student, and the lecture series enlivened by experimental demonstration, psychology yields to but few studies in point of attractiveness, rivaling even subjects so intrinsically interesting as physiology; while its difficulty is no greater, and may be less, than that of some of the other old-established features of the college curriculum.

A Psycho-physical Vocabulary.

The following translations are additions to or substitutes for the renderings of German terms offered in this JOURNAL, Vol. VII, pp. 78 ff.

Anfangsgefühl, initial feeling.
Endgefühl, terminal feeling.
Gebilde, formation.
Gegenfarbe, antagonistic color.
Gesammtvorstellung, aggregate idea.
Randcontrast, marginal contrast.
Schärfe, accuracy, acuteness.
Zwangs-, imperative.

The whole vocabulary should be compared with the glossary appended by Professor Wundt and Dr. Judd to the English translation of Wundt's *Grundriss*. It is noteworthy that Wundt has approved 'affective' as the equivalent of *Gemüths*. On the other hand, the rendering of *Gebilde* by 'compound' is not only inadequate, but in places becomes self-contradictory. The geological association of the term 'formation' seems to be, at least, harmless.

News.

Mr. J. F. Crawford has been appointed Demonstrator in Experimental Psychology at Princeton University.

Dr. W. B. Pillsbury, recently made Instructor in Psychology at Cornell University, has been called to the charge of the Department of Psychology in the University of Michigan.

Dr. G. Simmara has been nominated to the chair of Physiological Psychology in the Government School of Science, Madrid.

An International Congress of Neurology, Psychiatry, Medical Electricity and Hypnology will be held at Brussels from Sept. 14 to Sept. 19 of the present year. Address of the general secretary, Dr. Crocq *fils*, 27 Avenue Palmerston, Brussels.

A section will be devoted to Experimental Psychology at the forthcoming meeting of the British Association in Toronto. Notices of papers should be sent to Dr. A. Kirschmann, University of Toronto, Toronto, Can.

Books Received.

Aars. Die Autonomie der Moral mit besonderer Berücksichtigung der Morallehre Immanual Kants. Pp. 124. L. Voss, Hamburg u. Leipzig, 1896. Price, 3 m. Notice in No. 3, p. 423.

Basch. Essai Critique sur L'Esthétique de Kant. Pp. 623. F. Alcan, Paris, 1896. Price, 10 f.

BERGSON. Matière et Mémoire. Essai sur la Relation du Corps a L'Esprit. Pp. iii-280. Alcan, Paris, 1896. Price, 5 f. Notice in No. 3, p. 419.

BINET. L'Année Psychologique. Troisième Année. Librairie C. Reinwald, Paris, 1897. Pp. 825. Price, 15 f.

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INDEX.

ORIGINAL ARTICLES.

PSYCHOLOGICAL LITERATURE.

I.—SUBJECT INDEX.

II.—Names of Authors.

(The names of those who have contributed original matter are printed in SMALL CAPITALS.)